# The Impact of Information Systems on Business Flexibility from the Managerial Perspective: Multiple Cases of Enterprise Systems Enhancement and Ongoing Changes


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# DECLARATION

None of the materials contained in this thesis has been submitted for publication prior to the start of candidature. However, some of the work in the thesis has been published or submitted for publication in refereed international conferences or journals prior to the completion of this thesis.

# PUBLICATION

## Conference Paper

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# ABBREVIATIONS

API – Application Programming Interface

ARIS – Architecture of Integrated Information Systems

BI – Business Intelligence

BOM – Bill of Materials

BPR – Business Process Reengineering

CR – Critical Realism

CRM – Customer Relationship Management

CRP – Capacity Requirements Planning

CSF – Critical Success Factor

ERP – Enterprise Resource Planning

ES – Enterprise System

FIFO – First In First Out

IM – Inventory Management

IS – Information System

IT – Information Technology

JIT – Just-in-time

KPI – Key Performance Indicator

MPS – Master Production Schedule

MRP – Material Requirements Planning

MRPII – Manufacturing Resource Planning

OPT – Optimised Production Technology

POD – Proof of Delivery

RDBMS – Relational Database Management System

SCM – Supply Chain Management

SQL – Structured Query Language

STO – Stock Transaction Order

TEI – Total Enterprise Integration

TQM – Total Quality Management

WMS – Warehouse Management System

# ABSTRACT

Today, flexibility is widely concerned as the key capability an organisation should possess due to the fast change of business and technology environment (Haeckel 1999; Golden and Powell 2000). Business is fundamentally concerned with and driven by changes. It requires flexibility to quickly respond to new conditions, to absorb sudden shocks and to accommodate diversity and heterogeneity. All of these demands, in turn, feed through to the computer-systems that modern organisations rely upon (CBDi Forum 2001). The attainment of information system flexibility is becoming an essential requirement for the business (Golden and Powell 2000; Behrsin et al 1994). Despite IT/IS has been developed to achieve great flexibility and functionality in order to provide more agile and more effective solution for the businesses, it is also widely subject to criticism for its inflexibility and rigidity (Allen and Boynton 1991; Avison et al 1995; Davenport 2000). This research addresses the IS flexibility issue and studies "how organisations adapt their ISs/ESs to accommodate ongoing business changes?" A model of tactical ES adaptation for ongoing business changes has been developed from three organisations' ES post-implementation experience. This model depicts a complicated decision making process for ES adaptation to support ongoing business changes and attain flexibility. It demonstrates the dynamic relationship among emerging business needs, adaptation tactics, adaptation activities, performance and resource measurement, and risk evaluation.

# CHAPTER 1

# Introduction

## 1.1 Overview

Business environment is changing at a far faster rate than ever before. Products, manufacturing processes, markets, distribution channels and competitive boundaries are in a state of continuous flux especially in high technology arenas (Evans 1991). The changeful nature of business environment, coupled with maturing markets, has resulted in enormous pressure on organisations in their efforts to continue performing at high levels (Das and Elango 1995). It can be argued that the business environment is "intensely competitive, continuously innovative, and contains uncertainties about which there can be little or no prior knowledge" (Evans 1991). Organisations that are subject to the influence and pressure of the environment in which they operate are required to concentrate on flexibility as a way to achieve new forms of competitive advantage (Upton 1995). Haeckel (1999) suggests that "the only kind of strategy that makes sense in the face of unpredictable change is a strategy to become adaptive". Now flexibility has emerged as an important criterion for organisations after efficiency and quality because it is a wide consensus in industry that achieving low cost and high quality is no longer enough to guarantee success in a fiercely competitive and uncertain business environment.

Today, flexibility is widely concerned as the key capability an organisation should posses due to the fast change of business and technology environment (Haeckel 1999; Golden and Powell 2000). Business is fundamentally concerned with and driven by changes. How to effectively manage these changes, either strategic or operational, calls for flexibility. It requires flexibility to quickly respond to new conditions, to absorb sudden shocks and to accommodate diversity and heterogeneity. All of these demands, in turn, feed through to the computer-systems that modem organisations rely upon (CBDi Forum 2001). The attainment of information system flexibility is becoming an essential requirement for the business (Golden and Powell 2000; Behrsin et al 1994).

Information technology (IT) and computer information systems (IS) have been developed to achieve great flexibility and functionality in order to provide more agile and more effective solution for the businesses. Some technologies, such as object-oriented technology, COTS (components off the shelf) are promoted as flexible. Enterprise Systems (ES) or Enterprise Resource Planning (ERP) Systems such as SAP are a recent departure, offering enterprise wide integration, functionality and customisation by using standard configurable and modularised packages. They offer an original solution to the demands of flexibility by virtue of their scale, functional integration and standard, configurable architecture. For a long time, IT/IS has been proposed as a tool to promote business flexibility (Behrsin et al 1994, Ducan 1995; Lucas 1994). However, it is also widely subject to criticism for its inflexibility and rigidity (Allen and Boynton 1991; Avison et al 1995; Davenport 2000).

Although flexible ISs are highly valuable for the success of the businesses, it seems difficult to plan and measure because there is no common, operational definition (Duncan 1995). A comprehensive definition and framework of flexibility is required to guide the investigation. Based on the previous work of Gerwin (1993), Golden and Powell (2000), Evans (1991), Slacks (1987, 1989) etc., this research started to review the literature of management science, engineering (manufacturing systems) and information systems. A more comprehensive definition and framework of flexibility dimensions and measurement are formed and operationalised. Then, being guided by the comprehensive framework of flexibility, this research addresses the IS flexibility issue:

- how organisations adapt their ISs to accommodate ongoing business changes?

The following sections in this chapter are going to present the importance of flexibility and the emerging needs of flexible IS solution to accommodate ongoing business change which motivate this research. The chapter then introduces the research objective, the method approach, contribution of this study and then concludes with the structure of the thesis.

## 1.2 Motivation for the Research

### 1.2.1 The need for business flexibility

Business environment is changing at a far faster rate than ever before. According to Haeckel (1999), Director of Strategic Studies at IBM's Advanced Business Institute, between 1994 and 1998, among more than 3,000 executives who attended strategy courses at IBM's Advanced Business Institute, more than 75% of them expected to face discontinuity and challenges from unpredictable business environment. Das and Elango (1995) argue that "the inevitability of rapid change in the competitive environment of business is an accepted fact in this last decade of our millennium". Products, manufacturing processes, markets, distribution channels and competitive boundaries are in a state of continuous flux especially in high technology arenas (Evans 1991). The changeful nature of business environment, coupled with maturing markets, has resulted in enormous pressure on organisations in their efforts to continue performing at high levels (Das and Elango 1995). These pressures include the globalisation of market, rapid technological change, shortening of product life cycles, and increasing aggressiveness of competitors (Volberda 1996). It can be argued that the business environment is "intensely competitive, continuously innovative, and contains uncertainties about which there can be little or no prior knowledge" (Evans 1991).

Organisations that are subject to the influence and pressure of the environment in which they operate are required to respond and compete in new ways. With the advent of scientific management, organisations have being competing with each other on the basis of two dominant strategic imperatives; efficiency and quality. According to Volberda (1999), efficiency was the most important criterion for organisations in the 1950s and 1960s, which was dictated by a major change in technology for mass production; in the 1970s, quality became an additional important criterion as customers became more quality-oriented and required higher levels of service and more value for their money; now flexibility has emerged as an important criterion for organisations because it is a wide consensus in industry that achieving low cost and high quality is no longer enough to guarantee success in a fiercely competitive and uncertain business environment. According to Haeckel (1999), "the only kind of strategy that makes sense in the face of unpredictable change is a strategy to become adaptive". Volberda (1996) shares the similar view, and proposes that in the new mode of hyper-competition, competitive advantage cannot be predicted but only be responded to more or less efficiently, ex post. Hence, superior organisations in hypercompetitive environments must generate superior adaptive capability. In essence, organisations must become more flexible.

### 1.2.2 The paradox of information systems flexibility

In the modern business world, organisations are more and more relied on their IT/ISs – whether they are to compete or just to keep their business operations running (Behrsin et al 1994). Businesses and IT systems are more and more closely entwined. While business does not stand still, business moves on, it requires ISs to serve the business as quickly and effectively as possible. As Allen and Boynton (1991) put it, "the competitive business must be much more dynamic and adaptive than in the past and, for this purpose, will need the most flexible information system it can find". However, it is sometimes treated as axiomatic that modern information technology contributes to business flexibility. Such a message is endemic to the sales pitch of the IT industry, justifying the MIS for its ability to alert managers to new conditions, and justifying operational systems for their ability to harness new ways of working. Yet inside the sales message is a constellation of nostrums, half-truths and contradictions. Theory and empirical evidences are much harder to find, especially from a longitudinal perspective.

The accounts of IT and organisational flexibility generally fit one of two camps: motivational and critical. The motivational literature explains the reasons how and why IS might contribute to business flexibility. For example, Lucas and Olson (1994) state that information technology can contribute to organisational flexibility in three major ways - by altering the time and place of work, by altering the nature and pace of work and by enabling firms to respond quickly to changing market conditions. An alternative account is provided by Avison et al (1995). They reach into the complex and uncertain nature of business to suggest motivations for flexible information systems. They state that an organisation needs flexible information system where system requirements cannot be precisely defined, where future user requirements are uncertain and difficult to foresee and where the information system performance might otherwise be prone to mismatch of requirements. The critical literature explores the negative impacts of IT on business flexibility (Golden and Powell 2000). It is sometimes argued that it is just too difficult for information systems to fit the full range and connotations of business needs, with the consequence that the adopting organisations may end up doing business in a way that they do not really want (Davenport 2000). Allen and Boynton (1991) point out that "IS efforts generally automate the status quo, freezing the organisation into patterns of behaviour and operations that resolutely resist change." Lucas and Olson (1994) argue that the inflexibility can be incarnated by the increased time, effort, and cost involved in changing systems and related workflows and organisation structure. A similar argument suggests that IT projects are geared to the needs of a particular business environment and that flexibility is rarely expressed as part of the primary requirements to meet the challenge of further organisational change (CBDi Forum 2001; Boynton 1993). It can be concluded that IT/ISs do not necessarily assist organisational flexibility and can be the cause of rigidity.

### 1.2.3 Enterprise systems and flexibility

Despite the conclusion above, there is a general recognition that flexible IT/ISs shall lead to successful business performance. Researchers and engineers have strived hard to make IT/ISs more adaptive and effective. ESs are a recent departure as such, offering enterprise wide integration, functionality and customisation by using standard configurable and modularised packages. ESs were originally motivated by the need of standard application software for real-time back-office business processing. ESs was a huge success in the 1990s. Their success was ascribed to general factors associated with the resolution of problems associated with traditional legacy IT systems. ESs resolve the issues of incompatibility of ISs, maintenance effort of disperse systems, real time processing and integration of ISs, and uncertainties for custom application development (Scheer and Habermann 2000; Davenport 2000). Moreover, ESs are used as a tool by most managers to enforce standard business practices throughout the organisation by using their built-in business logics (Davenport 2000). Today, ESs have transcended where they started out as back-office systems and extended to front-office applications. ESs now support thousands of business activities. Hence ESs offer an original solution to the demands of flexibility by virtue of their scale, functional integration and standard, configurable architecture. However, it is also widely subject to criticism for its inflexibility and rigidity (Markus et al. 2000; Davenport 2000; Greenwood and Kawalek 2000; Ni, Kawalek and Ran 2002). Davenport (2000) points out two aspects of criticism about the inflexibility of ESs; it is too difficult to fit an ES to a business, and it is too difficult to change how organisations work and are organised once an ES is installed. Markus et al (2000) make a similar claim that lack of feature function fit, and concerns about company strategic flexibility and decentralised decision-making style are two of the reasons for not adopting ESs. If companies that continually change their organisational structures and business models and particularly those that are not run in a very top-down manner may find ES unsuitable as a corporate solution. In essence, ESs are designed to support an archetype of efficient working within business functions by their own logical templates that describe how the business processes in each function should work. However, "operational flexibility is not emphasised" (Greewood and Kawalek 2000) – change is primarily supported through new versions of the software issued by the software vendor. The contradictory voices from industries and academics imply that although ESs overcome the problems and rigidity of legacy IT systems, in this increasing dynamic business world, ES or standard packaged software seems not capable enough to provide flexible solutions to the demands from the businesses in spite of that some claims of flexibility are based on unfounded optimism and unverifiable wisdom. Therefore, it has become an emerging need for research to understand the extent to which the ISs particularly ESs can support business flexibility, and how organisations use their adopting ISs/ESs to cope with ongoing business changes.

From the discussion above, some key points can be summarised as follows:

1. modern organisations are constantly under pressure for change, which requires adopting ISs to provide flexible solution to support these ongoing changes;
2. although ISs are widely recognised as a tool to support business strategy and operations, ISs do not necessarily assist business flexibility and can be the cause of rigidity;
3. ESs are the recent departure to support business flexibility by virtue of their scale, functional integration and standard, configurable architecture, but the extent to which ESs are able to support business flexibility is not well understood.

## 1.3 The Research Objective and Scope

Organisations view flexibility as a strategic capability that should be possessed to compete in this dynamic business world. More and more organisations are increasingly concentrating on flexibility as a way to achieve new forms of competitive advantage (Upton 1995). However, in IS intensive organisations, the extent to which ISs are able to support business flexibility is still unknown and not well understood. Hence, the purpose of this research is to study how organisations use their adopting ISs to support ongoing business changes.

The scope of the study is narrowed down to ESs because there are a number of types of ISs available which have different design philosophy in nature. ES is selected as an appropriate research object because:

1. ESs are widely adopted by organisations in the world.
2. ES is the critical information system to support day-to-day business operation.
3. Besides the benefits and also great flexibility promised by ES vendors, ESs are criticised for its rigidity and inflexibility (Greenwood and Kawalek 2000; Markus, Axline, Petrie and Tanis 2000; Davenport 2000; Ni and Kawalek 2001).

Moreover, from the IS maintenance point of view, ESs maintenance has not been addressed primarily in ESs research (Glass and Vessey 1999). Although IS maintenance is the most costly life cycle phase in software (Glass and Vessey 1999), ESs maintenance has been neglected and not emphasised comparing to the research of ES implementation. This study seeks to contribute to ESs research by addressing ESs maintenance aspects.

This research is aiming to understand the perception of ES adoption organisations about system's capability for business flexibility and conceive a model of post-implementation ES support for ongoing business changes. The model will help IS adoption particularly ES adoption organisations to understand, analyse, plan and achieve system flexibility in face of business environment uncertainty. The study is exploratory since the research topic, namely "IS Flexibility", to date has received little attention and there is no adequate literature.

The following research question is aimed to be investigated by this research:

- "How organisations adapt ISs/ESs to support business flexibility?"

By answering above questions, the research aims

To develop a model of post-implementation ES support for ongoing business changes that allows academics and practitioners better understanding the nature of business changes, various options for coping with these changes with their adopting ESs, and resource and cost associated with these changes. The model would enable academics and practitioners to analyse, plan and achieve system flexibility in face of business environment uncertainty.

## 1.4 The Research Approach

As discussed above, this research is motivated by the emerging needs for IS/ES flexibility to support ongoing business changes. However, it seems difficult to plan and measure IS/ES flexibility because there is no common and operationalised definition (Duncan 1995). Based on the previous work of Gerwin (1993), Golden and Powell (2000), Evans (1991), Slacks (1987, 1989) etc., this research started to review the literature of management science, engineering (manufacturing systems) and information systems about flexibility. A more comprehensive definition and framework of flexibility dimensions and measurement are established and operationalised to guide the investigation. Further, although the research is focusing on the post-implementation phase of ESs where little research has been done, the rich literature of IS/ES implementation benefits the study by providing sound ground for concept and theoretical issues about IS/ES adaptation during the implementation phase. This helps the research to preliminarily identify issues towards ES post-implementation adaptation.

In the mean time, one provisional case study at a UK local authority was conducted to get a clear picture and better understanding about issues and processes of ES implementation. Then one pilot case study at an international electric company in China was conducted as part of the exploration phase of this research. The main objective of the pilot case studies was to reach conceptual and practical clarifications that assist the researcher to develop a more focused theme and improve the research design. Moreover, the pilot case studies (including the provisional case study) helped the researcher to learn about the research process, the interview schedule, the overall length of the interview and observation and interview techniques (Glesne and Peshkin 1992).

The overall research approach is to build theory from multiple-case studies. This approach is appropriate as this study, being the first to specifically address the issue, is exploratory in nature, and aims to develop a novel and tentative theory about IS/ES post-implementation adaptation (Eisenhardt 1989). The purpose of exploratory research is to investigate little understood phenomena and identify or discover important variables to generate hypotheses for further research (Marshall and Rossman 1989). This research approach consists of inducing theory using multiple-case studies. The multiple-case design was adopted to improve the robustness of the study and the analytic generalisability (Yin 1994; Robson 1993). The full investigation is limited to the study of three selected organisations (two in the UK and one in China). All of these three organisations have already installed SAP systems with multiple functional modules in place and have more than 3-year experience of using, maintaining and supporting their ESs. The primary method of data collection used was personal interview and retrospective analysis.

## 1.5 Contribution

The key contribution of this research is in five aspects:

1. This research provides a comprehensive literature review of flexibility which lays the foundation for future research in flexibility. The generic framework of

flexibility adapted from Gerwin (1993) and further developed into multi-dimensions and measures can be adopted by academics and practitioners to develop their own model for analysing and better understanding the flexibility issue in other research disciplines.

2. This research develops a tactics model for ESs post-implementation adaptation that enables academics and practitioners to analyse, plan and achieve system flexibility in face of business environment uncertainty. It provides a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes.

3. Six generic adaptation tactics are identified in the research. There are technical adaptation, technical banking, technical workaround, business workaround, procrastination and inaction. The impact of the adaptation tactics is presented. This provides ES practitioners an alternative angle to look at business flexibility and an alternative approach to handle business flexibility.

4. A significant lesson learned in the research is that "optimal flexibility" is the goal that organisations are seeking to respond to their constant changing business environment. This means that the traditional view of flexibility i.e. cost-effective or a combination of maximised performance expected and minimised resources required (Slack 1983; Evans 1991; Upton 1994; Volberda 1996) does not always apply in today's organisations. Instead, organisations need to assess their organisational conditions and evaluate the effect and the cost of attaining flexibility, and trade off between them in order to achieve optimal flexibility. For this, two level of assessment is proposed in the research:

1) actual flexibility assessment and 2) contextual flexibility assessment. The two level assessments for flexible adaptation involve the systematic identification and valuation of the risk and feasibility for attaining flexibility. The method of two level of assessment helps ES practitioners and researchers to analyse the impact of an adaptation solution and identify key areas and risks that should be focused on for adaptation.

5. The research evaluates the impact of multidimensional feature of ES adaptation. Besides the adaptation tactics have been discussed in-depth, the adaptation activities are also depicted. This provides ES practitioners a general view of the impact of adaptation activities on business flexibility.

## 1.6 Structure of the Thesis

This thesis is organized as follows:

Chapter 1, "Introduction", is an overview of the thesis. It describes the position of and the motivation for the research. It also provides an overview of the research objective, the methodological approach, and the contribution of this research;

Chapter 2, "Literature Review on Flexibility", defines the concept of flexibility based on the previous work primarily in management science and manufacturing systems about flexibility. Based on the conceptual framework, adapted from Gerwin's (1993) conceptual model for manufacturing, multi-dimensions and metrics of flexibility are identified;

Chapter 3, "Literature Review on Enterprise Systems", reviews the ES origins, technical and functional characteristics, benefits and issues of ES adoption and success factors of ES implementation. This chapter also reviews the maintenance aspect of traditional ISs and ESs as the research is focusing on post-implementation enhancement and changes;

Chapter 4, "Research Objective", outlines the research objective for this study. It first explains why choosing ESs as the research object. Then it outlines the research questions;

Chapter 5, "Research Method", first explains the philosophical stance of the researcher. Second it review and evaluates a range of research methods which are appropriate for exploratory information systems research. Then it describes the research approach, design and justification for using a qualitative perspective. Finally it describes the process of the research;

Chapter 6, "A Model of Tactical ES Adaptation for Ongoing Business Changes", describes post-implementation ESs enhancement and ongoing changes of three case study organisations;

Chapter 7, "Findings and Discussion", reports the findings of the cross-case analysis to explain the tactics model for ESs enhancement and change emerged from the investigation;

Chapter 8, "Conclusion", provides a critical review of the model and conclusions reached, the contributions, implications and limitations of this study and, additional topics to develop in further ES research from this investigation;

The appendix comprising Letter of Introduction, Confidentiality Statement, Pilot Case Study Questions, Case Study Protocol are also included to support information.

# CHAPTER 2

# Literature Review on Flexibility

## 2.1 Introduction

Inarguably flexibility is a good thing but the concept still remains the least understood for performance measures. Common definitions of flexibility are concerned with the ability to change, or how to respond to environmental uncertainty by changing with minimal cost and effort and the least disturbance on other performance variables (Volberda 1999; Slack 1989; Upton 1994). There are several fundamental reasons associated with the difficulty of understanding flexibility: 1) flexibility is a multi-dimension measure (Ansoff 1965; Evans 1991; Upton 1994; Gupta 1989; Slack 1989; Volberda 1999), 2) it is difficult to measure flexibility in a quantitative manner (Son and Park 1987), and 3) flexibility is related to an ability to the future, which makes it even harder to evaluate it in current environmental settings (Slack 1983).

Management scientists have been researching flexibility for decades, with most studies and contributions focusing on strategic flexibility in the context of manufacturing systems. Manufacturing system flexibility has attracted many researchers and practitioners because

- manufacturing flexibility is frequently considered a way to respond to increasing market competition and environmental turbulence (Eppink 1978), and
- the advance of process and information technology deployed in manufacturing systems require organisations to understand their full potential and use them to their full advantage (Slack 1989).

The research of flexibility in manufacturing has been conducted from different angles by

- using a general approach – studying the manufacturing system as a whole to a) define and classify the type of flexibility desired, and examine interrelationship between different types of flexibility (Browne et al. 1984; Slack 1987; Slack 1989; Gupta and Goyal 1989; Sethi and Sethi 1990; Gerwin 1993; Upton 1994; Cheng, Simmons and Ritchie 1997; Parker and Wirth 1999; Narain et al. 2000), b) operationalise the measures of flexibility (Gupta and Goyal 1989; Slack 1989; Gerwin 1993; Sethi and Sethi 1990; Parker and Wirth 1999; D'Souza and Williams 2000), and c) identify critical factors and methods of delivery (De Meyer et al. 1989; Hill and Chambers 1991; Carlsson 1992; Narain et al. 2000), and
- focusing on specific aspects of manufacturing system, e.g. manufacturing processes (Gerwin 1987; Upton 1997), human resources management (Adler 1988; Gupta 1989; Denton 1994), business process reengineering (Zhang and Cao 2002), product design and development processes (Sanchez and Mahoney 1996), administrative aspects of flexibility

(Kathuria 1998), resources management (Correa 1994), and machine adaptability (Brill and Mandelbaum 1990; Mandelbaum and Brill 1989).

Various models and measurements around manufacturing system flexibility are then developed to help organisations to understand, analyse, develop and accomplish flexibility.

## 2.2 Definition of Flexibility

The concept of flexibility is not a recent phenomenon. Golden and Powell (2000) pinpoint that the research of flexibility in business has been conducted for over sixty years. The term or the sense of flexibility has been used ubiquitously and its meaning has been defined in various forms, yet its definition has not been clarified and standardised (Evans 1991; Harrison et al. 2000). Flexibility is a polymorphous or multidimensional and paradoxical concept which makes it complex and hard-to-capture.

Evans (1991) points out that flexibility is "a polymorphous concept". He discusses various concepts/terms resembling flexibility, such as adaptability, resilience, robustness, elasticity, versatility etc., and denotes that those capabilities which are appropriate for the provision of flexibility in one situation may not be transferable for other situations. Upton (1994) furthers that "constructing a definition of flexibility is not a straightforward matter, since definitions are often coloured by a particular managerial situation or problem". Building on the common recognition of the multidimensional nature of flexibility, researchers have attempted to identify multiple types of flexibility so that their relationships can be examined, and their individual impact on business performance can be analysed, helping organisation to prioritise, measure and improve upon them.

Flexibility is not a "free good" (Carlsson 1989). Gaining flexibility is always associated with cost, stress, and lack of focus (Das and Elango 1995). Ozer (2002), studying online business, finds out that "there is a risk that flexibility might overwhelm the customer with options and decisions to make, thereby becoming a potential liability in generating revenues." Flexibility requires stability to avoid chaos (Volberda 1996 and 1998; De Leeuw and Volberda 1992). Without the concern of stability, flexibility can cause overreaction, excessive information search, and wasted resources (Volberda 1996). The need for stability when being flexible can also be deduced by some definitions of flexibility, e.g. "the ability to change or react with little penalty in time, effort, cost or performance" (Upton 1994), "flexibility is dependent not only on the range of states it can adopt, but also on the ease with which it can move from one state to another" (Slack 1983). These imply that although the goal of being flexible is to meet constantly changing business needs, without considering the impact of change, implementing flexibility may move from one extreme (i.e. rigidity) to another extreme (i.e. overreaction) (Adler 1988). De Leeuw and Volberda (1992) discuss the duality of flexibility by using control theory. They further that flexibility is the balance between the controllability or responsiveness of the organisation and the dynamic control capacity of management.

Here flexibility is defined as the capability to make changes and the capacity to control to achieve best fit towards business needs with little consumption of resources and disturbance on performance. Capacity and capability are different facets of flexibility, which most researchers fail to differentiate clearly. Capability is the ability to change from one state to another (Slack 1989). The capability to change is positively associated with the resources required (Figure 1). Capacity is the design adequacy of the organisational conditions (Zelenovic 1982; Volberda 1999). It can be measured by the maximum level of output or number of scenarios or templates built-in. In the context of manufacturing systems, capacity is widely recognised as volume capacity. Switching between different levels of output and scenarios within the capacity needs low level of capability to change, while upgrading the capacity to a higher level would consume lots of resources and require a higher level of capability (Figure 2). Zelenovic (1982) names capacity as application flexibility. He states capacity is closely related to the degree of utilisation of system parameters, and it is possible for a highly flexible system to have low degree of utilisation of these parameters in relation to simple tasks. Too much capacity could be a waste of resources.

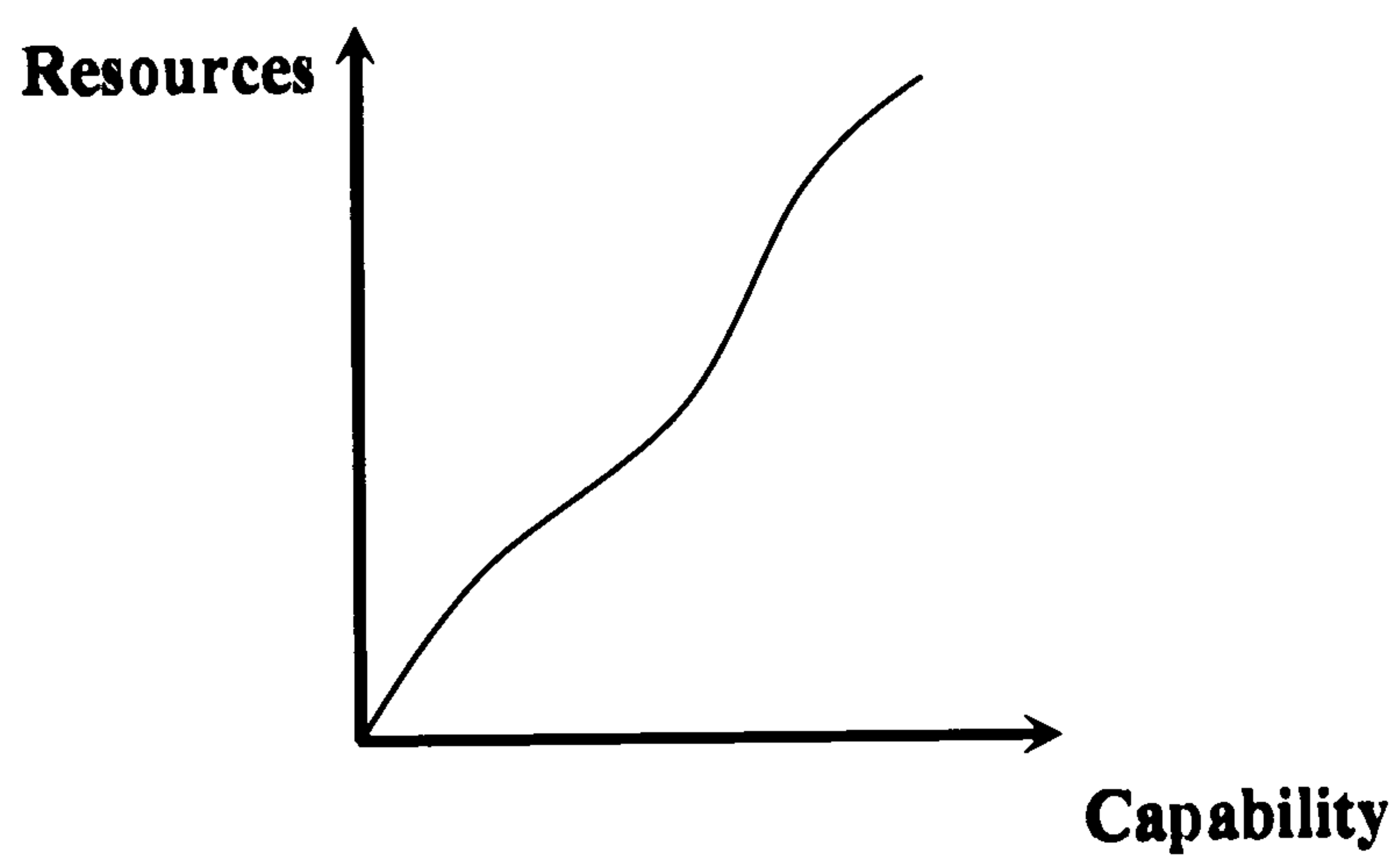


**Figure 1 Relationship of resources required and level of capability for change**

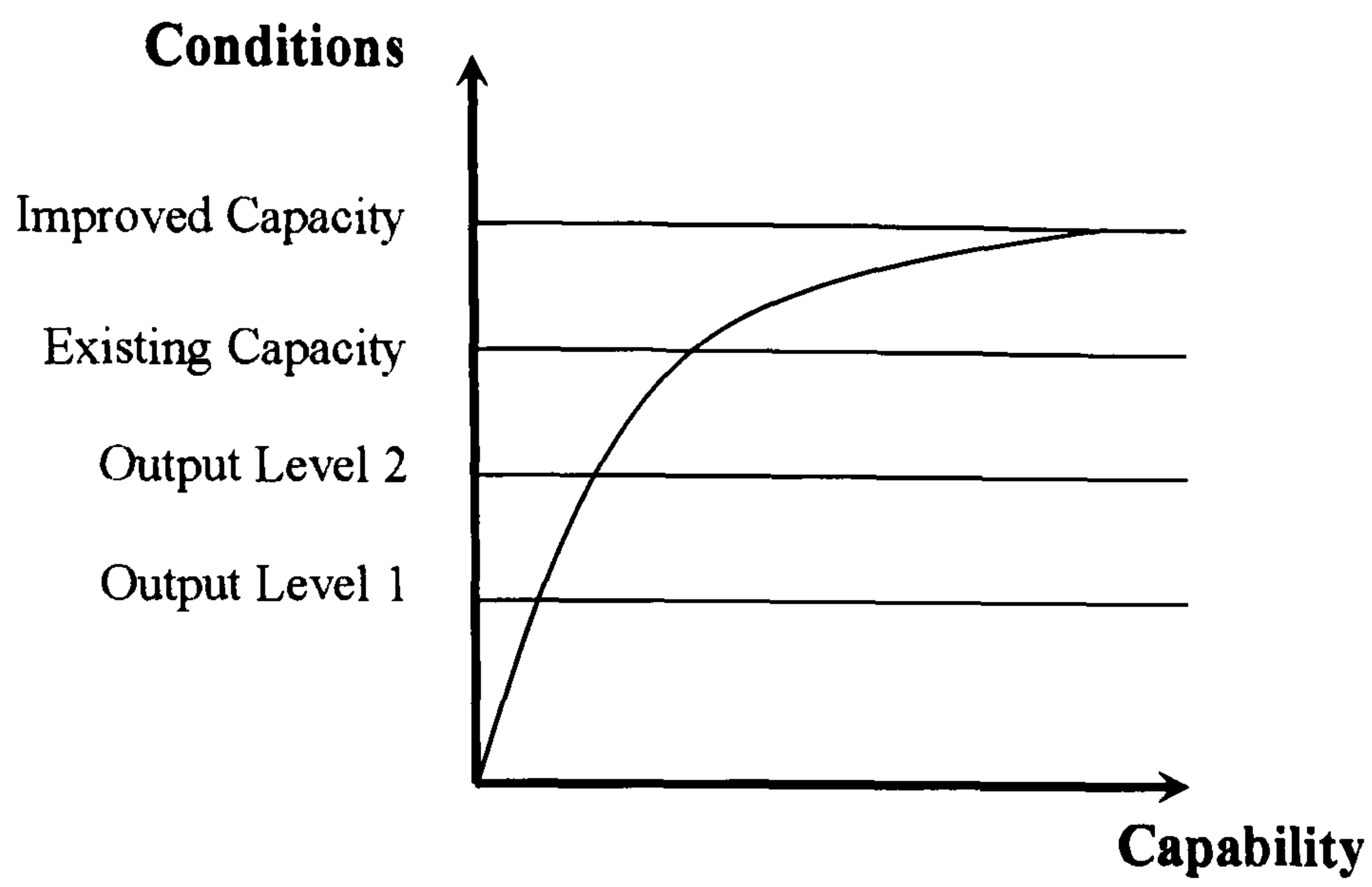


**Figure 2 Relationship of capacity and capability**

## 2.3 Motivations for Flexibility

Change is inevitable. Brown (2000) states that "change can bring risks to those unprepared, or open up new avenues of business to those best able to take advantage of the opportunity it brings". The effective way of managing change, which leads to successful business performance, calls for flexibility. Changes are the driving forces for flexibility. These driving forces have been discussed and distinguished in various ways.

Eppink (1978), after observing the changes that organisations face, proposes that changes lie in the field of operation, competition and strategic manoeuvre. The operational changes, which are familiar and reversible, lead to temporary shifts in the level of activity of the organisation. Competitive changes cause a major transformation in the market position of a firm. Strategic changes share similar effects but involve a high degree of unfamiliarity and urgency.

Carlsson (1989) suggests a similar typology of changes with respect to flexibility; operational, tactical and strategic. He links them with specific time frames – short-term, medium-term and long-term respectively. Operational flexibility refers to fixing the plant and equipment available to the firm and the "software" associated – such as standardised routines and procedures etc. in a short time period. Tactical flexibility presents the ability to cope with changes in the rate of production or in product mix, as well as moderate changes in design over the medium term. Strategic flexibility is related primarily to infrastructure and reflects how the firm reposition itself in a market and changes their game plans.

Brown (2000), researching large-scale component-based IS development methods, distinguishes three forces of change; business, technology, and organisational change. For him the success of an organisation relies on the ability to understand the business context in which it operates, and to enhance that business with computer systems. Hence, computer systems must change to continue to provide appropriate functionality as changes occur in the business environment. He further categorises three significant trends of business change: changes in government policies and practices, organisations' acquisition, mergers, and takeovers, and major political and economic events. All these changes will result in major impacts on business practices. For technology change, he states that "some of the most far-reaching changes being faced by organisations are as a result of significant advances in technology". For a large-scale software development project, technology choices made early in the project life cycle will be made obsolete by technology advances that take place before the results of the project can be deployed. Therefore, the organisation needs to make a number of choices concerning how they intend to deal with technological changes. He adds that the technology change in the software industry is particularly evident with the latest wave of internet-based technologies such as Java, web-browsers, and application servers. Moreover, organisations are facing unprecedented change as they adopt new work practices and management styles encouraged and supported by the changes in business practices.

Fitzgerald (1990) points out that the reasons for system enhancement fall into three main groupings: environmental, technical and organisational. Environmental changes are basically external influences on the organisation, such as government legislation, industrial relations, and external agencies. Organisational change refers to influences from strategy, policy, organisational structure, procedures etc. Technical change is caused by developments in hardware, software, communications and the technical environment in general.

It can be concluded that the driving forces of change are occurring for two major reasons: technological advances and business advances. The initiates of former category of changes are purely technical, although they do involve some business benefits when they are successfully deployed. At the business level, changes can be further divided into two levels: strategic and operational. The strategic change here refers to the changes to achieve competitive advantages by reconfiguring the existing business and introducing new business, whereas the operational change refers to the changes of day-to-day operation of the business.

## 2.4 Multidimensions of Flexibility

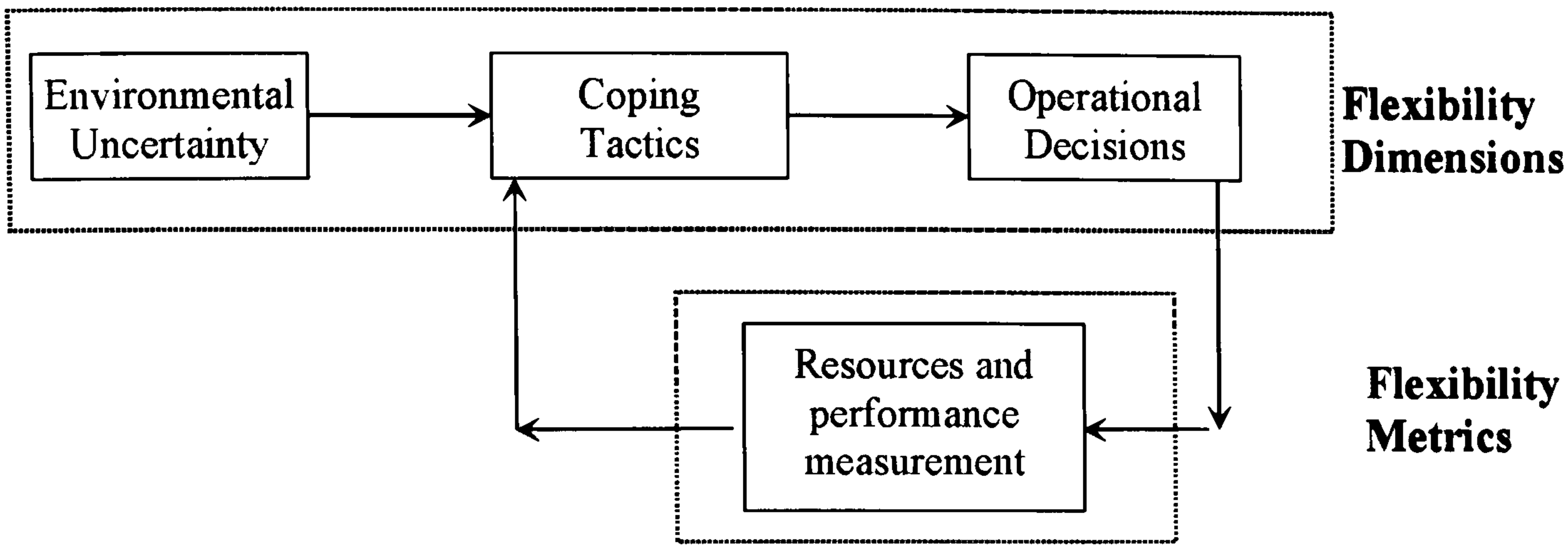


**Figure 3 Conceptual framework for flexibility (adapted from Gerwin 1993)**

The concept of "dimensions" of flexibility is constructed on the basis of the previous studies of organisational flexibility, such as Evans's (1991) strategic flexibility model for temporal and intentional manoeuvres, Volberda's (1998) essential dimensions of dynamic control model, and Golden and Powell's (2000) four dimensions model (temporal, range, intention and focus). The identification of dimensions for flexibility in the previous research has been discussed from different perspectives, e.g. environmental, strategic and operational. Whereas the course of change illustrates a series of consequences from environmental uncertainty to the responding actions and then to the impact on the organisation, it seems that, although it is widely accepted that flexibility is a multidimensional concept, few have recognised the multidimensions of flexibility in a complete and systematic manner. A conceptual framework (**Figure 3**), adapted from Gerwin's (1993) conceptual model for manufacturing flexibility, is proposed here to help identify and understand the multi-dimensions of flexibility. The conceptual framework consists of four variables, representing environmental uncertainties, coping tactics, operational decisions and a feedback loop from resource and performance measurement. The dimensions of flexibility can be identified at three levels:

- environmental level, characterising the nature of environmental uncertainties, or the cause of responses,
- tactical level, reflecting the level of responses or intervention, and
- operational level, depicting the nature of responses.

### 2.4.1 Environmental dimension

This dimension of flexibility indicates the nature of changing environment. Krijnen (1979) points out that "organisations are subject to the influence of the environment in which they operate; in their turn those organisations have an influence on the environment". The environmental dimension can be further discussed in the sub-dimensions of level of change.

#### 2.4.1.1 Level: operational vs. strategic

This dimension defines the typology of environmental change: operational and strategic. Eppink (1978) observes irreversible and reversible changes, and then outlines the following typology of environmental change: operational, competitive and strategic. Operational changes lead to temporary shift in the level of activity of the organisation. Competitive changes and strategic changes both cause major transformation of an organisation; while there is a higher degree of unfamiliarity and urgency around strategic changes. Consequently he suggests three types of flexibility: operational, competitive and strategic flexibility, each of which is linked to corresponding type of change. Krijnen (1979) argues that changes may appear to be necessary at three levels of decision-making process: strategic, organisational, and operational. Organisation may have to adapt itself at a strategic level, i.e. the level of strategic policy at which the economic and social basic-goals, the strategy and the product market combinations of the firms are fixed. At the organisational level, organisational structure, and the decision-making and communication processes may be subject to change. Finally, changes may be essential at the operational level. For Krijnen an organisation is flexible when it is able to implement necessary changes adequately at these three levels.

The literature shows that no matter what names are picked to represent a particular kind of a change, essentially business changes can be described in two aspects: strategic and operational, where the former one manifests major transformation of organisations, and the later one expresses minor shift to deal with day-to-day business needs.

### 2.4.2 Tactical dimension

Tactical dimensions characterise management's intervention for providing solutions to the environmental requirements. Gerwin (1993) call the tactics "game plan". In his framework, four generic strategies are identified: adaptation, redefinition, banking and reduction. There are classified according to whether they are defensive or proactive in nature, and according to their implications for flexibility. The following discusses some tactical senses in this dimension.

#### 2.4.2.1 Intention: defensive vs. offensive

The intention dimension recognises the posture the organisations take to pursue flexibility, in Evans's word "the offensive or defensive disposition" (Evans 1991). It implies that rather than protecting itself in a turbulent changing environment, organisations can control change and create flexibility by making "pre-emptive" and "exploitive" manoeuvres, e.g. creating options, setting the barrier for the rivals, introducing the standard in the industry or influencing customers about their expectations (Evans 1991). The sense of intention is closely related to Eppink's (1978) definition of active vs. passive. For organisations with an offensive stance, flexibility is a way of gaining powerful competitive advantage (Ansoff 1988; Gerwin 1993) or "maximising the chances of participating in breakthroughs" (Ansoff 1988). The flexibility to introduce new products, brands and models will pre-empt competitor actions and establish a strong market foothold, which leads to strong first mover market advantages (Ahmed, Hardaker and Carpenter 1996). Aaker and Mascarenhas (1984) consider that the offensive flexibility includes participation in different technologies and the development of R&D strengths, whereas in a defensive attitude, flexibility is regards as a means of limiting the negative impacts of the environmental change (Eppink 1978; Evans 1991; Golden and Powell 2000). The defensive approach represents the traditional use of flexibility. Hereby organisations may take measures, such as insuring against loss, eliminating excesses, repairing defects or learning from mistakes, to defend themselves against profit drops and operation fluctuation (Evans 1991). Broadbent and Weill (1997), researching the investments on organisational IT infrastructure, propose four views of IT infrastructure: none, utility, dependent and enabling. The dependent and enabling views represent the firm's offensive and defensive outlook towards its information and IT needs. A firm may adopt a dependent view to respond to specific current business plan, whereas an enabling view is engaged to provide flexibility in achieving long-term goals although an over-investment is inevitable.

### 2.4.3 Operational dimension

All environmental uncertainties will lead to some operational activities if organisation is determined to meet environmental needs to some extent. The operational dimension describes the nature of operational responses to environmental requests. Some senses of operational dimension are described as follows.

#### 2.4.3.1 Scope: limited vs. significant

The dimension of scope presents the extent to which changes are made to satisfy business requirements, or the complexity of flexibility attainment. Buzacott (1982), studying manufacturing system flexibility, argues that flexibility can be addressed in two levels: machine level and system level. Gerwin (1993), after studying multiple dimensions of manufacturing flexibility, notes that each dimension of the manufacturing system flexibility is meant to apply at different hierarchical levels such as machine, manufacturing system or cell, plant or multi-plant levels. Browne et al. (1984) categorise 4 types of flexible manufacturing systems according to the extent of use of their flexibilities: machine cell, machining system, transfer line and transfer multi-line. The manufacturing flexibility literature illustrates that flexibility can be addressed and realised in different levels along the system hierarchy. From a general system perspective, manufacturing systems hierarchical levels could be translated into function, multi-function, system and multi-system levels. Hence, the different level of operational flexibility indicates the complexity of adaptation. In information system literature, it is argued that the scope of adaptation effort may be indicated by extensiveness of adaptation, the number of different type used, how well the tailoring is done, the degree of change in data, interdependency among tailoring types, impact of system upgrade and organisational complexity (Brehm, Heinzl and Markus 2000).

#### 2.4.3.2 Utilisation: potential vs. acquired

Flexibility is regarded as an indication of potential (Slack 1989). This implies that flexibility is actually a resource that can be built-in, reserved in advance and utilised later when necessary. The resource view also suggests that flexibility can be acquired when requirements for flexibility exceed the existing capacity.

The manufacturing systems literature provides ample discussions on this dimension, especially potential and actual aspects. Browne et al. (1984) discuss the potential and actual aspects of routing flexibility by distinguishing the utilisation of flexibility. Flexibility is considered as potential when the flexibility is present but only used when needed, e.g. parts are automatically rerouted when a breakdown occurs. Upton (1994) notes that flexibility is often used to describe the potential of an organisation to perform a set of hypothetical tasks, but it is also used to describe demonstrated abilities, e.g. the ability of a company to produce a broad range of products that can be produced (potential) and are producing (actual/demonstrated). Upton's view implies that the potential dimension overlays the actual dimension. From the operational perspective, potential and actual dimensions both demonstrate the ability of using existing capacity.

Gerwin (1993) analyses the need for flexibility by revealing discrepancies between the required, potential and actual conditions. He outlines critical misalignments between these conditions. When the required is greater than the potential, he suggests that closing this gap calls for diminishing required flexibility through uncertainty reduction or raising potential flexibility by acquiring adaptive capacity. The former suggestion is pertinent to the level of strategic response, and the later one illustrates the method of delivering the flexibility.

| Level | Dimensions | Definition |
|---|---|---|
| Environmental | Level | Level of transformation. |
| Tactical | Intention | The posture the organisations take to pursue the flexibility. |
| Operation | Scope | The complexity of adaptation |
| | Utilisation | The method of utilising the resource for flexibility. |

**Table 1 Multidimensions of flexibility**

| Reference: | Flexibility Dimensions | | | |
|---|---|---|---|---|
| | Level | Intention | Scope | Utilisation |
| Aaker & Mascarenhas (1984) | | * | | |
| Ahmed, Hardaker & Carpenter (1996) | | * | | |
| Ansoff (1988) | * | * | | |
| Broadbent & Weill (1997) | | * | | |
| Browne et al. (1984) | | | * | * |
| Buzacott (1982) | | | * | |
| Eppink (1978) | * | * | | |
| Evans (1991) | | * | | |
| Fitzgerald (1990) | * | | | |
| Gerwin (1993) | | * | * | * |
| Golden & Powell (2000) | | * | | |
| Krijnen (1979) | * | | | |
| Slack (1989) | | | | * |
| Upton (1994) | | | | * |
| Volberda (1996) | | * | | |

**Table 2 Literature on multidimensions of flexibility**

## 2.5 Metrics of Flexibility

After understanding how to address flexibility by different angles or dimensions, one important issue left is how to measure flexibility. As Mandelbaum and Brill (1989) pinpoint, "the purpose of such measures is to provide a basis for comparing existing or potential systems, quantifying trade-offs between flexibility and cost, selecting and designing new systems, and so forth". Without proper mechanisms of assessing the level of flexibility, it is impossible to realise, monitor and improve the capability for change because the judgement towards flexibility becomes subjective and informal (Aaker and Mascarenhas 1984).

Measures of flexibility have been defined in various ways and terms, e.g. versatility/range (Slack 1987; Upton 1994; Golden and Powell 2000), time/responsiveness (Slack 1987; Upton 1994; De Leeuw and Volberda 1996; Golden and Powell 2000), stability/uniformity/resilience (Adler 1988; Upton 1994; Trisoglio 1995). A study of manufacturing system flexibility conducted by Slack (1987) shows that the managers' perceptions about the flexibility are twofold: range – range of states being able to achieve, and response – the ease (in terms of cost and time) of making the change. Upton (1994) argues a system is viewed as flexible when the performance measure is invariant or uniform, where he calls it uniformity. Along with the other two, range and mobility, he determines three distinct elements of flexibility. Golden and Powell (2000) argue that the measurement of flexibility must be measured against a given context in order to be meaningful. They propose four metrics for organisational flexibility measurement: efficiency (degree of fit within time limit), responsiveness (length of time needed), versatility (the ability to respond to foreseen changes) and robustness (the ability to respond to unforeseen changes). The literature of theoretical and empirical studies on flexibility demonstrates that the "given context" can be addressed in three areas: the ability or the quality to transition, the cost of transition and the impact of transition.

The ability of transition is fundamentally concerned with the quality of change or how well the transition is made against various requirements. In this context, range and versatility, demonstrating the ability to support and perform a range of possible activities, are widely adopted for the measure (Upton 1994 and 1997; Brill and Mandelbaum 1990; Slack 1987; Avison et al.. 1995). Something which is often neglected, however, is that there is a sense of effectiveness being interweaved with versatility. When assessing the capability of serving many functions, the essential task is to gauge the effectiveness of each specific function. Versatility is the embodiment of effectiveness within a defined domain. The cost of transition illustrates the context pertinent to the interest of minimising resources utilised. A system is more flexible if the change costs less resource or, in Upton (1994)'s word, incurs less "penalties". The cost is tangible, and can be measured quantitatively. These tangible costs are time – the temporal measure of responsiveness – and monetary expenditure – reflecting the economy of software, hardware and human resources involved. The third way to judge flexibility has to look at the impact of the transition. Flexible systems are those in which the transition causes fewer disturbances on performance in the organisation. Resilience is the measure of the ability of returning to normal position and operational routing under system changes. Hereby five metrics emerge from the literature: versatility, effectiveness, responsiveness, thriftiness, and resilience.

| **Context** | **Metrics** | **Object of measurement** |
|---|---|---|
| The ability of transition | Versatility | System |
| | Effectiveness | System |
| The cost of transition | Responsiveness | Time |

| | | |
|---|---|---|
| | Thriftiness | Financial cost |
| The impact of transition | Resilience | Business performance |

**Table 3 The metrics of flexibility**

### 2.5.1 Versatility

When talking about the flexibility, versatility is one of the most frequently articulated senses, reflecting the ability, for example, to "adopt a range of states" (Slack 1989), or to answer "more product variety" (Parker and Wirth 1999), or to support various choices made for decisions (Gupta and Buzacott 1989), or to "accommodate social and culture diversity" (CBDi Forum 2001) etc.

The term 'range' often represents versatility in the manufacturing literature, such as the range of sizes of components that can be processed, the range of volumes of output for which a plant is profitable, or the range of products which may be produced (Upton 1994). Each of the measures above indicates respectively the level of process flexibility, volume flexibility and product flexibility (Browne et al. 1984). Range is also often used in the literature of management system flexibility, e.g. the range of activities that the system can perform (Avison et al. 1995).

Golden and Powell (2000), studying the link between information systems and organisational flexibility, state that versatility is the measure of the range of activities for which the organisation has planned. This relates the concept of versatility specifically to the capability of the organisation to respond to a situation which it has foreseen. While for Evans (1991), "versatility provides a variety of response repertoires for dealing with unexpected or novel situations in an offensive manner, which is installed or developed, ex ante, before the nature of the initiating contingency is know." He also illustrates further that the primary meaning of versatility is the capacity for new situation and the ancillary meaning is the susceptibility of modification.

Thus, versatility manifests itself as the ability of the system to accommodate diverse business requirements or to serve various business functions competently. The level of versatility increases when the number of functions the system can serve increases. Therefore, versatility can be measured by examining the difference between the number of functions required or desired and the number of functions the system can support and take into effect.

### 2.5.2 Effectiveness

Versatility measures the ability of the system to serve the business requirements competently, which in fact not only reflects the breadth – the primary concern – but also the effectiveness – the ancillary concern – an organisation can perform, while the second sense of versatility tends to be neglected when addressing versatility. In order to clarify these two senses, here versatility is only focusing on the breadth, and effectiveness is used to address the issue of the quality of the system.

Hamilton and Chervany (1981a) state that system effectiveness can be viewed from two general perspectives: the goal-centred view – where effectiveness is determined by comparing performance to objectives – and the system-resource view – where effectiveness is conceptualised in terms of resource viability rather than in terms of specific task objectives. However, the second view on system effectiveness demonstrates strong senses of efficiency / resource consumption and resilience.

Das and Elango (1995) point out that strategic flexibility is the key to effective business performance. They further that given the particularly onerous vagaries of marketplace changes in modern times, to maintain successful performance levels needs a full organisational response embracing flexibility as a bedrock strategic dimension and as a design requirement at all levels of the organisation. Here effectiveness represents the ability to meet changing business requirements so that organisations can act in a more proactive manner to exploit opportunities in the future.

For Kanellis et al. (1999), effectiveness means "fit". They evaluate the information systems fit along the dimensions of decision-making, innovation and information acquisition and distribution, and then broadly conclude that the poor fit in the systems relates to the inability of the information system to respond the changes in the business cases or, put simply "inflexibility".

Thus, similar to versatility, the nature of effectiveness is shared by other resemblant terms, e.g. fit, alignment, success, or quality. All of them refer to the ability to accomplish objectives and the sophistication of the system to meet business needs.

### 2.5.3 Responsiveness

Responsiveness measures the speed of transition, which is an important measure of flexibility. Even if a transition could eventually provide functionalities to fully and exquisitely meet business needs and users requirements, it does not appear to be flexible if the transition takes effect within an inappropriate time frame.

Almost all researchers who study flexibility use responsiveness as the key indicator of flexibility. Eppink (1978), exploring the concept of strategic flexibility, proposes that one way to reduce the total loss of the company when confronting an unexpected threat is to reduce the delay in responding. Evans (1991), in his excellent review of strategic flexibility, reveals that one of the aims of organisations seeking strategic flexibility is to increase the speed of their manoeuvres. Among concepts within a family resemblance to flexibility identified by him, agility and liquidity recognise the sense of responsiveness vividly. Das and Elango (1995) define the responsiveness as the nimbleness and swiftness of an organisation to explore external opportunities. Slack (1987) calls this responsiveness "response flexibility" after discussion with managers about flexible manufacturing systems. For Upton (1994), responsiveness is defined under the dimension of mobility. He also suggests that the measure of time – a proxy for cost – should not mix up with the time that represents the general frequency of changes which occur.

Volberda (1999), in his book "Building the Flexible Firm", clearly explains how response time is formed. The time frame is split by three moments: the moment of actual flexibility needed, the moment of signalling the flexibility needed and the moment for action. This implies that in the real world the response time is not only the time spent on real change, but also the period of initiating the reaction. This point is further confirmed by his assertion that "the management may have the necessary capabilities, but may not be able to activate them in time" (Volberda 1996). Nelson and Ghods (1998) share similar thoughts and stress that it is important to consider both the actual time it takes to make change as well as the time involved in approving or processing the request for change when measuring the rate of response. They furthered that the responsiveness is often affected by process characteristics such as prioritisation, limited resources, or approval processes which are unrelated to the amount of time spending on actual transition.

Hereby it concludes that responsiveness or the speed of response is the essential factor of flexibility. Responsiveness is impacted not only by the design adequacy and capabilities of the system, but also the controllability of management, therefore it should calculate the actual time of transition as well as the time of processing the change requests.

### 2.5.4 Thriftiness

The other quantifiable measure of cost has to be displayed in financial figures. D'Souza and Williams (2000), after studying the manufacturing flexibility construct, conclude that most of the definitions make reference to the time, the cost and the effort required. Attaining flexibility is not free as it consumes resources. Upton (1994) calls it penalty. He asserts that the penalty of moving to a different point for operation is inevitable and flexible systems are those in which the transition penalties for moving within the range are small. For Upton (1994), low values of transition imply mobility, while for Slack (1987) they, combined with the cost of time, they represent response flexibility.

Aaker and Mascarenhas (1984) suggest that investing in underused assets is one of the approaches to increasing flexibility. Gerwin (1993) regards flexibility as an investment and that it may be used defensively to adapt to a sudden change in market conditions, or be employed proactively to redefine competitive condition. Although both of the above refer to preparing flexibility in advance to create excess capacity for the future, they outline the strong sense of financial involvement in providing the need for flexibility.

Eppink (1978) suggests a third way (the other two ways are to reduce the impact and to reduce the delay) of responding successfully to unforeseen environmental change is to reduce the costs of the response. The costs of response were found to be influenced by two factors: physical structure and the portfolio of technologies.

Thriftiness manifests the ability of the system to minimise the economic values for transition. These values have to include both external purchasing of hardware, software, and consultancy, and the internal consumption, e.g. the number of man/day involvement by employees.

### 2.5.5 Resilience

Resilience determines the ability of the system to moderate disturbance on the business performance of the organisation caused by the transition. Upton (1994) calls this "uniformity", reflecting indifference to where, and under what circumstances, the system is operating. He views a system as flexible when the performance measure is invariant.

Evans (1991) uses the term of resilience referring to the tendency to rebound or recoil, showing buoyancy or recuperative power, and the capability to withstand shocks without permanent damage or rupture. He furthers this idea and introduces elasticity and robustness in a similar vein. Elasticity regards the ability to spontaneously resume normal shape after following expansion, contraction or distortion. While in his definition, robustness refers to the system's ability to absorb, deflect, or endure the impacts of unanticipated changes, which implies that the system's capacity for new situation is the key to minimise the scope of system transition and finally reduce the impact on system performance.

Slack (1989) suggests that an alternative to flexibility ought to be considered. Flexibility may lead to less productivity because resources are dispersed to a wide range of tasks. He argues flexibility does have costs associated with it and therefore should not be squandered in areas where it is not needed. Here the "costs" mean the loss of business performance. Volberda (1999) emphasises that flexibility must be combined with stability if it is to have value. It can conclude that attaining flexibility should not cause unnecessary, unbalanced and unrealistic sacrifice on the system performance. Resilience is the measure of the impact of system transition on the performance.

| Metrics / Reference | Versatility | Effectiveness | Responsiveness | Thriftiness | Resilience |
|---|---|---|---|---|---|
| Aaker and Mascarenhas (1984) | | | | * | |
| Avison et al.. (1995) | * | | | | |
| Browne et al.. (1984) | * | | | | |
| CBDi Forum (2001) | * | | | | |
| D'Souza and Williams (2000) | | | | * | |
| Das and Elango (1995) | | * | * | | |
| Eppink (1978) | | | * | * | |
| Evans (1991) | * | | * | | * |
| Gerwin (1993) | | | | * | |
| Golden and Powell (2000) | * | | | | |
| Gupta and Buzacott (1989) | * | | | | |
| Hamilton and Chervany (1981a) | | * | | | |
| Kanellis et al.. (1999) | | * | | | |
| Nelson and Ghods (1998) | | | * | | |
| Parker and Wirth (1999) | * | | | | |
| Slack (1987) | | | * | * | |
| Slack (1989) | * | | * | * | * |
| Upton (1994) | * | | * | * | * |
| Volberda (1996) | | | * | | |

| | | | | | |
|---|---|---|---|---|---|
| Volberda (1999) | | | * | | * |

**Table 4 Literature on the flexibility metrics**

## 2.6 Summary

Without any doubt, flexibility is an important trait for an organisation as business is driven to advance by its surrounding environment. A good understanding of the concept of flexibility will help organisation to identify threats and opportunities from organisation's business environment and react properly. Nevertheless the term of flexibility has been used ubiquitously, yet the definition of flexibility is fraught with difficulties due to the fact that it has many dimensions (Golden and Powell 2000).

For the purpose of this research, a conceptual framework (Figure 3), adapted from Gerwin's (1993) conceptual model for manufacturing flexibility, is adopted to help identify and understand the multi-dimensions of flexibility. Flexibility is defined as having three dimensions – environmental, tactical, and operational, and some senses within each dimension are identified and discussed. It is important to note that the true meaning of each flexibility dimension is not limited to these senses. The environmental dimension characterises the nature of environmental uncertainties, or the cause of adaptation. At the tactical level, management could intervene and choose different "game plan" to respond to different environmental needs. The operational dimension describes the nature of operational responses to environmental requests if an organisation is determined to meet environmental needs to some extent.

Another way of better understanding flexibility is through its measurement, because assessing the level of flexibility leads to a more objective and formal judgement towards flexibility. Measuring the level of flexibility should look at three aspects; the ability of transition, the cost of transition and the impact of transition. The ability of transition is fundamentally concerned with the quality of change or how well the transition is made against various requirements. The cost of transition illustrates the context pertinent to the interest of minimising resources utilised, which can be measured quantitatively by time and monetary expenses. The impact of the transition or the level of resilience concerns disturbances on performance in the organisation that are caused by the transition.

# CHAPTER 3

# Literature Review on Enterprise Systems

## 3.1 Introduction

This research relies on the comprehensive understanding of ESs. This chapter presents ESs, the focus of this study. This chapter outlines several feature of ESs. First, it presents that ES is a technology evolution and management revolution from systems concepts and manufacturing concepts. Second the characteristics of ESs are described. It provides the technological and application foundations of ESs. This comprises of main ES features such as the concepts of modular construction, configuration and best practice. Third, the benefits and issues of ES adoption are outlined. The issues of ES adoption depict the criticisms from both business and technical side. Fourth the success factors of ES adoption are presented. The research is to focus on the post-implementation stage of ES adoption. Therefore, the comprehensive knowledge on IT maintenance is necessary. In the section of "System Change and Maintenance", it argues that IT maintenance is an important and most costly lifecycle phases in the entire system lifecycle. However, system maintenance is not as well regarded as and often viewed less important than the design and development phase of the system lifecycle (Lientz et al. 1978; Glass and Vessey 1999). This section outlines the different type of IS maintenance and key reasons that obstructs the conduct of system change and maintenance. Then the features of ES maintenance are depicted based on very limited IS/ES literature.

## 3.2 Enterprise Systems

Enterprise Systems are a recent departure in the pursuit of information systems that provide enterprise wide integration, functionality and customisation. By examining recent history, it can be inferred that the concept of ERP has evolved from simple inventory management system of the 1960s, to MRP systems in the 1970s and MRPII systems in the 1980s (Chung and Snyder 2000). Enterprise systems are now characterised as configurable, standard commercial system packages, which "provide so-called seamless integration of all the information flowing through a company – financial and accounting information, human resource information, supply chain information, customer information" (Davenport 1998). Over the past five years, enterprise systems have become the strategic de-facto standard in many companies (Holland, Light and Kawalek 1999). In the 1990s', enterprise systems became one of the largest IT investments, and ERP vendors such as SAP, BAAN, PeopleSoft, Oracle and JD Edwards gained major market successes.

By year 2000, the ERP revolution generated over $20 billion in revenues annually for suppliers and an additional $20 billion for consultancy firms (Willcocks and Sykes 2000). A recent survey predicts that spending on ERP will increase from $21.02 billion in 1998 to $72.63 billion in 2002 (Heald and Kelly 1998), which reflects approximately 2.7 percent to 6.4 percent of overall IT market respectively during the period (IDC 1999).

Thus, it can be argued that ERP systems have been the most significant phenomenon in the IT industry during the last decade. “For managers who have struggled, at great expense and with great frustration, with incompatible information systems and inconsistent operating practices", Davenport (1998) said, "the promise of an off-the-shelf solution to the problem of business integration is enticing."

### 3.2.1 Enterprise Systems – the technology evolution and management revolution

In order to better understand the value of ESs, it is useful to retrospect the history of the IS evolution and contrast ESs with the other ISs that organisations previously adopt to meet their information need. Although an information system's internal functions are limited to processing information by performing six types of operations – capturing, transmitting, storing, retrieving, manipulating, and displaying information (Alter 1999), the way that information systems organise and manage the information across the organisation makes a big difference among themselves. Therefore, the nearly 50-year annals of the development of business information systems demonstrate the journey of not only the IT advance but also the management revolution.

| Year | Types of ISs | Management focus | Technical infrastructure |
|---|---|---|---|
| 1950s | Conventional<br>bespoke IS | Data transaction<br>Data centric | Mainframe |

| | | | |
|---|---|---|---|
| 1980s | Conventional packaged software application | Process oriented<br>Functional | Mainframe<br>PCs |
| 1990s | Modern packaged software application | Process oriented<br>Knowledge management | PCs<br>Client/Server<br>Web-enabled |

**Table 5 The history of information systems in business**

#### 3.2.1.1 Traditional information systems

Davenport (2000) in his renowned book "Mission Critical" vividly portrayed the business life before and after ESs. He points out that for most of the time since 1954 the born of the first business application developed by what is now Anderson Consulting, when a business function needed computerised information, it used a "stand-along" application. One reason for this is the technical limitations that at the early stage of business application of computers, the computer was initially very short on memory and had little storage and communication capability, thereby limiting the size and therefore the complexity of the application that could be run (Behrsin, Mason and Sharpe 1994). For example, in the 1970s, the main focus of computerising the business function is tied to automating the functional business transaction, such as payroll, inventory and billing, which has relatively simple and standard application logic and is heavily relied on record keeping. The other reason is the lack of sophisticated corporate management models that require synthesising the information and streamlining the information flow to coordinate planning across different business functions. Accordingly systems were designed for specific individual business functions. Even with the emergence of advanced technology such as Internet, client-server computing, "we haven't totally left this approach behind today" (Davenport 2000). Correspondingly an individual organisation might have hundreds of individual business application systems, each of which had its own application logic, its own information, and its own user interface.

The traditional IS could be characterised as function-based or function-fragmented and data centric, since the focus of traditional ISs is to support small, static number of big processes, typically associated with specific system resources, connected via an explicit set of fast message channels, and no direct data sharing across different business applications is needed.

Davenport (2000) points out that "chopping up ISs this way makes it impossible to coordinate planning across different business functions". Under the fragmented traditional IS settings, although the information is there within the company, it is not accessible or comparable and the automated coordination is simply impossible which makes things frustrating for those who need it. When the cross-function and cross-geographic-area coordination are needed, it requires middle managers to collate and pass the information around the organisation. Davenport (2000) exemplifies the frustration of a company who has separated manufacturing systems and sales systems; "The sales force didn't know what manufacturing had produced recently, and manufacturing didn't find out until later what the sales force had sold. The idea of 'available to promise' inventory just didn't exist".

The architecture of disparate ISs creates a maintenance nightmare. Firstly multiple disparate IS means tens of computer languages and technical platform and standards – some of which are not compatible with each other, also hundreds of different maintenance and update schedules, and thousands of pieces of documentation. Secondly, these systems could not intercommunicate directly among each other. The communication is made through creating ad hoc connections or interfaces. Managing these interfaces is continual and enormous work because all of the interfaces have to be changed when any of the system is changed. Just as Davenport (1998) portrays "maintaining many different computer systems leads to enormous costs – for storing and rationalizing redundant data, for rekeying and reformatting data from one system for use in another, for updating and debugging obsolete software code, for programming communication links between systems to automate the transfer of data".

#### 3.2.1.2 Enterprise Systems

Enterprise Resource Planning (ERP) System is the interchangeable name for ESs. The name of ERP is an alternation of MRP and MRPII, representing the historical evolution of ERP systems that emerged from a natural, smooth, regular and steady progression starting from simple inventory control systems in 1950-60s, to MRP in 1970s, to MRPII in 1980s, all of which were designed for manufacturing operations (Chuang and Snyder 2000). The evolutionary path can be traced in Table 6.

| Year | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s |
|---|---|---|---|---|---|---|

| Name | Inventory mgmt. | MRP | Closed loop MRP | MRPII | ERP | ERPII |
|---|---|---|---|---|---|---|
| Feature | Economic order quantity, order point | Master production scheduling | Demand mgmt. | CIM, executive IS | Finite scheduling, OLAP, workflow, email | Portals, business intelligence |
| Mgmt. Concept | | | | TQM, JIT OPT | World class manufacturing | SCM, CRM, e-commerce |
| Application focus | Stock control | Operational planning and control | Operational planning and control | Integration | Internal efficiencies | External connectivity |
| Underlying methodological approach | Manual system | Scientific solutions | System solutions | Simplify | Business solutions | Virtual business solutions |
| Enabling technologies | Machine language | High level procedural lang., e.g. Fortran, COBOL | | Open systems, 4GL | GUI, objects, components, TCP/IP | WAP, VoIP (data/voice convergence) |
| Underpinning hardware technologies | Mechanical | Batch computing | Online mainframe | Mini-computers, workstations, PCs | Client-server LANs | Distributed networks |
| Electronic technologies | Vacuum tube circuits | Transistor circuits | Semi-conductors | Semi-conductors | Semi-conductors | Semi-conductors |

**Table 6 The evolutionary model for ERP (source: Harwood 2003 pp. 41)**

It is wise to have a closer look at the evolution of ERP from MRP and MRPII that stand as the heart of ERP systems. Material Requirements Planning (MRP) has been introduced for plant managers and their supervisory staff to deal with complex issue of inventory control as a high level scheduling, priority and capacity management system (Chung and Snyder 2000). According to the definition of MRP set by Orlicky (1975), MRP balances material supply and demand based on a set of logically related procedures, decision rules, and records designed to translate a master production schedule (MPS) into time phased net requirements, and the planned coverage of each requirement, for each component inventory item needed to implement this schedule (Chung and Snyder 2000). MRP is simply build around the Bill of Materials (BOM) process in manufacturing. MRP only looks at material constraints, and it does not look at capacity. The output of MRP is fed into the Capacity Requirements Planning (CRP) to determine the capacities required by work centres periodically in the short-to-medium ranges to meet the production goal. MRP systems were originally mainframe based. Moreover, MRP systems lack of technical capabilities to integrate with major business functions in the firm.

Instead of being confined to the planning and control of materials, in 1980s, a new type of system was developed and its scope was broadened to incorporate all manufacturing resources. This new type of system was termed by Oliver Wight as Manufacturing Resource Planning (MRPII) System. Despite the implementation results falling short of expectations, MRPII established itself in many manufacturing companies due to the decreasing cost/increasing performance of computing technology and the increasing scope of integrated functionality and sophistication of standard MRPII software through continuous development and modification (Harwood 2003). MRPII was regarded as "the application of information and manufacturing technology, plans and resources to improve the efficiency of a manufacturing enterprise through integration effort" (Chung and Snyder 2000). It is reported that the superiority of the traditional MRPII over earlier manufacturing planning and control systems is limited by certain intrinsic drawbacks, which include, lack of dynamic resolution of under-capacity or overcapacity without the assistance of a very experienced planner, and the narrow focus on core manufacturing activities which, in effect, turns MRPII into an isolated planning and scheduling system without logical links to distribution, quality and design, for example (Yusuf and Little 1998). On the technical side, MRPII systems of 1980s could be installed on the multiple IT platforms and run on multi-user networks.

However, still MRPII was called as "islands of automation". There are two major reasons. First as MRPII systems were developed with a narrow focus on core manufacturing activities and without considering communication with other traditional business functional areas. Second, as a standard software application, MRPII systems were purchased separately from other systems. The proprietary standard and protocols create an obstacle to technical integration with other software applications (Chung and Snyder 2000).

Since the requirements of manufacturing have changed tremendously in the last few decades, and isolated integration solution provided by MRPII now represents inadequate business solutions, there is the need for a move towards an enterprise-wide solution to enable various functions within an organization to obtain the right information in real-time thereby enabling the organization to improve on its response rate (Yusuf and Little 1998). ERP, a concept developed by Gartner Group, answered this call. It is suggested that ERP is an extension of MRPII with enhanced and added functionalities (Kumar and Hillegersberg 2000). However, ERP systems go far beyond the manufacturing domain, and its business scope is far boarder than a simple extended resource planning systems for production. ERP system support thousands of business activities across and between organisations from back-office operations, such as warehouse management, supply chain, financial accounting, and human resources systems, to front-office applications, such as sales and order management, marketing, purchasing (Figure 4). Furthermore, with the advent of Internet, ERP is extended further to support collaboration and integration outside the organisations with partners, suppliers and customers. As a matter of fact, ERP systems are the response to the call for an integrated architecture and a framework for organisational information systems to support seamless enterprise-wide business integration or total enterprise integration (TEI) – a termed coined by Langenwalter (2000). An integrated ERP platform solves many potential problems such as data reliability and consistency that exist in previous software applications. Companies are able to build whole enterprise applications on top of it. Therefore, the name of ERP is clumsy and no longer appropriate (Davenport 2000), and Enterprise System (ES) is widely adopted to replace the name of ERP.

| | Module name | Description | Key elements |
|---|---|---|---|
| FI | Financial accounting | Designed for automated management and reporting of GL, A/R, A/P, and other sub-ledger accounts with a user-defined chart of accounts. | General ledger, Accounts payable, Accounts receivable, Treasury, Special-purpose ledger, Legal consolidation, Accounting information system. |
| CO | Controlling | Represents the company's flow of cost and revenue, and is a management instrument for organizational decision. | Cost/profit centre accounting, Job order accounting, Project accounting, Product costing analysis, Activity based costing, Profitability analysis. |
| AM | Asset management | Designed to manage and supervise individual aspects of fixed assets. | Plant maintenance (repair, schedule), Inventory control, Traditional asset accounting (depreciation, etc.), Investment management. |
| PS | Project system | Supports the planning, control, and monitoring of long-term, highly complex products with defined goals, accelerates work and data flows. | Funds and resource management, Quality control, Time management, Project management. |
| WF | Workflow | Links SAP R/3 modules with cross-application technologies, tools, and services to automate business processes. | |
| IS | Industry solutions | Combines SAP R/3 modules with additional industry specific functionality. | Segments: Consumer packaged goods, Utilities/ tele-communications, Healthcare, Process industries, Oil & gas, High tech/electronics, Automotive. |
| HR | Human resources | Supports the planning and control of personnel activities | Payroll accounting, Travel expense accounting, Benefits, Recruitment, Workforce planning, Training administration, HR information system. |
| PM | Plant maintena | Supports the planning, processing, and completion of plant maintenan | Processing of unplanned tasks, Service management, Maintenanc |

| | | | |
|---|---|---|---|
| | nce | ce tasks, track maintenance costs, and make maintenance decisions | e planning, Maintenance bill of materials, Plant management information system. |
| QM | Quality management | Supports quality planning and control for manufacturing and procurement. | Quality inspection, Quality planning, Quality management system. |
| PP | Production planning | Supports planning and control of manufacturing activities. | Bill of materials, Work centers, Sales and operations planning, Master production scheduling, Material requirements planning, Shop floor control, Product costing, Kanban. |
| MM | Materials management | Supports the procurement and inventory functions in daily operations. | Purchasing, Inventory management, Reorder point processing, Invoice verification, Material valuation, External services management. |
| SD | Sales & distribution | Helps optimize all tasks and activities carried out in sales, delivery, and billing. | Pre-sales support, Inquiry processing, Quotations, Sales order processing, Delivery processing, Billing. |

**Table 7 SAP R/3 application modules (source: Bhattacherjee 2000)**

Note: This list of SAP R/3 modules is not complete. New modules were being added since then, such as BIW (Business information warehouse) and APO (Advance purchase optimization).

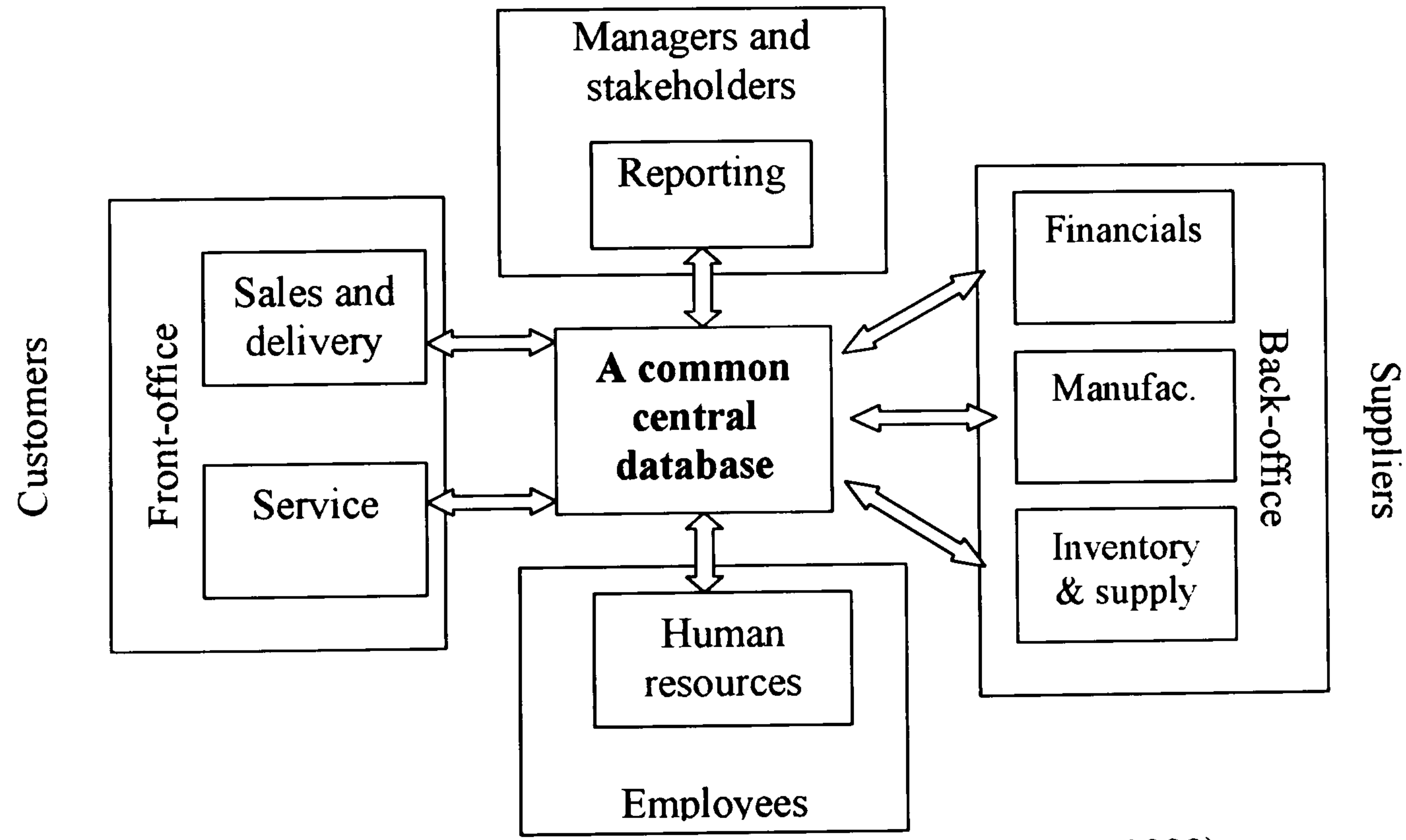


Figure 4 The anatomy of an Enterprise System (source: Davenport 1998)

### 3.2.2 Characteristics of Enterprise Systems

ESs are widely considered as "a technical tour de force" (Davenport 2000). It comprises key characteristics and technical capabilities, which are identified by many ES researchers, to enable a very high level of complexity and functionality and have important implications on organisations that adopt ESs. For example, Markus and Tanis (2000) identify integration, packages, best practices, some assembly required and evolving as the key characteristics of ESs. Chung and Snyder (2000) distinguish three technical features in ESs architecture that could facilitate compatibility between task and technology in ESs. They are data dictionary, middleware, and repository. Davenport (2000) discerns several technical capabilities that are key to how an ES works, including modular construction, client/server architecture, configuration, common central database and variable interfaces.

Here from the IT infrastructure perspective, the characteristics of ES are described in 2 layers: technological characteristics – the basic technological building blocks of the system, and application characteristics – the business logic and definition of application functions.

Technological characteristics:

- System architecture – client/server architecture. Hardly say client/server architecture is the ESs' technological characteristic since early versions of ESs ran on centralized mainframes. Still some firms are using mainframe ES solutions. The client/server software architecture is a versatile, message-based and modular infrastructure that is intended to improve usability, flexibility, interpretability, and scalability compared to centralized, mainframe, time sharing computing (SEI 2003). Beside this reason, the intention to keep technical currency and withdrawing support for the mainframe version of the software enforce organisations to move toward installation of client/server versions of ESs (Davenport 2000). Contemporary ESs are running on three/multi-tier architecture. Figure 5 is the typical software architecture of SAP R/3. It can be thought of in terms of three layers; presentation layer (or referred to as the graphical user interface /GUI) which is used for browsing data and data entry; application layer where business logic for business applications posited to fetch data from the database layer and write the resulting new data back to that layer; and database layer which manages an organization's operational or transactional data and also the metadata maintained in the ESs, which describes the database structure. Client/server computing architecture requires powerful servers and relatively powerful PCs.

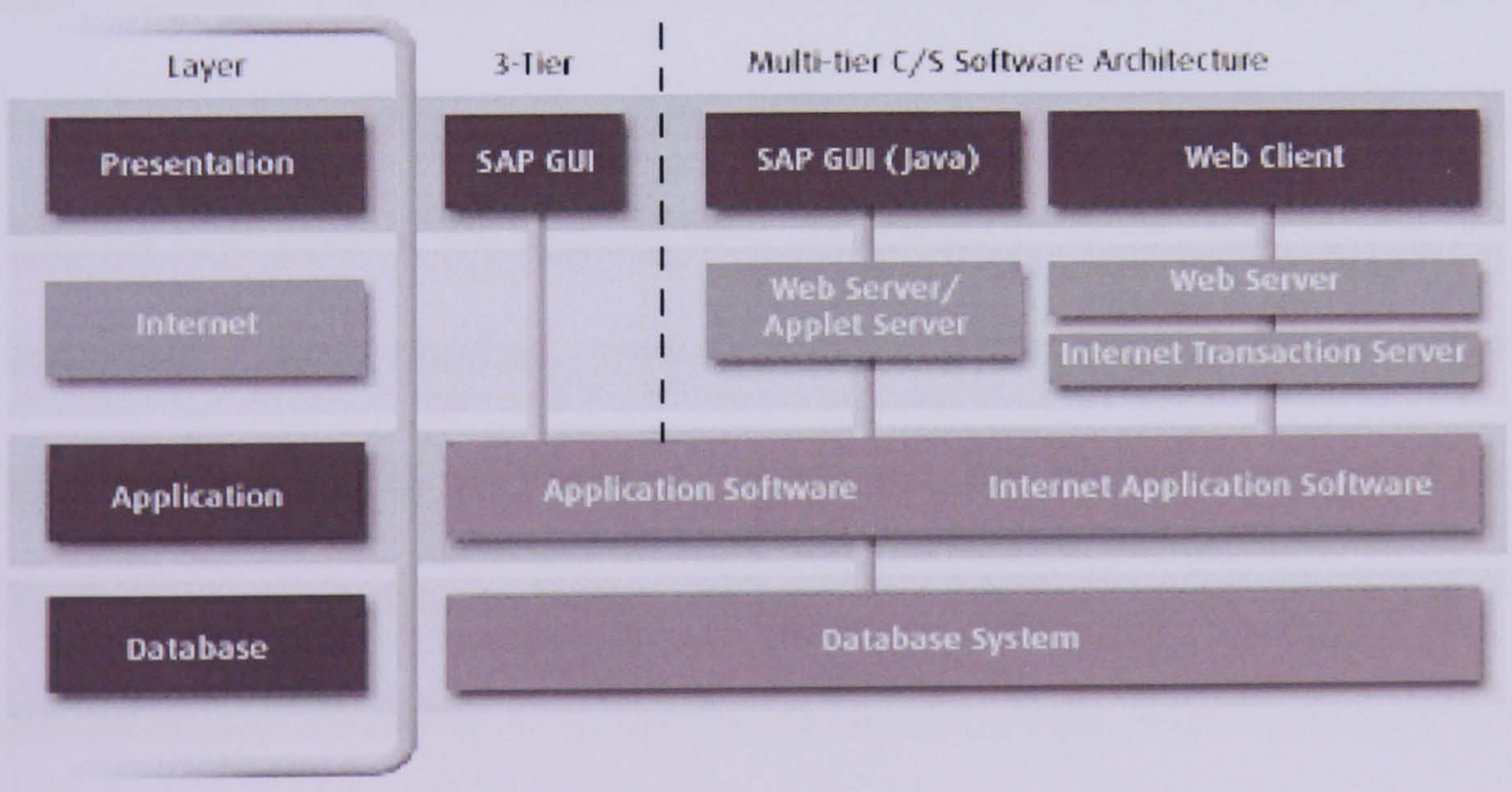


**Figure 5 SAP Architecture (source: www.humningbird.com)**

- Database – a common central database. ES is based on a single large database to achieve the highest level of data integration. The database layer manages an organization's operational or transactional data underlying the application functionality. However, making sense of the structure of the data in these databases is difficult because of the cryptic naming of tables and columns. Any requirement for access to enterprise application data will require an understanding of the data structure (Silwood Technology Ltd. 2002). Therefore the database layer also manages metadata or "data about data" maintained in data dictionary, which describes the database structure. Metadata or data dictionary specifies thousands of domains that are associated with supporting fields and arranged in numerous tables (Chung and Snyder 2000). The database, run by industry-standard relational database management systems (RDBMS) that harness structured query language (SQL) for defining and manipulating all data, drives the ES (Hummingbird Ltd. 2003).
- Communication – middleware and variable interfaces. ESs feature middleware and variable interfaces (Sweat 1998; Davenport 2000), which serve to "glue together" or mediate between two separate and often already existing programs. Middleware makes the applications independent of the system interfaces of the operating system, database system, and communication system used and ensures optimal handling of the business transaction (Buck-Emden and Galimow 1996). With these advanced communication tools, users are able to set up application modules and databases at different locations (Chung and Snyder), demonstrating the global nature of ESs (Davenport 2000). Moreover, variable interfaces (e.g., SAP R/3 has more than 1,000 APIs - Application Programming Interfaces)

enable user organisation to use ES as a backbone and then build custom feature on top of it.

Application characteristics:

- Modular construction. ESs are renowned for its modular construction. These modular applications supports various company business functions such as finance, human resource, logistics and manufacturing etc. Table 7 displays the application modules and primary function areas of SAP R/3 system. ESs also supply certain industry-specific programs, such as programs for the oil industry, publishers, hospitals, and banks (Rockefeller 1998). Therefore, instead of installing the whole jumbo package, companies can select among the available modules offered by an ES vendor and assemble their choices of modules and install them as a complete system, perhaps adding some more additional applications from third-party vendors (Davenport 2000). Based on a single large database, each module is able to directly talk to each other. When new information is entered into a modular application, related information is automatically updated in the others (Davenport 1998).
- Configuration. ESs are "configurable information systems packages that integrate information and information-based processes within and across functional areas in an organisation" (Kumar and Hillegersberg, 2000). The configurable feature is achieved by the repository where ES reference model is stored (Buck-Emden and Galimow 1996). The repository is the foundation of the business framework, because the repository captures all semantics in the business processes, business objects, and organisation model (Curren and Keller

1998). The reference model of SAP R/3 consists of the following components (Buck-Emden and Galimow 1996):

a. Function model: showing the main business functions of the R/3 system with their sub-functions in a hierarchical structure.
b. Process model: describing the functions' chronological dependencies, and also the input and output functions and the organisational units entrusted with function execution.
c. Information flow model: describing the information relationships between sender and recipient within the business application solution.
d. Communication model: reflecting the communication relationships between the actual existing operational organisational units.
e. Organisational model: describing the organisational structure of companies and allocate certain business tasks to organisational units.
f. Distribution model: describing the distribution scenarios supported by the R/3 system.
g. Data model: representing the information objects relevant to a company and their relationships to each other from a business point of view, in the form of an Entity Relationship Model.

The reference model enables user organisations to tailor the functionality of the system to the way it chooses to do the business without fundamentally changing the system source code. However, configuration is far more complex. For example, the most complex ES has more than 8,000 configuration tables. But still companies find ESs don't support their idiosyncratic ways of doing business (Davenport 2000).

- Best practices. Given the nature of "Packaged Software", ESs are constructed to support generic business, because they are supposed to fit the requirements of many organisations. The notion of "Best Practices" is promoted by ES vendors, which are embedded through reference models in the ESs to reflect the best fit of business practices as well as organisational structures. While Soh et al. highlighted "there can be considerable mismatches between the actual country, industry, and company specific business practices and the reference models embedded in the ERP Systems." He furthered "It might be attractive of the idea of universal best practices at the abstract level, but it will cause considerable implementation and adaptation problems at the detail process level" (Kumar and Hillegersberg 2000). Marketing claims that, in today's state of art, no single enterprise systems meets all the information processing needs of the majority of organisations (Markus and Tanis 2000). Uncertainties caused by changes to the internal or external business environment also enlarge these mismatches. Mismatch can also occur between the assumptions about organisational structure implicitly embedded in the reference models of the ES software and the actual organisation, because the current generation of ESs is based upon a traditional hierarchical, functional view of organisations (Kumar and Hillegersberg 2000).

ESs provide standard, pre-packaged software solutions to business information systems, which can be purchased or leased from software vendors rather than being developed in house (Markus and Tanis 2000). Its technological and application characteristics have important implications on organisations that adopt ESs. The central database concept and advanced compunction tools provided by ESs implies the high level of integration. Data records are shared across different business functions and different operation locations. Information entered into a modular application will be automatically updated in the others (Davenport 1998). The major implication is that rather than adopt IT systems to the needs of the business, with ES the primary driver is to adopt the business to the operations of the IT systems (Scheer and Habermann 2000). This runs contrary to the conventional Information Systems (IS) and Software Engineering (SE) approaches which emphasis to mould solutions to the particular needs of an organisation. "An enterprise system imposes its own logic on a company's strategy, culture and organisation", Davenport (1998) pointed out, "it pushes a company towards generic processes even when customised process may be the source of competitive advantage." It might be that ES adoption could kill the innovative strategy for competitive advantages. By now, more and more companies have installed or are going to install ESs. Market analysts observed that most of the Fortune 500 companies have installed ESs. One question is raised that how to differentiate our information-based process to achieve the competitive advantages with these similar standard information systems. Although configuration tables and reference models enable tailoring of the systems to some degree, the flexibility of customisation is limited. It makes it impossible to support companies who have idiosyncratic ways of doing business. Moreover, the given pre-packaged nature of ERP also requires the adopting organisation to have a long-term relationship with software vendor for further upgrading and maintenance etc. It can create dependency on software vendors (Markus and Tanis 2000).

## 3.3 Benefits and Issues of ES Adoption

The outstanding characteristics of ESs promoted by the ES vendors indicate great expectation of benefits that ES adoption organisations wish to realise by proper implementation project. However, Gartner Group reported that only 50 percent of companies that installed a SAP solution have put it to full use (Bylinsky, 1999). Standish Group reported that among the companies with more than $500 million in revenues, few ES implementations hit their initial targets (Buckout, 1999). Analysts pointed out that many companies are still dealing with making these systems live (Davenport 1998; Bylinsky 1999). These negative report and assertion along with the growing number of failed or uncompleted ES projects shall give managers and IS consultants some time to introspect and self-question:

- Given the huge initial investment on ES project, are ESs living up to companies' expectation?
- What benefits or values the user organisations can get from ESs?
- What are the issues associated with the adoption of ESs?

### 3.3.1 Benefits

ES benefits have been reported by various IS researchers, such as Davenport (2000), Markus and Tanis (2000), Daneva (2001), Irving (1999), Ash (2000) etc. By synthesising previous research on benefits from IT investment and published ES success stories from ES vendors' websites, Shang and Seddon (2003) develop the most comprehensive framework for classifying the benefits from ESs. The framework helps process owners to assess and manage the benefits of ESs. The ES benefits are classified in 5 categories as follows:

1 Operational benefit

1.1 Cost reduction

- Labour cost reduction
- Inventory cost reduction
- Administrative expenses reduction

1.2 Cycle time reduction

- Customer support activities
- Employee support activities
- Supplier support activities

1.3 Productivity improvement

1.4 Quality improvement

1.5 Customer services improvement

2 Managerial benefit

2.1 Better resource management

- Better asset management
- Better inventory management
- Better production management
- Better workforce management

2.2 Better decision making

- Improved strategic decisions
- Improved operational decisions
- Improved customer decisions

2.3 Better performance control

- Financial performance
- Manufacturing performance
- Overall operation efficiency and effectiveness management.

3 Strategic benefit

3.1 Support current and future business growth plan

3.2 Support business alliances

3.3 Build business innovation

3.4 Build cost leadership

3.5 Generate or enhance product differentiation

3.6 Build external linkage

3.7 Enable worldwide expansion

3.8 Enable e-business

4 IT infrastructure benefits

4.1 Increased business flexibility

4.2 IT costs reduction

4.3 Increased IT infrastructure capability

4.4 Flexibility

5 Organisational benefits

5.1 Support business organisational changes in structure, and processes

5.2 Facilitate business learning and broaden employees' skills

5.3 Empowerment

5.4 Changed culture with common visions

5.5 Changed employee behaviour with shifted focus

5.6 Better employee morale and satisfaction. (source: Shang and Seddon 2003)

### 3.3.2 Issues

It is axiomatic that ES is a big leap from traditional enterprise information processing environment by reviewing these characteristics and benefits that are claimed and reported with great relish by ES vendors and researcher. The worldwide adoption of ESs indicates the success of ES and ES vendors in the IT industry in the 1990s. However, ES is not a panacea. Besides the customer success stories published by the ES vendors, there are growing number of stories of failed and out-of-control ES implementation projects (Davenport 1998; Hammer 1999). ESs have received criticisms from both business and technical sides – "ESs have their faults" (Davenport 2000). Most problems perceived in ES adoption experience seem to lie in the "outstanding" ES characteristics promoted by ES vendors, such as pre-packaged nature of ESs which leads to the emphasis upon generic processes (Kawalek and Wood-Happer 2002; Davenport 1998), the complex configuration tasks (Davenport 1998 and 2000; Markus and Tanis 2000; Kumar and van Hillegersberg 2000), and integration (Davenport 2000).

#### 3.3.2.1 Limitation of generic processes

The emphasis of realisation of ESs is very different from traditional IS project. The traditional IS approach or bespoke solutions emphasise the needs to mould solutions to the particular needs of an organisation (Kawalek and Wood-Harper 2002). "Much effort is spent on up-front requirements and design activity, with all of the rich political and socio-technical problems involved" (Kawalek and Wood-Harper 2002). While with ESs, ES "... imposes its own logic on a company's strategy, organisation and culture" (Davenport 1998), and user organisations are required to adapt the business to the operations of the generic functionalities supported by ES packages. Therefore, this will involve the reworking of business processes through some degree of business process redesign (Markus and Tanis 2000). The dramatic business change or business process reengineering work will lead to long period system implementation and associated great expenses and high risks (Davenport 2000; Kumar and van Hillegersberg 2000; Markus and Tanis 2000). Common project duration is three to five years (Davenport 2000). Moreover, Davenport (1998) argues that ES pushes a company towards generic processes even when customised processes may be a source of competitive advantage".

#### 3.3.2.2 Limitation of customisability

Because ES applications are based on generic business processes, some established business functions might be lost or amended when adopting ESs. This means idiosyncratic ways of doing business will not get support from ESs, however important these functions happen to be (Davenport 1998). Adjusting the system to match business needs is through its complex configuration table that requires extensive knowledge to carry out the configuration tasks properly. Modifying the source code is strongly discouraged by the ES vendors due to the future problems in the later system lifecycle of ES. The configuration table is far from sufficient enough to customise the system to support various business needs in organisations. Users have to work around – manually to perform the specific functions or use an old system. For this reason, it is feasible that whilst ESs may achieve efficiency benefits with its routines, the overall business efficiency might be reduced. Moreover, this mismatch will enlarge especially when organisations adopt accelerated implementation method. Because "these methods are usually based on offering a minimal fit" (van Everdingen et al. 2000), after the system goes live, users may find some functions may miss and require re-analysis the business operation's requirement.

#### 3.3.2.3 Lack of adaptability

Greenwood and Kawalek (2000) point out "ERP Systems are designed to support an archetype of efficient working within business functions," their "operational flexibility is not emphasised – change is primarily supported through new versions of the software issued by the software vendor." Hence, enhancing the functionality of the ES in the adopting organisation will rely on upgrading the version of the existing ES. Apart from the problem of vendor lock-in and feature function fit, there will be a problem of adapting the functionality in a timely manner, as business needs dictate.

#### 3.3.2.4 Tight integration

Davenport (2000) points out "the integrated nature of ESs makes it difficult to make change in one area without affecting another." Problems will arise when reconfiguring the initial settings of ESs and updating the system application. For example, after implementation, users may find some initial settings are wrong or not exactly as they expect or want. Reconfiguration, though technically feasible, might be difficult to achieve without disruption to business operations.

#### 3.3.2.5 Lack of independency on software development

Markus and Tanis (2000) point out that organisations that purchase ESs enter into long term relationship with software vendors. It is argued that no single ES can meet all the information processing needs of the majority of organisations (Markus and Tanis 2000). For organisations who attempt to satisfy their idiosyncratic and critical business needs, instead of modifying the source code under the conventional IS context, ES user organisations have to customise the system through its configuration table or add on ES vendor licensed third party applications. Attempt to modify the packages is discouraged because it will cause troubles in the later ES adoption lifecycle and reduce user organisations' ability to benefit from vendors' continuous development of the packages. Consequently, many organisations depend on the vendor for continuous enhancement of the package. Organisations become vulnerable because of the lack of independency on software development.

## 3.4 Success Factors of ES Implementation

Since ESs touch many aspects of a company's business operation, the successful deployment and use of ESs are critical to organisational performance (Markus et al. 2000). Identification of factors that are necessary or critical for successful implementation of ESs is of great importance to many organisations (Parr, Shanks and Darke 1999). Thus it is no surprise that the factors research becomes one of the major streams of ES studies (Lorenzo 2003). The factors research of ESs seeks to understand successful implementation of ESs by identifying factors that either facilitate or impede the implementation progress and evaluating their criticality. Table 8 depicts the factors appearing in the previous ES success factors studies.

| | **Authors** / **Factors** | **Sumner (2000)** | **Parr et al. (1999)** | **Bingi et al. (1999)** | **Holland and Light (1999)** | **Nah et al. (2001)** | **Umble et al. (2003)** | **Al-Mashari et al. (2003)** |
|---|---|---|---|---|---|---|---|---|
| **Management** | Top management support and commitment | X | X | X | X | X | X | X |
| | Proper project management control | X | X | | X | X | X | X |
| | Champion | X | X | | | X | | |
| | Effective communication | X | | | X | X | | X |
| | Business plan and vision | X | | | X | X | X | X |
| | ERP strategy | | X | | X | | | |
| | Monitoring and feedback | | | X | X | X | X | X |
| **Technology** | Integration | X | | X | | | | X |
| | Minimum customisation | X | X | | X | X | | X |
| | Appropriate legacy systems | X | | | X | X | | X |
| | Software testing & troubleshooting | | | | X | X | | X |
| | Data accuracy | | | | | | X | |
| | Package selection | | | | | | X | X |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Process** | BPR | X | | X | X | X | X | X |
| **User capability** | Sufficient end-user training | X | | X | | | X | X |
| | Effective communication | X | | | X | X | | X |
| | Teamwork and effective skill mix | X | X | | | X | X | |
| **Technical support** | Qualified ERP developers / consultant | X | X | X | | | | |
| | Effective communication | X | | | X | X | | X |
| | Sufficient training and reskilling of IT workforce | X | | | | | X | X |
| | Business analyst/consultant | X | X | X | | | | |
| | Teamwork and effective skill mix | X | X | | | X | X | |

**Table 8 A sample of success factors for the ES Implementation by authors**

Table 8 illustrates various factors as being critical or important to ES implementation. It is shown that the results are relatively consistent. The most recurrent factors are: top management support and commitment, project management, communication, business plan and vision, BPR, minimum customisation etc. These factors could be categorised into 5 groups – management (including project management), technology, process, user and technical support – which are dedicated to be responsible of meeting the requirements of these factors.

### 3.4.1 Management issues

It is argued that ES implementation is about people and management, not processes or technology (Bingi et al. 1999). ES adoption has an enormous impact on the business and causes organisations under through a major transformation. Hereby "... management of this change must be carefully planned and meticulously implemented" (Bingi et al. 1999). The management issues here address two aspects – top management and leadership factors and project management factors (although sometimes top management factor is included in the project management activities).

By reviewing the literature of successful ES implementation, top management factors are the key to ensure a smooth change management and system rollout (Bingi et al. 1999). The tremendous cost and investment associated with ES implementation require top management to allocate sufficient resources and fund to the project. The enormous impact on the competitive advantage of the organisation needs top management to consider the strategic implications of ES adoption (Bingi et al. 1999). Top management must set the tone for the direction of the business and align the project mission with these business strategy and needs. Furthermore, top management must lead their employees effectively in order to harness the energy and creativity of employees, to enable the business to perform, to implant modern concepts such as BPR and to exploit the technology capabilities of an ES (Al-Mashari et al. 2003). When conflicts arise, top management must intervene and to mediate between parties to bring everybody the same thinking, and to build cooperation among diverse groups in the organisation (Bingi et al. 1999).

Good project management is essential (Trepper 1999; Nah et al. 20001) to accomplish a complex task as ES projects. This includes

- a clear definition of objectives and scopes should be established at the outset of the project in order to avoid complicating the implementation (Umble et al. 2003);
- an aggressive but achievable work plan and resource plan and schedule should be established according to the number of modules being implemented, the scope of implementation, the extent of customisation, and the number of other systems the ES is going to be connected with (Bingi et al. 1999);
- the presence of champion to market and oversee the project throughout the organisation (Sumner 1999);
- effective monitoring and evaluation of performance from the beginning in order to assure the schedule, budget and quality against tasks are on the track (Nah et al. 2001), and avoid problem enlargement in the later phase of ES lifecycle (Markus and Tannis 2000).

### 3.4.2 Technology issues

The comprehensive business solutions of ESs are built on a complex technical system incorporating a variety of technologies e.g. client/server, middleware, database, and internet/LAN. It is essential for ES adoption organisations to consider technical aspects of ES implementation project. These include package selection, integration, minimum customisation, legacy systems, data, and software development, testing and troubleshooting.

It is imperative to conduct the ES package selection process with great care to assure the new technology's capabilities does not mismatch with the organisation's existing business processes (Umble et al. 2003; Al-Mashari et al. 2003). It is reported that 80% to 90% of a particular system will be the same across different implementations, but 10%-20% will be different and tailored to the specific needs of the organisation (Ptak 1999). Therefore, the company must identify its critical business needs and the desired features and characteristics of the selected system (Umble et al. 2003). Umble et al. (2003) recommend thirteen-step selection process: create the vision, create a feature/function list, create a software candidate list, narrow the field to four to six serious candidates, create the request for proposal, review the proposals, select two or three finalists, have the finalists demonstrate their packages, select the winner, justify the investment, negotiate the contract, run a pre-implementation pilot and validate the justification.

One of the complexities associated with ES implementation is related to the cross-module integration nature of the system (Soh et al. 2000). Since no single application can do everything an organisation needs, organisations have to use other specialised software products that best meet their unique needs. These products, either bespoke or third party software, must be integrated with the ES backbone (Bingi et al.1999). The problems are: first, middleware is not available for all software products; and second middleware vendors tend to focus on the technical aspects of application interoperability rather than linking business processes together (Bingi et al. 1999). Therefore, organisations have to develop their own interfaces. Moreover, the different technology environments within one organisation created delays in establishing consistency and coordination in the platforms, database management systems and operating systems (Sumner 2000). Technology bottlenecks can occur when attempting to bridge between ES modules and other software products.

Appropriate legacy systems are important to the success of ES implementation. Since legacy systems encapsulate the existing business processes, structure, culture and IT, they determine the amount of organisational and IT change required to successfully implement an ES (Holland and Light 1999). Existing legacy systems have to be carefully defined and evaluated to determine the nature and scale of problems that an organisation may encounter during implementation (Holland and Light 1999).

Another important factor is minimum customisation which is always associated with BPR. ES should not be modified as much as possible (Sumner 2000), and instead the organisation should adopt the processes and options built into the ES (Parr et al. 1999). Minimum customisation could avoid errors and minimise maintenance effort in installing the patches and upgrading the system into a newer version (Light 2001; Ng 2001). Organisations can use certain modelling tools to help align business processes with the standard package (Holland and Light 1999).

Software testing and troubleshooting is essential, beginning in the project phase (Nah et al. 2001). As the implementation of an ES cannot be realised in a single step, adequate system testing and validation of an ES is important to ensure that the software technically works along with existing functionalities and other systems, so as not to lead to later system problems (Al-Marshari et al. 2003). Holland et al. (1999) point out that troubleshooting errors is critical. Organisations should work well with vendors and consultants to resolve software problems so as to ease the implementation.

Data accuracy is important for the integration nature of ESs (Umble et al. 2003). One mistake in one business function area will lead to a negative domino effect throughout the entire enterprise. ESs require that users should not work around the system in order to assure the data accuracy and consistency throughout the entire organisations (Umble et al. 2003).

### 3.4.3 Process issues

ES, by its own very nature, requires user organisations to adapt or reengineer their business processes to fit ES imposed application logic. ES is essentially developed as instruments for improving business processes (Al-Mashari et al 2003). Therefore rather than modifying the system to fit the bad processes, organisations should review and analyse current business processes to identify the potential chances of reengineering (Scheer and Habermann 2000). Business process redesign is a prerequisite to take full advantage of an ES (Holland and Light 1999). Moreover, customisation of the software package will increase the total cost and risk of the implementation (Bingi et al. 1999). Sumner (2000) points out that any attempt of organisations to go to war with the package and try to make it meet their business process requirements, only leads the way to cost overruns and project failure.

### 3.4.4 User issues

User issues shall be carefully considered for the ES implementation project not only because their acceptance and use of the system will lead to effective operation of the system, also because being a member of implementation team, they are experts of the real world, who understand the real needs of the business.

Success ES implementation requires sufficient end-user training so that end users can use the system properly and the full benefits of ES can be realised (Umble et al. 2003). Training is also an effective way to boost user morale and acceptance of the new system. However, Umble et al. (2003) indicate that the "knowledge transfer" process does not only lie on the education and training. Besides, the learning process comes from hands-on use under normal operating conditions. Also periodic meeting of and communication between end users would help share experience of system use and problem solving and increasing familiarity with the system. Moreover, some end users are selected as members of implementation teams. They are key users to provide insights of business knowledge and needs. Also working with consultant and technical staff help them gain the necessary business and technology knowledge and skills. They become instructors to train and instruct other end users to use the system effectively.

### 3.4.5 Technical support issues

A sound implementation team consisting of consultant, business analysts, technical staff, and users is no doubt the key to the success of ES implementation. The "best" business analysts should have both business and technology knowledge (Sumner 2000). They provide the business expertise to form the foundation for the new system configuration. They should be released from all duties to work on the implementation although it was not always achievable (Parr et al. 1999). Recruiting and retaining qualified ES developers is a critical issue because of the high turn-over of high-tech professionals (Sumner 2000). Also finding right consultants and keeping them through the implementation is a major challenge for organisations because of the shortage of competent consultant (Bingi et al. 1999). An ideal consultant should possess multiple skills – functional, technical and interpersonal skills along with specific industry knowledge (Bingi et al. 1999). However not many consultants have all required skills. Besides that, it is important to mix consultants and internal staff to work together on a project team to enable internal staff to grow necessary skills for ES design and implementation (Sumner 2000). Adequate training and reskilling for the IT workforce is another important way to gain necessary skills. Moreover, the implementation team should communicate with employees throughout every level of the organisation about what is happening including the scope, objectives, activities and updates (Sumner 2000).

## 3.5 System Change and Maintenance

The post-implementation stage of a system is the final and also an important phase of the entire IS lifecycle. It is a stage to keep system operational to assure day-to-day business operation and ascertain the benefits of its investment, and to adapt or enhance system to meet changing business needs and user requirements (Lientz et al. 1978; Markus and Tanis 1999). It involves various activities like bugs fixing, upgrading, system integration etc. However, it seems that the IS community likes to give maintenance a broad meaning to include all post-implementation activities. Traditionally, software maintenance has been defined as the modification of a software system after delivery, to correct faults, to improve performance or other attributes, or to adapt the product to a changed environment (ANSI/IEEE 1983). Takang and Grubb (1996) synthesis a number of factors that will motivate the maintenance of software systems:

- To provide continuity of service: This entails fixing bugs, recovering from failures, and accommodating changes in the operating system and hardware;
- To support mandatory upgrades: These are usually engendered by changes in government regulations, and also by attempts to maintain a competitive edge over rival products;
- To support user requests for improvements: Examples are such as enhancement of functionality, better performance and customisation to local working patterns; and
- To facilitate future maintenance work: This usually involves code and database restructure and updating documentation.

Maintenance is one of the most costly lifecycle phases in the entire system lifecycle (Glass and Vessey 1999; Smith 1999). Expenditures go into maintenance and enhancement are estimated at about 40 – 70 percent of totally costs of the entire lifecycle of the software system (Takang and Grubb 1996; Lientz et al. 1978; Glass and Vessey 1999; Fitzgerald et al. 1999). Glass and Vessey (1999) point out that there is a 60/60 rule for system maintenance and enhancement; roughly 60% of software dollar for a given product is spent on its maintenance, and 60% of the maintenance dollar is spent on enhancement (comparing 17% being spent on correction).

One of the greatest challenge facing software and system engineers is to manage and control changes to systems in order to make system useful where the usefulness of systems is termed as functionality, flexibility, continuous availability and correctness (Takang and Grubb 1996). Especially, in today's turbulent business environment and IT intensive operational environment, organisations have to swiftly change their IT systems to keep pace of the rapid changes in the organisation or its environment. Systems must be changed to address the current business problem rather than one that existed when the system was first built or even implemented. A survey conducted by Fitzgerald et al. (1999) reports that 78% of the organisations had one or more "problematic systems" require substantial enhancement and/or redevelopment, and that the degree of change required to enhance then, as a percentage of the effort required for the original development, was large at 126%.

However, system maintenance is not as well regarded as and often viewed less important than the design and development phase of the system lifecycle (Lientz et al.

1978; Glass and Vessey 1999). Often maintenance is regarded as a continuation of new development (Figure 6), but there is a fundamental difference between them (Takang and Grubb 1996). This is due to the constraints that the existing system imposes on maintenance.

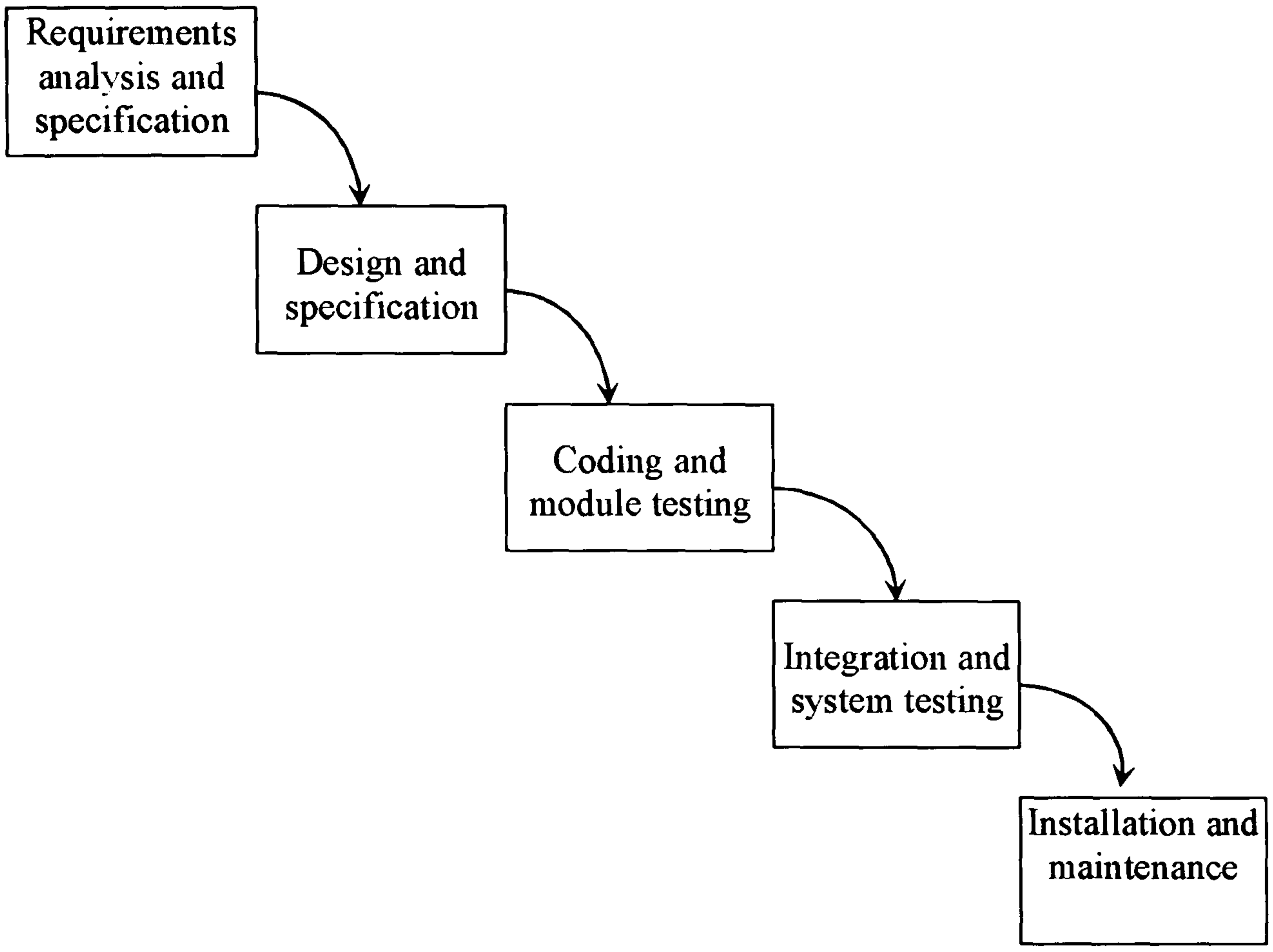


**Figure 6 Classic Waterfall model of a software lifecycle**

### 3.5.1 Traditional IS maintenance and enhancement

Conventionally, IS maintenance and enhancement is classified in four dimensions: corrective, adaptive, perfective and preventive changes (Swanson 1976; Takang and Grubb 1996).

- Corrective maintenance includes any work of correcting software defects or errors in design, code, and implementation/logic. Design errors can result from misunderstanding of business requirements and incorrect, incomplete design; implementation errors can result from invalid tests and conclusions, incorrect implementation of design specification, faulty logic flow or incomplete test of data; and coding errors are caused by incorrect implementation of details logic design and incorrect use of the source code logic. All these errors are called "bugs".

- Adaptive change is a change driven by the need to accommodate modifications in the environment of the software system (Takang and Grubb 1996). The term environment in this context refers to the totality of all conditions and influences which act from outside upon the system, for example, business rules, government policies, work patterns, software and hardware operating platforms.
- Perfective change refers to the work to expand existing system requirements, such as improving processing efficiency, performance, or maintainability, and enhancing existing system functionality to better meet user requirements (Takang and Grubb 1996; Nah et al. 2001).
- Preventive change includes work like code restructuring, code optimisation and documentation updating (Takang and Grubb 1996). The aim of preventive change is to prevent malfunctions or to improve maintainability of the software system by periodic inspection of systems.

Many researchers have adopted the terminology (corrective, adaptive, perfective and preventive). However, meanings to these terms are not unanimous among researchers, industries and even technical standards, as Chapin et al. (2001) point out. They compose an evidence-based typology of software system maintenance based on

Swanson's (1976) classic typology and compare it with technical standards and industrial definitions (Table 9).

| Evidence-based | | Technical standards (intention-based) | | | Industrial definition (activity-based) | |
|---|---|---|---|---|---|---|
| Cluster | Type | Swanson | IEEE | ISO/IEC | Kitchenham et al. (1999) | Harjani & Queille (1992) |
| Support interface | Training | NI | NI | ALL | NI | User support |
| | Consultive | NI | NI | ALL | NI | User support |
| | Evaluative | NI | NI | ALL | ALL | ALL |
| Doc. | Reformative | Perfective | Perfective | Perfective | ALL | Preventive |
| | Updative | Perfective | Perfective | Perfective | ALL | Preventive |
| Software properties | Groomative | Perfective | Perfective | Perfective enhancement | Enhancements | Perfective |
| | Preventive | Perfective | Perfective / preventive | Preventive / perfective enhancement | Preventive | Anticipative / preventive |
| | Performance | Perfective | Perfective | Perfective enhancement | Corrections, implementation change | Anticipative / preventive |
| | Adaptive | Adaptive | Adaptive | Perfective enhancement | Changed existing requirements | Anticipative / adaptive |
| Business rules | Reductive | Perfective | Perfective | Perfective enhancement | Changed existing requirements | Evolutive |
| | Corrective | Corrective | Corrective | Corrective | Corrective | Corrective |
| | Enhancive | Perfective | Perfective | Perfective enhancement | New requirements | Evolutive |

**Table 9 Approximate correspondence between definitions of types (source: Chapin et al. 2001)**

**(NI – not included, ALL – implicit in all included activities)**

There are many reasons, either from business environment or technical environment, that will invoke the application of software system maintenance and enhancement activities and processes illustrated above. Fitzgerald et al. (1999), in their UK survey of software maintenance and enhancement, break down the types and causes of changes (Table 10).

| Types of maintenance | Main causes of changes | (%) |
|---|---|---|
| Corrective | Original specification not properly implemented | 4 |
| | Original specification inadequate | 11 |
| Adaptive / Perfective | Organisational changes | 13 |
| | Personnel changes | 3 |
| | Government/legal changes | 9 |
| | External factors (e.g. banks, Inland Revenue, suppliers) | 7 |
| | New business/strategic development | 22 |
| | New policies (e.g. security review/financial cutbacks) | 6 |
| Preventive / Perfective | Technology (e.g. old hardware no longer maintainable) | 18 |
| All | Other | 7 |
| | Total | 100 |

**Table 10 Main causes of changes (source: adapted from Fitzgerald et al. 1999)**

Ideally, these variations in the business and technical environment call for swift change of adopting IT system to keep the advancement of the system. In practice, as Takang and Grubb (1996) point out, it is difficult and not always possible due to several reasons:

- Resource limitations: Lack of skilled and trained maintenance staff and the suitable tools and environment to support their work are the major hindrances to the quality and productivity of maintenance activities. Cost may also be an issue;
- Quality of the existing system: Changes to old systems could lead to unpredictable ripple effects and a potential collapse of the system;
- Organisation strategy: The desire to be on a par with other organisations, especially rivals, can be a great determinant of the size of a maintenance budget;

- Inertia: The resistance to change by users may prevent modification to a software product, however important or potentially profitable such change may be.

Therefore, various measures are developed to cope with costly and exhaustive maintenance and enhancement activities and processes. Benamati and Lederer (1999) propose 11 types of coping mechanism for rapid IT change:

| Coping mechanism | Items |
|---|---|
| 1. Education and Training | ▪ Educate IS professionals about new IT through classes<br>▪ Customise education on new IT<br>▪ Learn new IT informally without classes<br>▪ Maintain your own training staff for new IT<br>▪ Document the differences between new and previous IT |
| 2. Inaction | ▪ Ignore problems |
| 3. Internal support | ▪ Use internal staff to write required interface between IT<br>▪ Use internal staff to rewrite applications<br>▪ Attend conferences to keep informed of available new IT<br>▪ Read to keep informed of available new IT |
| 4. Vendor support | ▪ Rely on IT vendors to provide solutions to problems<br>▪ Work with IT vendors to improve future versions of IT<br>▪ Have vendors customise new IT<br>▪ Engage the vendor to write required interfaces between IT |
| 5. New procedures | ▪ Use a well defined IT acquisition procedure<br>▪ Consider only new IT compatible with existing IT<br>▪ Consider only new IT successfully used by other organisations<br>▪ Learn about new IT through vendors<br>▪ Use a well defined IT implementation procedure |
| 6. Persuasion | ▪ Pressure vendors of new IT to provide support<br>▪ Pressure IS professionals to use new IT<br>▪ Inform IS professional of the benefits of new IT |
| 7. Endurance | ▪ Solve problems using exclusively internal resources |

| | |
|---|---|
| | ▪ Work around problems without fixing them<br>▪ Coordinate communicate among multiple vendors |
| 8. Additional technology | ▪ Purchase additional new IT |
| 9. Consultants & others users | ▪ Obtain support from another company already using the new IT<br>▪ Engage a consultant to help plan for new IT<br>▪ Engage a consultant to provide ongoing support for new IT<br>▪ Engage a consultant to help in addressing problems<br>▪ Engage a consultant to aid in the implementation of new IT |
| 10. Staffing | ▪ Restructure the IS organisation<br>▪ Motivate retention of staff who are knowledgeable in new IT |
| 11. Delay | ▪ Delay acquisition of new IT |

**Table 11 Coping mechanisms for rapid IT changes (source: Benamati and Lederer 1999)**

### 3.5.2 ES maintenance and enhancement

The magnitude of the cost/investment and problems associated with ES implementation along with its potential benefits have secured enormous attentions by researchers and IS practitioners to identify and solve implementation issues by examining the ES implementation experiences of enterprises. Nevertheless the traditional view of the importance of IS maintenance, and the crucial standing of ESs because of its broad influence on organisation behaviour and business processes adoption and vast investment, the life with ESs after the original implementation processes is less understood and properly studied (Glass and Vessey 1999; Light 2001; Gable, Chan and Tan 2001; Ng 2001). Some research reports have already revealed the imminent necessity of researching on ESs maintenance. Glass and Vessey (1999) discover that annual ES client-initiated maintenance costs on average approximately

25% of the initial ES investment. AMR Research states that an ES upgrade costs approximately a further 25-33% of the initial investment (AMR Research 2002). To date, there is finger-countable number of research about ESs maintenance.

Glass and Vessey (1999) point out the reasons why researchers have not yet addressed ERP maintenance issues:

a. ERPs are still a relatively new phenomenon. Not very many companies have had lengthy experience with maintaining their ERP systems.
b. Maintenance, even in the traditional information systems world, is generally thought of as an uninteresting topic.
c. Little theory has been developed regarding the topic maintenance, where "theory-based research" is an important facet of many traditional research studies.

Nevertheless, the limited research on ES maintenance has demonstrated some unique features of ES maintenance and enhancement. It is largely because of the pre-packaged nature of ESs. Arguably, the modification and configuration or "tailoring" (Brehm et al. 2000) done during the system implementation can be regarded as the first maintenance project on an ES, as these activities are done after the delivery of the generic solution of an ES (Ng 2001). Researchers have been looking at this issue from different perspective, e.g. implication of customisation on future maintenance effort (Light 2001), roles and relationships of ES maintenance (Hirt and Swanson 2001), ES maintenance and upgrade (Ng 2001), classification of ES maintenance tasks (Nah et al. 2001) etc.

Ng (2001) points out that in an ES environment, maintenance and enhancement activities originate from two main sources, the ES user organisation and the vendor where traditional IS maintenance and enhancement activities originate mainly from internal requests. The former includes request for enhancement, bug fixes, ongoing system support, and helpdesk. The latter comprises support package or patch and upgrade, which are distributed by the vendor but implemented by an ES user organisation. The external requests from vendors, either mandatory such as LCPs (legal change patch) or optional such as upgrade, are the major reasons to prevent user organisations to modify adopting ESs (Ng 2001). This is because the implementation of external request maintenance and enhancement will overwrite some of the custom code and previous modifications. Therefore, more effort is required to conduct impact analysis to verify their effects, and also sometimes reapplication and retesting of some of the previous modification are required (Ng 2001). The level of modification or customisation on ESs will directly affect the cost of ES maintenance and enhancement job. The constraint on modification implies that user organisations could loose the control over the future software development and shift it to software vendors (including ES vendors and other external parties).

This is also reflected in Hirt and Swanson's (2001) extended relational foundations (ERF) model for ES maintenance (Figure 7). Their research focused on various participants, including users, project team, steering committee, IS staff and external parties, and their roles in the post-production phase of ESs. Some important characteristics are identified as follows (Hirt and Swanson 2001):

- The ES implementation project and its management is made permanent, with principal responsibility for ongoing system maintenance;
- Project management remains with the user community;
- A steering committee is established to guide important system change;
- Key-users comprise the project team membership and increasingly become the system experts, while also representing the interests of other end-users;
- External expertise and services offered by ES vendors, consultants, and other third parties are frequently needed and called upon accordingly;
- The IS department is largely relegated to providing technical support services, including needed network capacity and the installation of software fixes and releases.

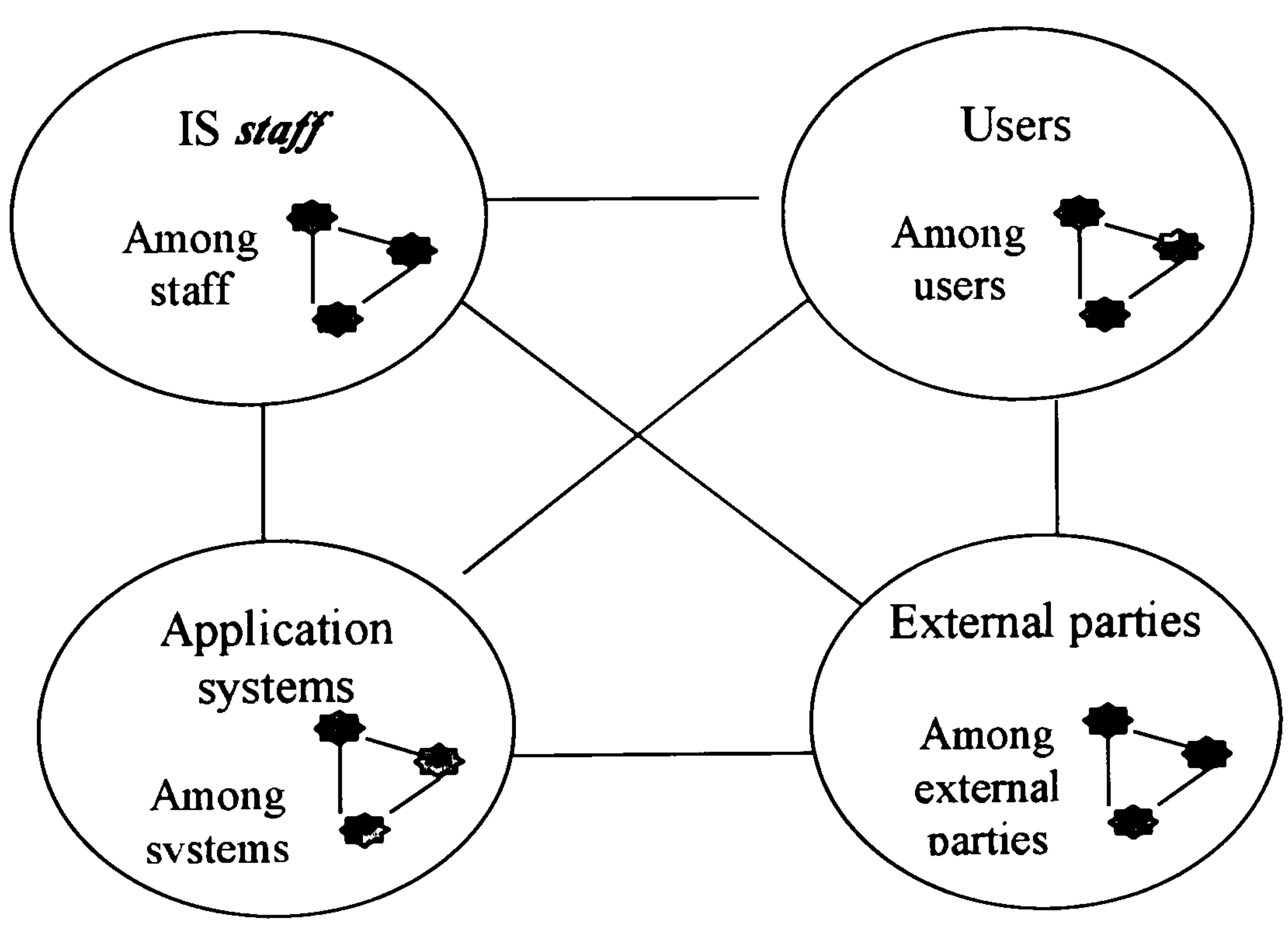


**Figure 7 The extended relational foundations (ERF) model (source: Hirt and Swanson 2001)**

ES maintenance and enhancement comprise various tasks, some of which are not typically performed during the maintenance of traditional be-spoke system (Nah 2001). Table 12 displays the classification of ES maintenance and enhancement tasks, which incorporates Nah et al.'s (2001) classification and Brehm et al.'s (2000) typology of ES adaptation. These activities are categorised into 6 categories: corrective maintenance, adaptive maintenance, preventive maintenance, perfective maintenance, user support and external party activities.

| **Maintenance categories** | **Maintenance tasks** | **Description of tasks** |
|---|---|---|
| Corrective maintenance | Application of patches | Incorporate system patches sent by ES vendor |
| | Troubleshooting | Resolve anomalies reported by users |
| | Import new objects from ES vendor | Incorporate objects (lines of code) send by the vendor to solve problems |
| Adaptive maintenance | Transfers | Moving new features from development to test to production environment |
| | Testing | Integration testing after patches application and configuration changes |
| | Configuration (customisation in SAP parlance) | Setting of parameters (or tables), in order to choose between different executions of processes and functions in the software package. |
| | Screen masks | Creating of new screen masks for input and output (soft copy) of data. |
| | Workflow programming | Creating of non-standard workflows |
| | Extended reporting | Programming of extended data output and reporting options. |
| | User exists | Programming of additional software code in an open interface |

| | | |
|---|---|---|
| | ERP programming | Programming of additional applications, without changing the source code (using the computer language of the vendor, e.g. SAP's ABAP/4) |
| | Package code modification | Changing the source-codes ranging from small change to change whole modules. |
| | Authorizations | System password maintenance, changes in access permissions as staff arrive, leave, or change positions |
| | Tuning of system interfaces | Tuning interface with other software |
| Perfective maintenance | Version upgrade | Justification, planning, and actual implementation of new software versions |
| Preventive maintenance | Routine administration | Monitoring average system response times and thresholds, file sizes, tape backups, and error logs |
| | Monitoring workflow | Tracking flow of maintenance work items |
| User support | Training users | Training users on new or existing features |
| | Help desk | Answering user questions about the system |
| External parties | Coordination and administration | Coordinating work and relations among ES team members, vendors, contractors/consultants, and external user organisations |
| | Creation of online service system (OSS) notes | Online query or reporting of problems to the vendor, tracking vendor's progress towards resolution of problems reported |

**Table 12 Classification of ES maintenance and enhancement tasks**

## 3.6 Summary

There is a general recognition that flexible IT/ISs shall lead to successful business performance. Researchers and engineers have strived hard to make IT/ISs more adaptive and effective. ESs are a recent departure as such, offering enterprise wide integration, functionality and customisation by using standard configurable and modularised packages. ES is a technology evolution and management revolution from systems concepts and manufacturing concepts from simple inventory control systems in 1950-60s, to MRP in 1970s, to MRPII in 1980s (Chuang and Snyder 2000).

ES comprises key characteristics and technical capabilities to enable a very high level of complexity and functionality and have important implications on organisations that adopt ESs. The characteristics of ES are described in 2 layers:

- ✓ technological characteristics – the basic technological building blocks of the system, including client/server architecture, a come central database, middleware and variable interfaces, and
- ✓ application characteristics – the business logic and definition of application functions, such as modular construction, configurability and reference model, and best practices.

The outstanding characteristics of ESs promoted by the ES vendors indicate great expectation of benefits that ES adoption organisations wish to realise by proper implementation project. Besides the customer success stories published by the ES vendors, there are growing number of stories of failed and out-of-control ES implementation projects (Davenport 1998; Hammer 1999). ESs have received criticisms from both business and technical sides (Davenport 2000). Most problems perceived in ES adoption experience seem to lie in the "outstanding" ES characteristics promoted by ES vendors, such as pre-packaged nature of ESs which leads to the emphasis upon generic processes (Kawalek and Wood-Happer 2002; Davenport 1998), the complex configuration tasks (Davenport 1998 and 2000; Markus and Tanis 2000; Kumar and van Hillegersberg 2000), tight integration (Davenport 2000). Other problems for ES include lack of independency on software development (Markus and Tannis 2000), and lack of adaptability (Greenwood and Kawalek 2000). All these problems reflect the criticism for ES rigidity and inflexibility. In essence, ESs are designed to support an archetype of efficient working within business functions by their own logical templates that describe how the business processes in each function should work. "Operational flexibility is not emphasised" (Greewood and Kawalek 2000) – change is primarily supported through new versions of the software issued by the software vendor. The contradictory voices from industries and academics imply that although ESs overcome the problems and rigidity of legacy IT systems, in this increasing dynamic business world, ES or standard packaged software seems not capable enough to provide flexible solutions to the demands from the businesses in spite of that some claims of flexibility are based on unfounded optimism and unverifiable wisdom. Therefore, it has become an emerging need for research to understand the extent to which the ISs particularly ESs can support business flexibility, and how organisations use their adopting ISs/ESs to cope with ongoing business changes.

Furthermore, the life with ESs after the original implementation processes is less understood and properly studied (Glass and Vessey 1999; Light 2001; Gable, Chan and Tan 2001; Ng 2001) despite the importance of IS maintenance and the crucial standing of ESs. This is because

- ✓ ERPs are still a relatively new phenomenon. Not very many companies have had lengthy experience with maintaining their ERP systems.
- ✓ Maintenance, even in the traditional information systems world, is generally thought of as an uninteresting topic.
- ✓ Little theory has been developed regarding the topic maintenance, where "theory-based research" is an important facet of many traditional research studies. (Glass and Vessey 1999)

However, some researches have revealed imminent necessity of researching on ESs maintenance or the ES post-implementation adoption (Glass and Vessey 1999; AMR Research 2002).

# CHAPTER 4

# The Research Objective and Questions

## 4.1 Introduction

This chapter discusses the rationale of this research, based on the emerging needs for flexible IT/ISs for ongoing business changes and pluralism of IT/IS flexibility. A particular focus of this research concerns how organisations use their adopting ISs to cope with ongoing business changes. The aim of the research is to generate a descriptive and explanatory theory of IS/ES post-implementation adaptation. Then this chapter explains the reason of choosing ESs as the research object. Finally the key research questions are defined.

## 4.2 The Research Objective

It has been discussed in previous chapters that flexibility is highly desired for the success of organisations in today's business. More and more organisations are increasingly concentrating on flexibility as a way to achieve new forms of competitive advantage (Upton 1995). The wide adoption of IT/ISs for day-to-day business operation suggests that business and IT systems are more and more closely entwined. Therefore, the need for flexible IT system to support ongoing business changes has emerged. In spite of the general recognition that flexible IT shall lead to successful business performance, it is argued that IT/ISs do not necessarily assist organisational flexibility (Allen and Boynton 1991; Golden and Powell 2000). The accounts of IT and organisational flexibility generally fit into two camps: motivational – which explains the reasons how and why IT/ISs might contribute to business flexibility (Lucas and Olson 1994; Avison et al 1995), and critical – which explores the negative impacts of IT/ISs on business flexibility (Golden and Powell 2000; Davenport 2000; Allen and Boynton 1991; Lucas and Olson 1994). Despite of these attempts of studying the relationship between IT/ISs and business flexibility, none of them has provided a descriptive and explanatory theory. It can be concluded that despite the critical need of flexible IT/ISs for business changes, the extent to which ISs are able to support business flexibility is still unknown and not well understood.

Furthermore, new technology and computer information systems have been developed in order to achieve flexibility to meet the challenge of daily business operations. Some technologies, such as object-oriented technology, COTS (components off the shelf), have emerged to promote flexibility. ESs such as SAP are seen as a recent departure, offering enterprise wide integration, functionality and customisation by using standard configurable and modularised packages. They offer an original solution to the demands of flexibility by virtue of their scale, functional integration and standard, configurable architecture. Still, ESs have been subject to criticism for its rigidity (Davenport 2000; Markus et al 2000; Greenwood and Kawalek 2000; Ni et al 2002). Davenport (2000) criticise ESs for the difficulty of fitting ESs into business and difficulty of changing the business operations once they are installed. Markus et al (2000) make a similar claim that lack of feature function fit, and concerns about company growth, strategic flexibility and decentralised decision-making style are two of the reasons for not adopting ESs. Greenwood and Kawalek (2000) argue that ESs are designed to support an archetype of efficient working within business functions by their own logical templates that describe how the business processes in each function should work, but the operational flexibility is not emphasised and change is primarily supported through new versions of the software issued by the software vendor. However, all these criticisms are not based on the empirical evidences from post-implementation stage of ESs adoption, but the findings from the study of ESs implementation. The main reason of it is the lack of research on ESs maintenance (Glass and Vessey 1999). Notwithstanding the traditional view of the importance of IS maintenance that costs around 25-33% of the initial investment (AMR Research 2002), and the crucial standing of ESs because of its broad influence on organisation behaviour and business processes adoption and vast investment, the life with ESs after the original implementation processes is less understood and not well studied (Glass and Vessey 1999; Light 2001; Gable, Chan and Tan 2001; Ng 2001). The contradictory voices from industries and academics imply that although ESs overcome the problems and rigidity of legacy IT systems, in this increasing dynamic business world, ES or standard packaged software seems not capable enough to provide flexible solutions to the demands from the businesses in spite of some claims of flexibility that are based on unfounded optimism and unverifiable wisdom. Therefore, it has became an emerging need for research to understand the extent that ESs can support business flexibility, and how organisations use their adopting ESs to cope with ongoing business changes.

Hereby, the purpose of this research is to generate a descriptive and explanatory theory of how organisations use their adopting ISs/ESs to support ongoing business changes.

The scope of the study is limited to ESs not only because there are a number of types of ISs available that have different design philosophy in nature, which would complicate the research, but also because as discussed above:

1. ESs are widely adopted by organisations in the world;
2. ES is the critical information system to support day-to-day business operation;
3. Besides the benefits and also great flexibility promised by ES vendors, ESs are criticised for its rigidity and inflexibility (Greenwood and Kawalek 2000; Markus, Axline, Petrie and Tanis 2000; Davenport 2000; Ni and Kawalek 2001); and
4. ES maintenance/post-implementation has received little research.

Therefore, the selection of ESs as a research object seems appropriate and the research on ESs post-implementation adaptation is considered as the starting point for the research on ISs flexibility in general.

The study is exploratory since the research topic, namely "IS Flexibility", to date has received little attention and there is no adequate literature. The research aims:

> to develop a model of post-implementation ES support for ongoing business changes that allows academics and practitioners better understanding the nature of business changes, various options for coping with these changes with their adopting ESs, and resource and cost associated with these changes.

The model would enable academics and practitioners to analyse, plan and achieve system flexibility in face of business environment uncertainty.

## 4.3 The Research Questions

As discussed in above section, this research is exploratory. "The purpose of exploratory research is to investigate little understood phenomena and identify or discover important variables to generate hypotheses for further research" (Marshall and Rossman 1989). The following research question is aimed to be investigated by this research:

- "How organisations adapt ISs/ESs to support business changes/flexibility?"

RQ1: How organisations adapt ISs/ESs to support ongoing business changes?

In answering this question, it is necessary to follow the conceptual framework for flexibility (Figure 3) to examine the process of ESs adaptation for business changes. The flexibility dimensions in the conceptual framework serve as a framework to identify business uncertainties, associated strategies and responses for delivering the flexibility. The business flexibility metrics (Table 3) is to measure the capability of ESs satisfying diverse changing business requirements.

RQ1.1: What is the nature of business uncertainty that organisations encountered?

By answering this question, it helps to understand and identify the nature of business changes organisations require. In Chapter 2, business flexibility is categorised in two dimensions: operational and strategic.

RQ1.2: What coping tactics organisations employed to handle environmental uncertainty?

In IT intensive organisations, all of these demands for business flexibility will in turn feed through to the computer systems that modern organisations rely upon. To deal with these business demands, IT organisations can apply different coping tactics to alleviate these demands. This question is set to understand the coping tactics organisations employed to deal with business flexibility.

RQ1.3: What activities do organisations take to meet changing requirements?

After business flexibility is interpreted into implementable system change requests, some actions will be taken to change the systems. This question is set to understand what system flexibility is required to implement these change requests.

RQ1.4: How flexible can organisations make changes on their adopting ESs to support business change requirements?

Here is to gain objective evidence about the level of flexibility of organisations' adopting ESs. The measurement of ES flexibility will follow the business flexibility metrics which can be addressed in five dimensions – versatility, effectiveness, responsiveness, thriftiness, and resilience.

RQ1.4.1: Versatility: Do the adopting ESs provide versatile solutions towards the changes?

RQ1.4.2: Effectiveness: What is the level of effectiveness that system changes meet the requirements specified in the change request?

RQ1.4.3: Responsiveness: How long did it take to implement the change requests? Was the time spent acceptable?

RQ1.4.4: Thriftiness: How much did it cost to undertake the system change? What is the structure of the cost?

RQ1.4.5: Resilience: What is the impact on business performance due to the system change made?

## 4.4 Summary

This research is motivated by the emerging needs for flexible IT/ISs for ongoing business changes and pluralism of IT/IS flexibility. A particular focus of this research concerns how organisations use their adopting ISs to cope with ongoing business changes. The scope of the study is to focus on ES post-implementation experience as the starting point for the research on ISs flexibility in general due to the wide adoption of ES, the important of ES support for day-to-day business, and the criticism of ES flexibility.

# CHAPTER 5

# Research Method

## 5.1 Introduction

This chapter describes the philosophical stance and research methodology that underpin this research. First this chapter presents a review of main standpoint and branches of ontology and epistemology. Then it describes and discusses the researcher's philosophical belief (critical realism) and its relationship with IS research, and also the implication of critical realism on some practical issues of this research. Second, this chapter presents a review of a range of research methods that have been advocated as being suitable for research in the field of information systems. The general methodology followed is that of theory generation from case study evidence. The rationale behind the selection of the research method is discussed. Other practical methodological concerns are also presented. Then, it discusses the strength and weakness of the research approach. Finally, the process of theory generation from multiple-case studies is described in detail.

## 5.2 Philosophical Stance

Philosophy is the study of the ultimate reality, causes, and principles of that which underlays being and thinking. All forms of research necessarily come with some underlying fundamental assumptions that primarily concern the nature of the world (ontology) and the nature of knowledge and the process of knowing (epistemology). This section describes the philosophical stance of the researcher, which shapes up the researcher's belief and view towards the constitution of a valid research, which guides the selection of research approach.

### 5.2.1 Ontology

Ontology is a branch of metaphysics that studies the nature of being. Historically, there are two types of theories of universals that can summarise the answers to the questions of all ontological aspects of reality. They are nominalism / relativism and realism. Nominalism holds that the external universe is not real and its properties are not existents in themselves and "there are no universals that can be predicated of things other than the predicate expressions of language – where what it means to say that a predicate expression can be predicated of thing is simply that the expression is true of those things" (Cocchiarella 1996). In realism, the external universe exists independently of the human capacity for thought and language and that our conceptions of them reflect their existent natures. This is extended to include the view that the social world has an existence that is as concrete and substantial as the actual world. Hence the social world can also be described using measurable properties that are independent of the observer and the measuring instruments used. However, both extreme nominalism and realism try to detach the subject-object relation from the meaning coherence.

Critical Realism (Bhaskar 1978), which the researcher advocates, reconciles the subjective-objective views, and asserts that there is a "Reality" out there but that our knowledge is made up of the world (the object), our perception of it (the percept) and us (the subject). Critical realist claims a realist view of being in the ontological domain whilst accepting the relativism of knowledge as socially and historically conditioned in the epistemological domain (Mingers 2000). Critical realists assert that real objects, which is intransitive and relatively enduring, are subject to value laden observation which is transitive and changing (Dobson 2000). For Bhaskar (1978), reality is both intransitive and can be stratified into the domains of the real (contains structure, mechanisms, events and experiences), the actual (contains events and experiences), and the empirical (contains experiences) (Mingers 2000). The distinction of empirical domain of observable events and real domain in which generative mechanisms capable of producing patterns of events does underpin the ontological and epistemological ground of both positivistic approach that is adopted primarily in natural science research and interpretive approach that is adopted primarily in social science research. Therefore, critical realism has been accepted and adopted in social and organisational science research (Mingers 2000; Dobson 2000; Tsang and Kwan 1999). However, in social sciences, the inability to construct closed systems that provide ideal conditions for experiments implies that the primary aim of research must be explanatory rather than prediction or falsification (Tsang and Kwan 1999; Dobson 2000). In addition, the critical realist's conception of causality differs from the extreme realist's: it emphasises on tendencies of things to occur rather than predicting regular patterns of events.

### 5.2.2 Epistemology

"Epistemology refers to our theory of knowledge, in particular how we acquire knowledge" (Hirschheim 1992). There are primarily two opposing paradigms of epistemology; positivism and interpretivism (Galliers 1992; Hirschheim 1992).

Positivism is a dominant epistemology in natural sciences, seeks to reveal regularities and causal relationships through an analysis of the frequencies and sequences of events. Positivists seek to identify verifiable facts about phenomena and to devise and apply laws about their operation. Positivism is regarded as underlying the scientific method in the West (Hirschheim 1992). Four tenets that are central to positivism are proposed by various philosophers (Hirschheim 1992; Livesey 2004):

1. the unity of the scientific method, which implies that the scientific method for knowledge acquisition is valid for all forms of inquiry;
2. the search for human causal relationships, which reflects the desire to find regularity and establish causal-and-effect relationships that are true all time;
3. the belief in empiricism, which refers to the conviction that "valid knowledge can only be produced on the basis of direct observation that involves the ability to measure and record something" (Livesey 2004); and
4. the value-free nature of science (and its processes), which reflect the belief that positivism relies on an objective epistemology; a scientist must be objective and value free towards the observation or experiment; the methods used should not be dependant upon the subjective interpretations of a researcher and research should be capable of exact replication (Livesey 2004).

From the above, positivism entails the ontological position of realism and believe in empiricism, objectivity and replicability. Positivism is the dominant epistemology in information systems research (Orlikowski and Baroudi 1991).

The alterative paradigm of knowledge acquisition is interpretivism. Interpretivism entails the ontological position of relativism or nominalism. Interpretivism challenges the positivism paradigm in a way that it recognises that the complexity of social world changes over time and the culture differences make it impossible to discover laws as in the natural sciences (Dilthey 1988). Interpretivists acknowledge that human experience is a process of interpretation rather than sensory reception and apprehension of the external material world. Interpretivists tend to seek explanations and interpretations of social settings, and value subjective opinions and attitudes. There are three central principles of interpretivism (Livesey 2004):

1. People create and associate their own subjective and inter-subjective meanings as they interact with the world around them (Orlikowski and Baroudi 1991). In contrast to the descriptive positivistic studies, interpretive studies reject the possibility of an objective account of events and situations.
2. "Simple" cauls relationship will be impossible to establish empirically and future events couldn't be predicted as the conditions under which a relationship is theoretically established will have changed by the time that such a relationship was established.
3. Social world can be understood by different people in different situations in different ways.

Table 13 illustrates the philosophical assumptions and methodology of positivistic and interpretive research approach.

| Research Strategy | Positivistic | Positivistic (descriptive) | Interpretive (weak constructive) | Interpretive |
|---|---|---|---|---|
| Ontology | Realism | | | Relativism |
| Epistemology | Positivism | | | Anti-positivism |
| Type of research goal | Prediction and control | | | Understanding |
| Roles of value in research | value free | | | value laden |
| Research outcomes | • Laws<br>• Hypotheses<br>• Theorem proofs<br>• Tools<br>• IS instruments<br>• Techniques<br>• Methods<br>• Application of models | | | • Models<br>• Frameworks<br>• New concepts, insights or theories<br>• New application |
| Methodology | Experiment / Measurement | | | Participant observation, discussion, and textual analysis |

**Table 13 Comparison of positivist and interpretive research approach (source: adapted from Alexander, 2002)**

### 5.2.3 The researcher's philosophical position and justification

Dobson (2001) argues that philosophy "has an important role to play in research, not as a permanent statement of position, but as conditional and intimately related to the outcomes and practices of research". This view of philosophy emphasises the needs to "bother" with philosophy and define philosophical position in order to make their preferences clear from the outset, but also reflect a flexible view of adopting philosophical supposition as an integral part of the research process. The researcher's philosophical belief (critical realism) and its relationship with IS research, and also the implication of critical realism on some practical issues of this research are discussed as follows.

Various researchers contend that information system research should be considered more of a social science and not simply a technical one (Galliers 1992; Hirschheim 1992). Social science is the battle ground between nominalists or interpretivists and realists or positivists. In natural science and material world where realism and positivism prevail, universal or invariant laws are sought through verification and falsification. To social scientists, it seems that there are no intransitive objects for investigation and invariant laws are impossible in social science. Social phenomena are inherently different from material phenomena. The differences primarily lie in:

- social structures exist only in their effects or occurrences,
- social structure do not exist independent of the agent's conceptions,
- social system are inherently interactive and open,
- the possibilities of measurement to meaning are very limited, and
- social science is inherently self-referential (Mingers 2000).

These differences do put limits on the practice of social science. However, from a critical realist perspective, they do not make it different in principle from nature science (Mingers 2000): "it is still driven by the existence of an intransitive domain of generative mechanisms; a recognition of the epistemic relativity of knowledge; and a retroductive methodology that explains events by hypothesizing causal mechanisms."

It has been asserted in the Chapter 4 that the research in IS flexibility has received little attention and there is no sophisticated theory to underpin the theoretical ground of this research. Although the Gerwin's conceptual framework of flexibility is employed in this research, it is used as a guideline to understand the organisation's behaviours relating to the subject of IS flexibility rather than an underlying theory to create explicit hypotheses for testing. Obviously this research does not follow the typical positivistic research approach, i.e. the cycle of theory-hypothesis-testing-theory extension. The purpose of this research is to fill in the knowledge gap that typical positivistic research cannot attend to. Theory is to be built largely based on people's perceptions and opinions. Therefore, this implies that the research approach should be interpretive or descriptive in nature. Moreover, although replication and falsification is not to be sought in this research, the research outcome will complement future positivistic research by generating hypotheses for further investigation. All above demonstrates that this research approach shall sway between positivism (descriptive) and interpretivism (weak constructive) both of which shows very similarity between each other. The dilemma here is that which exact category this research shall fall in. The answer lies in the researcher's view of social reality. From a critical realism perspective, social phenomena exit not only in the mind but also in the objective world. Organisations, groups, social systems, ideas, concepts, meanings and categories are equally as real as physical objects. "They are emergent from, but irreducible to, the physical world, and have causal effect both on the physical world and the social and ideational world" (Mingers 2000). Once ideas are expressed, they are no longer wholly subjective, and become intransitive and available for investigation, debate and judgement by others (Mingers 2000). Therefore, the research approach falls into the positivistic descriptive research approach rather than weak constructivism interpretive approach.

## 5.3 Research Methods for Information Systems Research

A range of research methods has been proposed for the research of information systems. Galliers (1992) classifies the proposed research approaches into two categories; scientific and interpretive (Table 14). Yin (1994) points out that each method has peculiar advantages and disadvantages, depending upon three conditions:

a). the type of research question,

b). the control an investigator has over actual behavioural events, and

c). the focus on contemporary as opposed to historical phenomena.

| Scientific / Positivist | Interpretivist / Anti-Positivist |
|---|---|
| Laboratory experiments | Subjective/argumentative |
| Field experiments | Grounded theory |
| Surveys | Action research |
| Case studies | Case studies |
| Forecasting | Futures research |
| Simulation | Role/game playing |

**Table 14 Information systems research approaches (source: adapted from Galliers, 1992)**

### 5.3.1 Laboratory experiments

The basic idea of an experiment is to establish cause-and-effect relationships between variables in a designed, controlled environment using quantitative analytical techniques (Galliers 1992). Under this experimental environment, researchers virtually have control over all the independent and intervening variables that affect the dependent variables because variables are isolated to a small number (Galliers 1992; Golden 1997). Researchers can manipulate one or more independent variables, and then identify and compare the differences in the outcome variables (Punch 1998). Therefore, in this limited experimental environment, causal relationship between the variables can be studied at great intensity (Galliers 1992). The better control of extraneous variables to research subjects, the better internal validity (Punch 1996). However, the lack of realism due to the over-simplification of the experimental situation limits its applicability in social science research e.g. research of information systems (Galliers 1992; Punch 1996).

### 5.3.2 Field experiments

Field experiments or "quasi-experiments" are a type of experimental design which extends the experimental reasoning to a more practical and natural situation (Punch 1996; Galliers 1992). The problem relates to the alike-in-all-respects criterion of the experiment due to the possibility of extraneous variable influences on factors relevant to the outcome variable, which threatens to the internal validity (Punch 1996). Therefore, it is essential in conducting field experiment that researchers are able to identify these extraneous variables that matter, measure them, and extract their effects statistically (Punch 1996). It can be concluded that using field experiment method in a novel kind of situation is extremely difficult as controlled and uncontrolled variables are ambiguous and no testable hypotheses can be put forward (Golden 1997). Information systems research is a typical example.

### 5.3.3 Surveys

The survey is a research "strategy" (Robson 1993) referring to a group of methods which emphasise quantitative analysis, where data is collected in standardised form from a large number of organisations through data collection methods such as mail questionnaires, telephone interview, personal interviews, or from published statistics, and this data is analysed using statistical techniques (Robson 1993; Gable 1994). In theory a survey can be carried out for any of the research purposes whether exploratory, descriptive or explanatory. However in practice, surveys are not particularly well suited to carrying out exploratory work (Robson 1993). That is because it is far inefficient and ineffective to analyse answers of a wide range of largely open-ended questions instead of pre-defined standardised questions in such a data collection scale. Survey research normally seeks to describe the distribution of a wide range of characteristics for some particular questions (descriptive survey) or to discover causal relationship between variables (correlational survey). Moreover, "little insight is usually gained regarding the causes or the processes behind the phenomena under study" (Galliers 1992).

### 5.3.4 Case studies

Case study is regarded as a research strategy more than a method (Punch 1996; Galliers 1992) for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence (Yin 1994; Robson 1993). The intensive nature of case studies, which usually requires a small number of cases for study, enables the researcher to capture reality in considerably great detail and develop as full an understanding of that case as possible (Punch 1996; Galliers 1992). Gable (1994) indicates that case studies provides "the opportunity to ask penetrating questions and to capture the richness of organisational behaviour, but the conclusions drawn may be specific to the particular organisations studies and may not be generalisable. Case studies are normally criticised for the generalisability of research findings and also whether they can provide adequate evidence base for both the development and the answering of research questions (Robson 1993). Other major weakness includes the risk of improper interpretation and lack of control of independent variables which leads to the difficulties in distinguishing between cause and effect (Galliers 1992; Gable 1994). Moreover, the close involvement of researchers renders the potential for their influence on events and persons involved. Notwithstanding, case studies can be used to accomplish various aims: to provide description, test theory and generate theory (Eisenhardt 1989). Case study is a common approach to information systems research in the real world (Galliers 1992), because the objective of information systems research is to study contemporary evens and it is not necessary to control behavioural events or variables, as Yin suggests (1994).

### 5.3.5 Forecasting and futures research

Futures studies are a multi-disciplinary field, and are concerned with a wide range of views, either descriptive or prescriptive, about futures. Forecasting and futures research represent, respectively, the scientific and interpretivist aspects of this form of research (Galliers 1992). Forecasting uses statistical techniques such as regression analysis and time-series analysis to discover a pattern purely in historical data and extrapolate likely future trends. Futures research uses techniques like Delphi survey, change analysis, and scenario to deduce the emergence of new social form and behaviour based on the knowledge of and judgement from a group of experts. The validity of futures studies research methods replies on the precision of past data in forecasting method and the expertise of the scenario builder in the futures research (Galliers 1992).

### 5.3.6 Simulation and game/role playing

Simulation and game/role playing have several different purposes in the social sciences: prediction, performance, training, entertainment, education, proof, and theory discovery. This research method provides the opportunity to study complex systems that might be difficult or impossible to analyse by a replication so well constructed for the behaviour of a system. Simulations can serve as a suitable substitute for constructing and understanding field research. "Simulation enables studies of more complex systems because it creates observations by moving forward into the future, whereas other research methods attempt to look backwards across history to determine what happened, and how" (Dooley 2002). However, similar to experimental research, it is difficult by using this method to devise a simulation that accurately reflects the real world situations (Galliers 1992)

### 5.3.7 Subjective/argumentative research

The subjective/argumentative research method requires the researcher to adopt a creative or speculative stance rather than act as an observer. It is a useful technique since new theories can be built, new ideas and insights created, and then subsequently tested by more formal means. Positivist would question whether this method is genuinely research. Galliers (1992) supports the use of this approach because of its strength of creation of new ideas and insights which contributes to the building of theories. However, because of the unstructured and subjective form of research, there is a strong chance of researcher bias.

### 5.3.8 Action research

Action research is a form of research strategy to combine pure research (observation) with action (participation). The central of this method is the requirements for collaboration between researchers and practitioners, and for practitioner participation in the process. Therefore action research bridges the divide between theory and practice, enabling the researcher to develop applicable knowledge in the problem domain (Sanford 1970). In conducting action research, researchers directly intervene in the problematic situation facing the people or organisation whom the research is working with and attempt to develop a solution that is of practical value to them. In addition researcher seeks to develop theoretical knowledge. Similar to case studies, action research is usually restricted to a single organisation making it difficult to generalise findings. Moreover, the personal ethics of the researcher is a key issue as action researchers hold a great deal of responsibility when objectives are at odds with other groupings (Galliers 1992).

### 5.3.9 Grounded theory

Grounded theory is first described by Glaser and Strauss (1967), in which theories are developed from data rather than gathering data to test a theory or hypothesis. The theory is grounded in the data which represents the real phenomenon. It contrasts with the hypothetic-deductive method or theory-hypothesis-testing-theory extension approach, where theories are generated from repetitive testing and refining of constructed hypothesis based on a previous theory. A grounded theory can be argued as a theory generated without a pre-conceived theory. Strauss and Corbin (1990) define Grounded Theory as "a qualitative research method that uses a systematised set of procedures to develop and inductively derive grounded theory about a phenomenon". Theory is developed and evolves gradually during the research process through the interaction between data collection and analysis. Grounded Theory meets four central criteria: fit, understanding, generality and control (Strauss and Corbin 1990).

## 5.4 Selecting the Research Approach: A Multiple-case Study Research

### 5.4.1 Selecting the research method

Trauth (2001) states three major factors influencing the choice of qualitative research methods in IS research: a) the research problem, b) the researcher's theoretical lens, c) the degree of uncertainty surrounding the phenomena.

First, Trauth (2001) states "what one wants to learn determines how one should go about learning it", meaning that the nature of the research problem should have the most significant influence on the choice of a research methodology. This research is motivated by the emerging needs for IS/ES flexibility to support ongoing business changes. The purpose of the research is to examine how organisations cope with constant business changes with their adopting ESs after initial implementation of ESs. Therefore this research is to aim to conduct "an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidences" (Yin 1994). Moreover as the research topic, namely "IS Flexibility", to date has received little attention and there is no adequate literature, the research is exploratory in nature to generate a descriptive and explanatory theory of ES post-implementation adaptation. Yin (2003) suggests that the case study research should be considered when the phenomena under study is little known and involves high complexity.

Second, the researcher's theoretical lens or philosophical and epistemology stance influence the choice of research method. Moreover, the purpose of this research is to fill in the knowledge gap that typical positivistic research cannot attend to. Theory is to be built largely based on people's perceptions and opinions. Therefore, this implies that the research approach should be interpretive or descriptive in nature, both of which show very similarity between each other. The dilemma here is that which exact category this research shall fall in. The answer lies in the researcher's view of social reality. From a critical realism perspective, social phenomena exit not only in the mind but also in the objective world. Organisations, groups, social systems, ideas, concepts, meanings and categories are equally as real as physical objects. "They are emergent from, but irreducible to, the physical world, and have causal effect both on the physical world and the social and ideational world" (Mingers 2000). Therefore, the research approach falls into the positivistic descriptive research approach rather than weak constructivism interpretive approach. Hence the positivistic case study approach is regarded as appropriate to fit the researcher's philosophical and epistemological belief.

Third, as asserted in the previous Chapter that the research in IS flexibility has received little attention and there is no sophisticated theory to underpin the theoretical ground of this research. The uncertainty surrounding the phenomena under study requires a research method that allows an exploration of a bounded system over time through detailed, in-depth data collection involving multiple sources of information rich in context (Creswell 1998). A number of research methods can be seen applicable for this, which includes case study and grounded theory. Multiple-case study research approach seems applicable for this, as it is regarded appropriate by Eisenhardt (1989):

1. to understand a phenomenon in its early stages of research when little is known about a phenomenon and extant theory is inadequate that allows generating a novel theory;
2. To use a fresh perspective that allows achieving better understanding of a specific phenomenon.

Grounded theory is applicable to be used in socially rich areas in order to elicit knowledge of a situation in such a way that the concepts that arise are "grounded" in the phenomenon rather than previous categories and theories (Glaser and Strauss 1967).

Moreover, because of limited knowledge and sophisticated theory of IS flexibility research, the researcher decided to employ Gerwin's (1993) conceptual framework of flexibility, which is from the manufacturing system research, in this research as a guideline to understand the organisation's behaviours relating to the subject of IS flexibility rather than an underlying theory to create explicit hypotheses for testing. Gerwin's (1993) conceptual framework is adopted to develop categories of organisation's response towards business uncertainties. In addition, this research also considered general ES literature (e.g. Markus and Tanis 2000; Davenport 2000), IS maintenance literature (e.g. Takang and Grubb 1996; Lientz, Swanson and Tompkins 1978; Benamati and Lederer 1999) and ES maintenance literature (e.g. Gable, Chan and Tan 2001; Nah, Faja and Cata 2001) that provide a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes.

Hence, by considering above three key factors, a multiple-case study research method is regarded the most appropriate and selected for this research. The data collection and analysis technique used in case study research method allow the researcher to investigate and understand in a natural setting about underlying and non-obvious issues about the use of ESs in ES post-implementation stage. The replication logic (literal replication and theoretical replication) underlying the use of multiple-case studies would allow the researcher to develop a rich theoretical framework. This replication procedure is useful in this research to investigate different tactics, operational responses and resources issues when ES adopting organisations are in face of constant needs for business changes.

At last, there are some practical issues need to be considered by the researcher. The selection criteria of case study organisations fall into Yin's (1994) suggestion about the logic underlying the use of multiple case studies. As the research is exploratory in nature and its interest is to investigate how organisations adapt their adopting ESs for constant business changes under different organisational and technical circumstances, both literal replication logic and theoretical replication logic have been taken in the research. This strategy would develop a rich theoretical framework of a particular phenomenon under specific conditions. The selection criteria were:

1. the selected organisations have at least three-year experience in using the ESs;
2. at least one business unit had key ES module installed;

3. the organisation had major developments since the initial implementation of ESs;
4. the organisation had constant change requests from users.

Furthermore, the researcher realised the differences between ES providers (e.g. SAP and Baan). In order to simplify the research, only SAP system adopting organisations were chosen. Finally, during the pilot case study, the researcher found out the end users had limited knowledge and insights about the decisions made for the system adaptation, therefore the interviewees required by the researcher are only managerial staff to ensure each interview could receive detail information regarding system and business adaptation. Moreover the level of access of these three studied organisations was very much limited to managerial staff.

### 5.4.2 Strengths and weaknesses of the multiple-case study method

Case study method including multiple-case study method has its strengths and weaknesses. Yin (1994) states that case study involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources. He articulates that the strengths of case study also lies within the triangulation of data collection and multiple analysis methods that ensure reliability and internal and construct validity. The methodology is focused on "ordinary events in natural settings" (Miles and Huberman 1994). The intensive nature of case studies enables the researcher to capture reality in considerably great detail and develop as full an understanding of that case as possible (Punch 1996; Galliers 1992). In Eisenhardt's (1989) work – "building theory from case study research", he stressed three strengths of case study research. The major strength of the theory generation from case study evidence is "its likelihood of generating novel theory" (Eisenhardt 1989). Secondly, the emergent theory is likely to be testable because constructs and hypotheses have already undergone repeated verification during the theory building process. Stake (1994) distinguishes three main types of case studies – intrinsic case study, instrumental case study and collective case study. The first two of these are single case studies, where the focus is within the case. The last one involves multiple cases, where the focus is both within and across cases, and the aim is to learn more about the phenomenon, population or general condition. Moreover, the resultant theory is empirically valid because the theory building process is so intimately tied with evidence (Eisenhardt 1989). Multiple-case designs have distinct advantages in comparison with single-case designs whereas single-case designs are considered appropriate when a single case represents a critical case for theory testing, or a unique case for revealing the phenomenon to be investigated (Yin 1994). The strengths of multiple-case design lies in the replication logic that would result in a literal replication or a theoretical replication. Moreover, the replication procedures adopted in the multiple-case study would enable researchers to develop a rich, theoretical framework (Yin 1994).

Case study approach is under criticism for its inherent subjectivity because case studies rely on analytical generalisations rather than statistician generalisations used in quantitative research (Yin 1994). The findings of research could be subject to biases, subjective and selective preconceptions, and interest of researchers. Actually this argument is surrounding most of qualitative research methods (Miles and Huberman

1994). Secondly, high investment is another big issue regarding to case study research especially multiple-case design due to its emphasis on "deep data" that requires extensive resources and time (Yin 1994).

### 5.4.3 The process of the multiple-case study research

This section describes the complete process of the multiple-case study approach of this research.

#### 5.4.3.1 The provisional pilot case study

One provisional case study was opted as the researcher's background when starting this research project was manufacturing technology. The provisional case study would help the researcher to get a sound knowledge about issues and processes of ES implementation which would help to design and develop more focused case studies. Moreover, the provisional case study helped the researcher to learn research processes and some interview skills. The site of the provisional case study was at a UK local authority. The organisation was chosen was mainly because of the ease of access and convenience. An interview guide for the provisional case study was designed by the researcher to enquire issues and processes of ES implementation. Eight interviews were conducted including interviews with one senior manager, five junior and middle managerial staff and two end users (see **Table 15**). Each interview lasted about one hour. A number of general questions and specific questions (see **Table 16**) were asked during the interviews.

A brief description of the context of the provisional case is described as follows. The UK local authority started off the SAP implementation with a business case developed by a major consultancy firm. The consultancy firm provided a standard configured system for Local Authorities. Based on that basic model, the UK authority changed the configuration to suit the needs of their business operations which avoided starting from scratch and achieved a relatively short implementation time scale – the whole implementation of SAP took around 6 months. The first two modules, general ledger and account payable, went live in April 2000, then was account receivable in September 2000. The purchasing (material management – MM module) went live on a phased basis in October 2000. The implementation of Human Resource Payroll Module was in three phases, with the main monthly payroll went live in November 2000. Some old systems were still running in parallel with the SAP system in order to keep the business operation running smoothly and avoid the sudden shock of system change. The results of the case study show how the UK local authority perceives as a radical change of business operations. Six findings were highlighted:

1. SAP is accredited with promoting more control within the organisation;
2. SAP improves the operation of daily tasks;
3. Some job roles have changed because of the SAP;
4. SAP has improved team motivation and group working;
5. Staff anticipate that SAP will improve their ability to satisfy customer needs; and
6. SAP is accredited with improving cross directorate working.

| Company | Interviewee's position | No. of interview |
|---|---|---|
| UK local government council | Financial systems manager (senior manager) | 1 |
| | Managerial staff<br>(Debtors and creditors manager,<br>Principle Assistant Group Accountant,<br>Team Leader for processing the purchasing orders,<br>Creditor Team Leader,<br>Debtor team leader) | 5 |
| | End user<br>(Purchasing assistant in IT area<br>Senior Administration Assistant) | 2 |
| | Total | 8 |

**Table 15 A summary of the provisional pilot case study interviews conducted**

| Questions | Topics covered |
|---|---|
| 1. Background questions | Implementation processes<br>Impact of SAP on business operation |
| 2. Specific questions to end users and managers | Business efficiency<br>The ease of carrying out your daily tasks<br>The level of IT skill<br>Team motivation and group-working<br>Ability to satisfy customer needs<br>Ability to work with other teams within department<br>Ability to work with outside teams<br>Encountered problems<br>Modification of the operation of the SAP system |

**Table 16 Questions and topics covered in the provisional pilot case study**

#### 5.4.3.2 The pilot case study

One pilot case study was conducted at an international electronic company in China as part of the exploration phase of this research. The main objective of the pilot case study was to reach conceptual and practical clarifications that assist the research to develop a more focused theme and improve the research design. Moreover, the pilot case study helped the research to learn about the research process, the interview schedule, the overall length of the interview and observation and interview techniques (Glesne and Peshkin 1992).

An interview guide (APPENDIX 3 Pilot Case Study Questions) was designed by the researcher according to the initial concerns of this investigation, and used by the researcher to lead the interviews. The pilot study was carried out in an international electronics company (Tianjin Samsung Electronic Display Ltd. or TSED) in China. TSED started to embark on SAP system implementation since 1998 and had a wide rang of SAP modules implemented since then. TSED was selected as it met all selection criteria (at least 3-year experience of using SAP system and having a wide range of SAP modules implemented). The other reason for selecting this company is the easy access to this site by prior personal contact.

As illustrated in Table 17, eleven semi-structured interviews were conducted in TSED in order to observe the ES phenomenon from different angles. Each interview lasted from one hour to four hours.

| Company | Interviewee's position | No. of interview |
|---|---|---|
| Samsung (TSED) | IS Director | 1 |

| | | |
|---|---|---|
| | Financial Manager | 1 |
| | Purchasing Dept. Manager | 1 |
| | End users from purchasing dept | 3 |
| | End users from finance department | 3 |
| | IS staff | 2 |
| | Total | 11 |

**Table 17 A summary of the pilot case study interviews conducted**

| Questions | Topics covered |
|---|---|
| 1. Background questions | Organisation's business environment<br>Business strategy<br>Corporative objective<br>IS strategy<br>ES plan<br>Budget control on is development and maintenance<br>Initiative of ES changes<br>Risk and benefits for the change |
| 2. To what extent does the technology used for ES provide flexibility? | Process of business / system change.<br>Technological components required to change<br>Cost of change<br>Flexibility evaluation<br>Properties for flexible it |
| 3. To what extent the management factors influence the capability of ES to change? | Human resources<br>Alignment of ES plan with IS plan<br>Alignment of IS plan with business plan<br>User satisfaction<br>User involvement<br>Minimal customisation<br>Longevity of ES use<br>Integration of ES with other adopted system<br>Organisational size |

| | |
|---|---|
| | Industry sector<br>Other factors |
| 4. What is the impact of ES change on the business operation? | Users' unwillingness for further change<br>Business efficiency<br>The ease of carrying out your daily tasks<br>IT skills retraining<br>Organizational roles<br>Team motivation and group-working<br>Ability to satisfy customer needs<br>Ability to work with other teams within your department<br>Ability to work with teams outside of your department and outside of your organisation<br>New problems arose because the change in ES |

**Table 18 Questions and topics covered in the pilot case study**

As the result of the pilot case study and further development in the literature review of flexibility, some issues arise regarding the flexibility of ESs for constant business changes. It demonstrates that the flexibility of ESs is not only a technical matter, it is also affected by organisational concerns such as available organisational resources, overall benefits for the changes, strategic planning etc.. Therefore, different tactics could be applied to cope with constant business change requests under different circumstances. Moreover, the flexibility of ESs can be measured by the resources utilised for conducting the changes and the performance measurement. Hereby, a research framework started to emerge to the research design. The research framework encompass five constructs: nature of the business change, tactics adopted, technical/business solution made, resource measurement, and performance measurement. The research framework is described as follows.

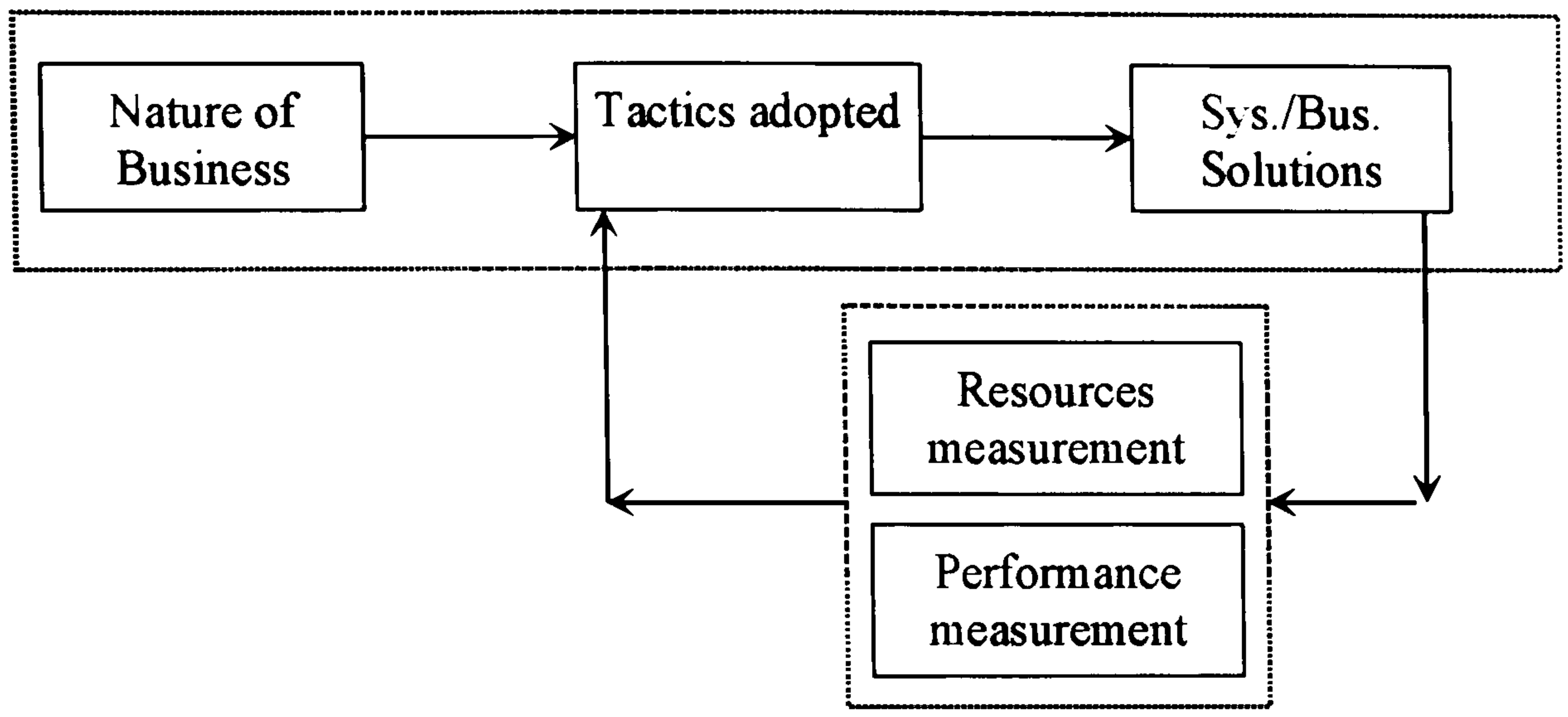


Figure 8 The research framework

Finally, the pilot study allowed the researcher to sharpen the research questions. The research questions designed to enter in the multiple-case research were as follows:

- What were the natures of business needs for the system change?
- What coping tactics were considered and/or adopted to meet the requirements of business change?
- What system/business solutions were provided to solve the problems?
- What resources could be / were used for these solutions?
- What was the implication of these changes on business operation?

By following these general questions, the interview protocol was re-designed for the multiple-case study (see APPENDIX 4 Case Study Protocol).

#### 5.4.3.3 The multiple-case study

The selection criteria fall into Yin's (1994) suggestion about the logic underlying the use of multiple case studies. As the research is exploratory in nature and its interest is to investigate how organisations adapt their adopting ESs for constant business changes under different organisational and technical circumstances, both literal replication logic and theoretical replication logic have been taken in the research. This strategy would develop a rich theoretical framework of a particular phenomenon under specific conditions. The selection criteria were:

1. the selected organisations have at least three-year experience in using the ESs;
2. at least one business unit had key ES module installed;
3. the organisation had major developments since the initial implementation of ESs;
4. the organisation had constant change requests from users.

Furthermore, the researcher realised the differences between ES providers (e.g. SAP and Baan). In order to simplify the research, only SAP system adopting organisations were chosen. The researcher also realised the practicality of obtaining access from organisations, about one hundred organisations were initially selected and contacted through posts. Four organisations agreed for some level access. One organisation was finally dropped as the level of access would not provide enough detail for analysis. The companies are called in this work as Machine (the sewing machine company), Brewery (the international brewery company), and Charity (the charity organisation). The names of the three sites are disguised for confidentiality reason. Finally, during the pilot case study, the researcher found out the end users had limited knowledge and insights about the decisions made for the system adaptation, therefore the interviewees required by the researcher are only managerial staff to ensure each interview could receive detail information regarding system and business adaptation. Moreover the level of access of these three studied organisations was very much limited to managerial staff.

### 5.4.3.3.A Machine company

Machine is a subsidiary company of a US based company (Machine Global). Machine Global has over 150-year history of innovative and successful operations. Machine Global is engaged in two principle businesses: sewing machine manufacturing and retail. Machine Global is a global retailer of not just sewing products, but a wide range of consumer products for the home. Machine Global remains the leading manufacturer and marketeer of sewing machines worldwide. Machine was split into two companies in 2002, one for manufacturing industrial sewing machine, the other one dedicated for retailing home sewing machines.

Machine started to implement SAP system since 1999. Its SAP system went live in October 2000. SAP modules implemented are FI, CO, MM, SD and PP. There are no other information systems implemented except a very few number of Microsoft Access databases. As a small sized company, Machine's business processes are not very complicated. Therefore, a vanilla SAP system approach was adopted as the implementation strategy. Machine did not heavily customise the SAP system as it believed that it would degrade the system efficiency and cause future maintenance problems. Machine is a small sized company, which employs around 200 employees. Machine has a very small Information Systems department comprising 5 staff; one MIS manager, two are in charge of technical infrastructure, and the other two are junior staff dealing with day-to-day helpdesk function and other administration duties. None of these five MIS people participated in the initial ES implementation. The culture of the company human resource policy is to "employ and use straightaway". Training is considered as an excessive cost rather than an investment, especially where SAP training is very expensive in local. Being a small sized organisation, Machine has limited amount of system support. Therefore Machine prefers to hire external consultant or party/vendor to provide timely solutions as employing a qualified internal SAP specialist is considered too costly. The internal IT staff especially MIS manager would participate in the whole process of ongoing system change implementation in order to learn as much about SAP system as possible.

Three visits were carried out over a period of six months. One telephone conversation and frequent email communication were made during this period. The primary methods of data collection were semi-structured interviews and each last from one hour to four hours. As determined from the outset of the research, the people interviewed were ES related managerial personnel: senior managers, IS manager and functional managers. Table 19 shows the role breakdown of the different interviewees. The researcher captured seven system changes after the initial implementation of SAP.

1. change cost centre arrangement,
2. change fix assets depreciation rate,
3. change the organisational structure,
4. improve inspection and quality control,
5. develop new inventory report,
6. introduce depreciation preparation, and
7. automate invoice numbering and printing.

#### 5.4.3.3.B Brewery

The second case study was conducted in Brewery, a UK subsidiary of an international brewing group which can trace its history back to the 19th Century. The group is now one of the largest brewing group in the world. The primary focus of the Brewing Group is the production, sale and marketing of beer, with secondary activities in soft drink and water production. Its three key markets are Western Europe, Eastern Europe and Asia. Brewery is first and foremost a brewer, although it does offer a full drink service to pubs, clubs and restaurants throughout the UK. This means that the company delivers wines, spirits and soft drinks alongside its beer products.

Brewery has 2 major sites, 16 depots and 18 locations in the UK. Brewery decided to implement the SAP system in a "big bang" approach. The implementation of SAP was viewed as a benefit driven project that would get rid of legacy applications and legacy reporting systems that had a lot of trouble of maintenance and enhancement. Although the implementation team tried to get the business to see the potential with SAP, they did not see the need to have it in the first place. The implementation actually ended up with a quite heavily bespoken SAP implementation. The SAP system was implemented in late 1999. The system went live in 18 months with 1300 users in June 2001. Major modules implemented are FI, CO, COPA, SD, MM, service management. The telesales module was developed with its SAP system implementation consulting firm. The IT function was born out of the implementation project. The existing IT function includes the IT service department headed by the IT Director for IT infrastructure and business solution team headed by the Business Strategy Director for supporting SAP implementation, developing changes and new elements of SAP. Despite the initial "big bang" approach selected for the SAP system implementation, Brewery ended up with a quite heavily bespoken SAP implementation and did not do any sort of business process re-engineering. It was because users were quite happy with the legacy systems that were tailored to how users wanted them to work. Therefore, Brewery actually manipulated the SAP to mimic the existing system in order to keep the same process flow.

Since the initial implementation of SAP, the IT department was bombarded with a great number of change requests from the business. In 2003, there were over 320 change requests from the business for anything from minor modifications to complete new elements. About 200 were delivered and 100 were rejected. The IT department has established a well structured process for change requests so that they can be properly dealt with by limited resources Brewery had. A 3 year plan for major projects was made and revised every year. Dealing with ongoing system changes seems a big challenge for the business and IT functions. Furthermore, it was even complicated by the consideration of Brewery global HQs of rolling out standard solution to its regional organisations.

Four visits were carried out over a period of six months. One telephone conversation and frequent email communication were made during this period. The primary methods of data collection were semi-structured interviews and each last from one hour to two hours. The people interviewed were ES related managerial personnel: senior managers, IS director and managers, and functional managers. Table 19 shows the role breakdown of the different interviewees. The researcher captured six system changes after the initial implementation of SAP in detail.

1. replace legacy warehouse management system,
2. introduce bulk pick operation,
3. improve KPI reporting,
4. develop new supplier performance report,
5. change discrepancy management process, and
6. introduce the packing operation for the promotional scheme.

### 5.4.3.3.C Charity

Charity, founded in early 19th century, has over 180 years of history for saving lives at sea. It provides, on call, the 24-hour lifeboat search and rescue service to 50 miles out from the coast of the United Kingdom and the Republic of Ireland, and a beach lifeguard service on 57 beaches in the south west of England. There are 232 lifeboat stations strategically placed around the UK and Republic of Ireland with an active fleet of 307 lifeboats backed by a relief fleet of 113. Clearly, the better the organisation becomes at fund-raising, administration, procurement and other operational activities the greater its income and the further its budgets will stretch. In the autumn of 1999, Charity decided to overhaul its information management systems as part of a broader strategy to modernise its business methods and deliver a better service within an SAP environment. Up to 1999, Charity had made extensive use of both package and in-house developed applications. However these applications were not well integrated and formal support for them was terminated at the end of 2000. There were also parts of the business that were still using paper systems. There were considerable logistics requirements geared to keeping boats and buildings in good order. What was needed was a charity-wide information system that could handle everything from monthly accounts, funds collection and individual expenses claims to sourcing spare parts and materials. In short, Charity needed a sophisticated IT infrastructure that could look after finances, HR administration, supply chain management and every other aspect of running a countrywide organisation. It opted for an SAP environment and needed expert help to design and implement a new infrastructure. The timeframe was desperately short – a matter of months. Charity selected a major consultancy firm as its SAP implementation partner because the consultancy firm offered a broad range of services available and promised a committed long-term relationship.

Despite the complexity, with the support from the consultancy firm, Charity achieved a rapid implementation. The SAP system (version 4.5B) project went live in two phases at the beginning of April and June 2000. The Charisma system went live at the end of June 2000. However the result of the implementation was not as good as the organisation expected. Some modules even ended up reimplementation. It was because before the implementation, Charity did not have any formal documented processes, and in lots of functional areas, there were role based manual which did not really cover the whole processes.

The IS function consists of total 11 staff which are split into 3 teams; one team of logistics looks after MM, SD, PP and PS modules, one team looks after HR and Finance and one technical team consists of 3 people. At the top level, there is the steering committee whose role is to define the forward strategy for SAP and to liaise different functions for cross-function changes. However the steering committee does not perform as well as expected, pointed out by the MIS manager. The members of the steering committee are the business owners of the modules. These business owners also normally chair their functional area user group. Within each function, the business owners authorise and approve change to their modules. The recent IS strategy is "to help the Charity in pursuit of its objectives, providing cost-effective information systems and technology".

Two visits were made over a period of nine months. Three telephone conversations and frequent email communication were made during this period. The primary methods of data collection were semi-structured interviews and each last from one hour to two hours. The people interviewed were ES related managerial personnel: senior managers, IS managers and functional managers. Table 19 shows the role breakdown of the different interviewees. The researcher captured two system changes after the initial implementation of SAP in detail.

| Company | Interviewee's position | No. of interview |
|---|---|---|
| Machine | MIS managerial staff (including MIS manager) | 5 |
| | Business solution administrator | 1 |
| | Accounting Manager (Manufacturing) | 2 |
| | Accounting Manager (Retail) | 2 |
| | Subtotal | 10 |
| Brewery | Business Strategy Director | 1 |
| | IS Director | 1 |

| | | |
|---|---|---|
| | Contract Director | 1 |
| | MIS managerial staff including Business Consultant Manager, Strategic Analyst Manager, Business Application Manager, SAP application administrator | 4 |
| | Warehouse Manager | 2 |
| | Subtotal | 9 |
| Charity | Financial Director | 1 |
| | MIS managerial staff including SAP Application Manager, Business Process Project Manager, SAP System Administrator | 3 |
| | HR training manager | 1 |
| | Logistics manager | 1 |
| | Subtotal | 6 |
| | Total | 25 |

**Table 19 A summary of research interviews conducted in multiple cases**

#### 5.4.3.4 Data collection and analysis

The result of the pilot case study and the further development in the literature review of flexibility have helped develop a conceptual framework for the research. The focus was to develop concepts of tactics and how resource and performance were related to the business and technical solutions. The data collection method was mainly semi-structured interview guided by well structured interview protocol (APPENDIX 4 Case Study Protocol). Frequent email communication was adopted by the researcher in order to clarify issues and concerns addressed during the interviews. Other source of evidence such as documents and observation were sought to give multiple perspectives on an issue and allows for cross checking (Eisenhardt 1989). However, apart from the first case of Machine company that provided limited access to document review, other two organisations did not offer the access to document review and observation for confidentiality reasons.

The data analysis followed the general analytic strategy of developing a case description. It is appropriate when theoretical propositions are absent (Yin 1994). The logic used in the data analysis of the research is pattern-matching (Yin 1994) or exploring the data (Robson 1993). It is applicable in multiple case studies to provide either literal replication or theoretical replication across cases (Robson 1993). The analysis of data in each case followed the Miles and Huberman's (1994) framework for qualitative data analysis. The analysis consisted of three concurrent flows of activity: data reduction, data display, and conclusion drawing/verification:

- Data reduction refers to the process of transforming data from the written-up field notes to a more focused and organized way that eases the conclusion drawing and verification;
- Data display is a second step in the process of transforming the data towards the generation of theory. Data displays organise, compress and assemble information (Punch 1998). The main displays used in this research are matrices / metrics and graphs. These displays allowed the researcher to assemble and organise data into a compact form so that the analysis was eased; and
- The final step of analysis is conclusion drawing and verification.

Coding and memoing are two operations for the data reduction and data display. Codes are labels for assigning units of meaning to the descriptive information complied (Miles and Huberman 1994). Coding entails some system for categorising the massive data collected during the research, therefore data will be differentiated and combined by specific codes that allow researchers to retrieve, find, and cluster the segments relating to a particular research question, construct, or theme (Miles and Huberman 1994). Thanks to the conceptual framework of flexibility developed through extensive review of past research on flexibility. Most of general coding categories are established on the conceptual framework of flexibility. One of the most important work of data analysis in this research is to identify and differentiate individual codes under each category. Pattern codes are also used in the data analysis to group codes into a smaller number of sets, themes or constructs (Miles and Huberman 1994). Memoing is conceptual in intent to connect pieces of data into a recognisable cluster or general concepts.

From the outset of the analysis activity, the researcher had a conceptual framework for the data analysis. It helped the researcher to foresee possible patterns, regularities and explanations. Despite that, conclusions were still vague, but became explicit and grounded by iterating data collection, data reduction and data analysis over time. Drawing conclusion followed Miles & Huberman's (1994) suggestions such as noting relations between constructs and building a logical chain of evidence. Verification encompassed checking field notes during the writing process, getting feedback from informants (i.e. people interviewed) and getting feedback from third parties (e.g. people participated in the research).

## 5.5 Summary

This chapter serves three purposes. First, it present the researcher's philosophical and epistemological stance which has an important role to play in research, not as a permanent statement of position, but as conditional and intimately related to the outcomes and practices of research (Dobson 2001; Trauth 2001). The researcher has expressed his philosophical belief – critical realism. From a critical realist perspective, the social science tendency of information system research does not make it different in principle from a nature science research (Mingers 2000).

Second, it discusses the methodological considerations for the selection of research method for this research. The consideration is based on Trauth (2001)'s three major factors influencing the choice of qualitative research methods in IS research:

a) the research problem. The purpose of the research is to examine how organisations cope with constant business changes with their adopting ESs after initial implementation of ESs. Therefore this research is to aim to conduct "an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidences" (Yin 1994). Moreover, as little has known about IS flexibility, the research is exploratory in nature to generate a descriptive and explanatory theory of ES post-implementation adaptation;

b) the researcher's theoretical lens. The research's philosophical belief is critical realism. As the purpose of this research is to fill in the knowledge gap that typical positivistic research cannot attend to, and theory is to be built largely based on people's perceptions and opinions, the research approach is a positivistic descriptive research approach; and

c) the degree of uncertainty surrounding the phenomena. As the research in IS flexibility has received little attention and there is no sophisticated theory to underpin the theoretical ground of this research, it requires a research method which allows an exploration of a bounded system over time through detailed, in-depth data collection involving multiple sources of information rich in context (Creswell 1998).

Hence a multiple-case study research method is regarded the most appropriate and selected for this research. The data collection and analysis technique used in case study research method allow the researcher to investigate and understand in a natural setting about underlying and non-obvious issues about the use of ESs in ES post-implementation stage. The replication logic (literal replication and theoretical replication) underlying the use of multiple-case studies would allow the researcher to develop a rich theoretical framework. This replication procedure is useful in this research to investigate different tactics, operational responses and resources issues when ES adopting organisations are in face of constant needs for business changes.

Third, it describes the process of the multiple case study research. First, a provisional case study was conducted by the researcher to get a sound knowledge about issues and processes of ES implementation which would help to design and develop more focused case studies. Moreover, the provisional case study helped the researcher to learn research processes and some interview skills. Then one pilot case study was conducted at an international electronic company in China as part of the exploration phase of this research. The main objective of the pilot case study was to reach conceptual and practical clarifications that assist the research to develop a more focused theme and improve the research design. Moreover, the pilot case study helped the research to learn about the research process, the interview schedule, the overall length of the interview and observation and interview techniques (Glesne and Peshkin 1992). Following that, it discusses the selection criteria of organisations of multiple case study and describes the process of case studies at Machine, Brewery and Charity.

# CHAPTER 6

# A Model of Tactical ES Adaptation for Ongoing Business Changes

## 6.1 Introduction

This chapter aims to answer the research question of this investigation: "How organisations adapt ISs/ESs to support business flexibility?" (see Chapter 1). For this, a model of tactical ES adaptation for ongoing business changes has been developed from three organisations' ES post-implementation experiences. This model describes 15 business change cases during their ES post-implementation period. This research is based upon multiple-case sampling in order to notice events and processes across many cases (Miles and Huberman 1994). By using a multiple-case study research strategy, the researcher is able to avoid superficiality and to keep the richness of each case. It follows therefore that a theoretical framework can be developed through the replication procedure adopted in the multiple case study research. The information collected through all 15 change tasks in three cases can be organised, condensed and assembled for theory generation and discussion.

This model presents the process of how organisations use their adopting ESs to support ongoing business changes. This model is established on the adapted conceptual framework for flexibility (see Figure 3) and has also considered general ES literature (e.g. Markus and Tanis 2000; Davenport 2000), IS maintenance literature (e.g. Takang and Grubb 1996; Lientz, Swanson and Tompkins 1978; Benamati and Lederer 1999) and ES maintenance literature (e.g. Gable, Chan and Tan 2001; Nah, Faja and Cata 2001). This provides a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes.

This model is presented in Figure 9, which depicts the concepts and interaction that emerged as significant from data analysis in this multiple-case study research. This chapter is structured as follows:

1. First explains the concepts and the logic of the model; and
2. Then three cases encompassing 15 change tasks are described to present evidences that support the concepts and the logic of the model. For each company described in following cases, a pseudonym is adopted due to the confidentiality reason. Each case comprises of several tasks relating to each ongoing business/system change since the original implementation of ESs. A summary of each change tasks is given at the end of each section. A comprehensive summary of each case will be provided at the end of each case.

## 6.2 Definition of concepts and the logic of the model

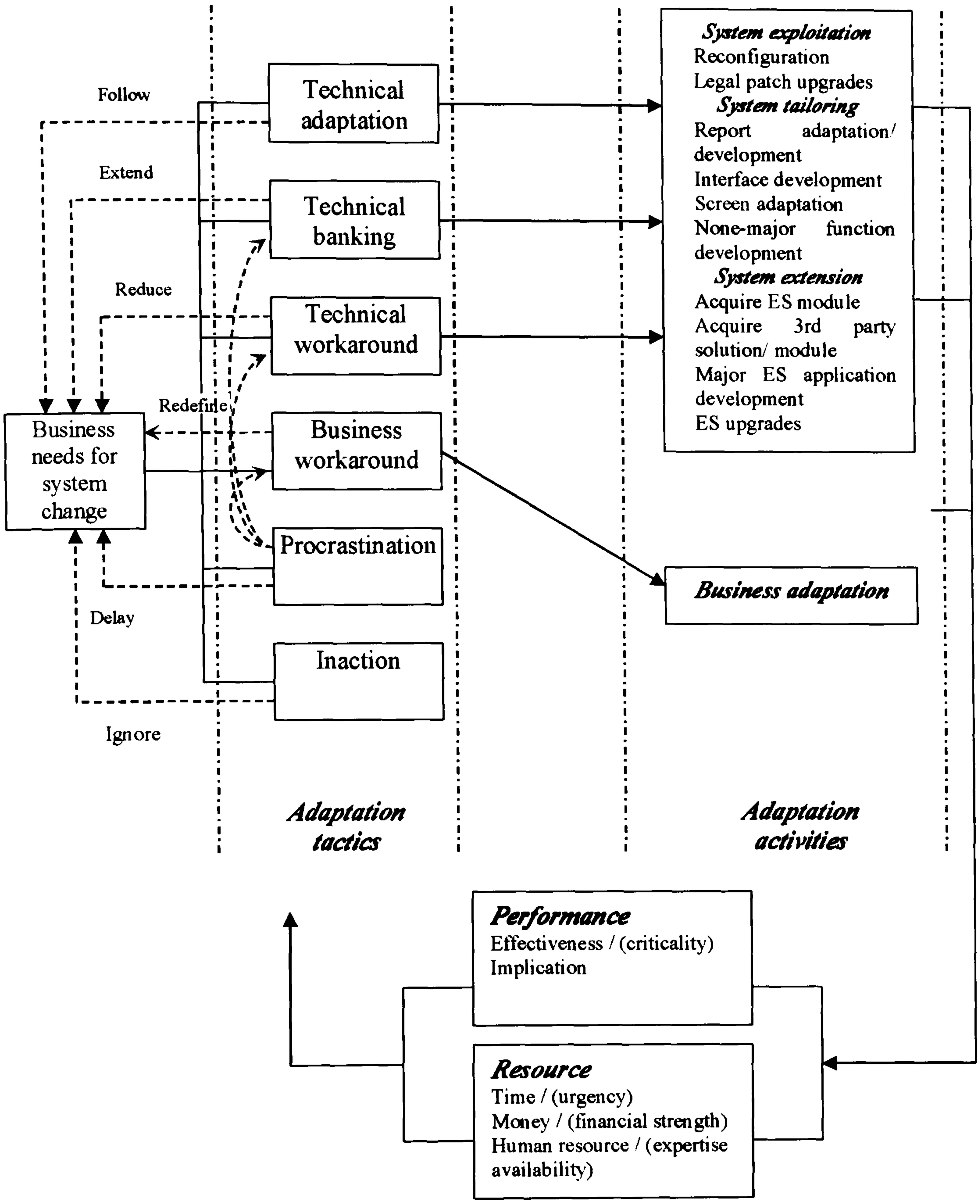


**Figure 9 A model of tactical ES adaptation for ongoing business changes**

This section describes the model of tactical ES adaptation for ongoing business changes (Figure 9). This model depicts a complicated decision making process for ES adaptation to support ongoing business changes and attain flexibility. It demonstrates the dynamic relationship among emerging business needs, adaptation tactics, adaptation activities, performance measurement and resource measurement. It contrasts with

- the traditional view of flexibility that organisations normally consider flexibility is a passive adaptive response towards business uncertainties (Gupta and Goyal 1989, Gerwin 1993) and
- the traditional view of information systems maintenance that the goal of system adaptation and enhancement is to accommodate business operation environment by correcting, adapting, preventing and perfecting information systems (Takang and Grubb 1996).

The experience of ES adaptation in the three studied organisations exposes a complicated process for ES support for ongoing business needs. The focus of this model is the adaptation tactics adopted to respond business needs. The research finds six adaptation tactics that are normally adopted to respond to ever-changing business environment. These are technical adaptation, technical banking, technical workaround, business workaround, procrastination, and inaction. In a traditional view of information system flexibility, it is purely a maintenance issue that concentrates on how to adapt information systems to satisfy either current or future business needs (Avison et al. 1995). To attain flexibility, organisations cannot only adapt their information systems to accommodate business requirements, but bank, compromise, delay and ignore business requirements as a result of a trade off between expected performance and expected costs for alternative solutions. These tactics and their usage will be described and discussed in the following sections. The extent of use of these tactics reflects the extents of organisation's learning and understanding of their organisational capabilities and technical capabilities.

The tactical ES adaptation model begins with new business needs for change (business context) that trigger the whole decision making process for adaptation. The nature of business change presents the level of impact of the business needs on overall organisation and business operation, i.e. operational or strategic. One of the difficulties in the data analysis is to assign a correct value to the level of business change. The researcher adopts Eppink (1978) and Krijnen (1979)'s typology of environmental uncertainties. Besides, the researcher allowed the interviewees to give their subjective determination on the level of business change. Moreover other factors were considered when confirming the final value. These factors are a). at what level the decision on business change was made – is the ES project a company initiated project or a user requested work, b). did the business change only refer to a particular business operation activity e.g. a particular accounting report, or a major transformation of a business function or organisation such as warehouse management. According to Volberda (1999), operational changes are adaptations on routine capabilities that are based on present structures or goals of the organisations. Operational changes require adaptation on low level of business activities within the organisation (Eppink 1978) and are normally proposed by operational staff/end users. Typical examples in the context of the information systems are report creation, changing screen layout and minor business process modification etc. While strategic changes refer to changes that would cause major transformation of the structure of an organisation or system such as organisational structure change, major business process change. Strategic changes require high attention of managerial capabilities and may consist of operational changes that are proposed in the past but put on hold due to resource concerns.

From the point of the emerging new business requirements, organisations shall evaluate the existing technology employed (technical context) that would be affected by ongoing business changes and propose possible solutions for adaptation. However, organisations shall not just adapt their IT systems passively to fulfil every requirement from the arising business needs. Instead, different system adaptation tactics can be adopted to accommodate these change requirements with best result. The most significant lesson of this model is to use the adaptation tactics to handle business uncertainties in order to achieve optimal flexibility of adopting ESs as a result of a trade off between expected performance and expected costs. This approach is similar to Avison et al (1995)'s lateral thinking method that is to search for alternatives for system changes. Six generic system adaptation tactics are developed in the study:

1. Technical adaptation is a common tactic and primary logical response that organisations would consider and adopt to answer the business call for IT change. With the technical adaptation tactic, the adaptation solution follows what business has come to expect IT systems to do. The main task is to alter IT systems to satisfy business change requirements;
2. Technical banking refers to an aggressive adaptation approach that instead of passively making the adaptation to fulfil the business change requirements, more system capacity and functional features can be built-in so that future business needs would be accommodated with minor adaptation effort. This adaptation

approach normally requires organisation to have a full review or analysis of their foreseen business requirements;

3. Technical workaround aims to accommodate part of business needs and a less desired IT solution will be provided to business problems. This approach sacrifices the efficiency and effectiveness of the business operation due to the concerns about resources, technical issues etc.;
4. Business workaround. Organisations normally consider flexibility is an adaptive response towards business uncertainty (Gupta and Goyal 1989). With business workaround approach, instead of simply adapting the IT system which is originally required by the business, organisations choose to redefine the need for IT flexibility. Business needs are solved by altering business processes and performing some manual intervention. Business workaround tactic is a proactive path for organisation to solve business problems. It takes off the pressure for adapting adopting IT systems, but focuses on what management itself can achieve to satisfy emerging business requirements. The business workaround approach is similar to the business reengineering and/or "big bang" approach of ES implementation where business is required to adapt to the best practices represented in ES packages and keep ES intact;
5. Procrastination is adopted to delay the need for IT change. Organisations may consider that the request for IT change because the business is not mature enough, or the current resource is tight and unavailable, or a desired IT solution is just under development by external party and will be available in the near future. Therefore, rather than boldly pursuing the change request, organisations choose to wait for a right time to conduct the adaptation; and

6. Inaction, an approach that organisations choose to totally ignore the business change request. This boldly answer is normally given to any business requirement that is not significant enough compared with other business requirements to attract the attention of the management of an organisation.

Tactical dimensions characterise management's intervention for providing solutions to the business requirements. Furthermore, adaptation tactics can be classified in the dimension of intention as described in Section 2.4.2.1 Intention: defensive vs. offensive. For the dimension of intention, management decision for dealing with business needs can be identified as offensive or defensive according to Evan (1991). In order to assign a correct value to this dimension, besides the researcher asked the interviewees for their personal opinions, several considerations were taken into account including:

a. Was the solution only to answer emerging business problems or other and future business needs would also be solved or enabled? Broadbent and Weill's (1997) dependent and enabling views towards information and IT needs are helpful here. An organisation takes a defensive/dependent stance to respond to specific current business plan, whereas if an organisation is engaged to provide flexibility in achieving long term goals through an over-investment, its intention is offensive;
b. Was the solution attempting to alter the IT system as required, or instead an alteration towards the business operation and administration was implemented? The former stance is a defensive action towards the IT system in that an IT function is just to do whatever they are told. However, an offensive stance

could be taken by exploiting the potential of human resources, business operation and business administration;

The adaptation tactics define the strategies of dealing with the business change requirements. At the tactic level, the original business change requirement may be altered or compromised in order to achieve the best overall outcome and benefit for the organisation. Then it initiates the adaptation activities that define the actual operational solutions for business problems. In the literature of flexibility in Chapter 2, operational solutions can be categorised in two dimensions: scope and utilisation (in Section 2.4.3.1 Scope: limited vs. significant and Section 2.4.3.2 Utilisation: potential vs. acquired). The different level of flexibility indicates the complexity of adaptation. In information system literature, it is argued that the scope of adaptation effort may be indicated by extensiveness of adaptation, the number of different type used, how well the tailoring is done, the degree of change in data, interdependency among tailoring types, impact of system upgrade and organisational complexity (Brehm, Heinzl and Markus 2000). The dimension of utilisation can be distinguished as potential or acquired. The former value refers to that an organisation is trying to use built-in functionalities in its IT system or exploit the potential of business operation to accommodate business change. While if an organisation is going to purchase IT solutions instead, this dimension is going to be assigned as acquired. Here, the dimension of utilisation is adapted to categories of system exploitation, system tailoring and system extension. With business adaptation activities, these adaptation activities are grouped into four categories:

1) System exploitation is to exploit built-in capacity provided by a given ES. ES is widely known to have a broader scope than traditional package software (Brehm, Heinzl and Markus 2000). When ES is acquired, the adopting organisations do not only acquire the functionalities they need at present, and some of functionalities may not have been employed during the initial implementation. Moreover, ES vendors continuously offer free support to ES adoption organisations to correct design errors and build new functionalities into ESs by issuing legal patch upgrades (Ng 2001; Markus et al. 2000). Although ES legal patches are provided after the initial implementation, they are considered as built-in capacity as the acquisition of ES is not only to acquire a piece of software its own but also the service and support from the vendor which are included in the original purchase price or license fee. Using the built-in features in ES would massively reduce the cost and effort for system development and adaptation. This approach includes two adaptation activities:

- reconfiguration, setting of parameters (or tables), in order to choose between different executions of processes and functions in the software package (Brehm, Heinzl and Markus 2000); and
- legal patch upgrades, installing legal change patch supplied by ES vendors.

2) System tailoring is classified differently from what Brehm et al (2000) state which includes all sorts of system modification and extension activities. Here it refers to minor or less significant technical adaptation work other than reconfiguration and legal patch upgrades. It encompasses technical adaptation activities such as

- report adaptation/ development, adapting data output and options for reporting;
- interface development, programming interface to other systems;

- screen adjustment, adjusting or creating new screens for input and output; and
- none-major function development, any minor development and programming of additional functions. This may include adaptation techniques of workflow programming, ERP programming and user exit.

3) System extension is needed when existing ESs cannot support new business requirements and new functionalities need to be acquired or upgraded either from the ES vendor or a third party software vendor or to be developed in house. System extension is major adaptation work that extends the boundary of the existing ES functions. It usually requires high cost and resources to implement the new acquisition or ES upgrades, and also attracts attention from senior management to support the implementation. System extension includes following adaptation activities:

- acquire an application module from the ES vendor;
- acquire a 3rd party solution/ module
- major ES application development; and
- ES upgrades.

4) Business adaptation refers to major changes in operational procedures, organisational structure and minor changes and intervention in the sequence of tasks (Lorenzo 2003). Organisations may choose the route of business adaptation when an absolute technical solution is not feasible to be implemented to satisfy business requirements. Business adaptation can be carried out along with technical adaptation to achieve part of business requirements.

These adaptation tactics and activities shall be integral with performance measurement and resource measurement when making decision on system adaptation. Organisations need to understand the effectiveness and the implications of the adaptation solutions and resources and costs required to conduct the change. Without a clear estimation about the extent to which the solution can meet business needs and the cost, time and human resources needed to implement the adaptation solution, it is impossible for organisations to justify the trade-offs among different adaptation approaches and make the right decision to support ongoing business changes (Gerwin 1993; Mandelbaum and Brill 1989). Based on the conceptual framework for flexibility, in the model, at the performance level, it is operationalised with two measurements:

1) effectiveness, refers to the degree the adaptation solution meets changing business needs;

2) implication is extended from the concept of resilience addressed in Chapter 2. Resilience measures the disturbance on business performance caused by the transition. Here, implication has a more general meaning. The concept of implication refers to the impact of adaptation on an organisation which may include implications for future system maintenance and extension, impact on IS planning and impacts on business plan, disturbance on business performance etc.

At the resource level, three issues are concerned:

a. Time, the temporal period required to achieve business needs. Cost (time) provides a value of timescale spend from the time the change request was approved to the time the solution is completed. However, in some cases, due to the confidentiality reasons, only abstractive values (short term, medium term, and long term) is given by the interviewees. Moreover, for procrastinated adaptation solution, time for adaptation comprises the time of procrastination and the time of actual execution of adaptation. Therefore, these two components of time consuming shall be both considered when making decision on selecting the adaptation solutions.

b. Money needed to support the adaptation. Cost (Monetary) gives a value of monetary spending on solving business change requests. However abstractive values are given by the interviewees for some cases due to two reasons, a. confidentiality reasons, b. some proposed solution were not conducted, therefore it is very difficult for them to give a realistic figure of how much could be spent on a particular proposed solution; and

c. Human resource, the right people including technical expertise, business expertise required to conduct the adaptation. This item describes how much human resource and what level of human resource were involved for each implemented solution or required for each proposed solution;

By assessing the above performance level and resource level measurements, it can only determine the flexibility level of the adaptation. It is found in the research that the decision for adaptation is not only based on the performance and resource measurement. They need to combine with issues of criticality, urgency, financial strength and available expertise (see Figure 9) to determine the risk level and overall outcome of adaptation so that organisation can make the suitable decision on selecting adaptation method.

1. effectiveness is associated with criticality that refers to the importance of business change towards the organisation;

2. time is compared to urgency that describes how quickly organisations want the change to be realised;
3. cost is valued against financial strength that organisations have;
4. human resource is concerned with the availability of technical and business expertise who can perform the change.

This model is applied in each change event section (6.3, 6.4 and 6.5) to describe each change event investigated in the case study research. A summary table is then constructed to summarize the process of relevant adaptation and optional methods to handle each arising business change request. The key issues associated with each change event such as cost, human resources, effectiveness and implication are also presented in the summary table. Table 20 provides the definition of key concepts used in the summary table of each change event.

| Key concept | Description |
|---|---|
| Business context | Ongoing business needs need to be accommodated |
| Nature of business change<br>*Level* | <br><br>*Operational*<br>*Strategic* |
| Technical context | Existing technology employed that would be affected by ongoing business change |
| Adaptation tactics | *technical adaptation*<br>*technical banking*<br>*technical workaround*<br>*Inaction*<br>*Procrastination*<br>*business workaround* |
| Solution (change activities) | System exploitation<br>System tailoring<br>System extension<br>Business adaptation |
| Cost (Time) | Timescale of change |
| Cost (Monetary) | Expenses of change |
| Human resource | Human resource required or actually involved in the change |

| | |
|---|---|
| required/involved | |
| Effectiveness | Implication of system change on business operation |
| Implication | Implication of solution on system maintenance and IS planning |

**Table 20 Definition of key concepts used in the summary table of change events**

This research has also developed a measurement scheme that organisations may be able to adopt to analyse the flexibility level and risk level for each adaptation approach, so that organisation is able to balance between the responsiveness and controllability of various adaptation approaches. However, it is a challenge to develop such an assessment scheme for the flexibility of ES adaptation in the absence of past research in detailed measurement on flexibility. Therefore, the actual flexibility can be approximate by summing the flexibility level of performance (effectiveness and implication) and resources (time, money, human resources). It would be ideal if the measurement could also factor in weightiness of each dimension of flexibility in order to get a more accurate measurement for flexibility. However, it is recognised that the organisational conditions do provide some meanings of the importance of each dimension of flexibility to some extent. Moreover the precise values of the weight factors are difficult to define. To simplify the measurement, it is defined that all performance and resource measurement are weighed equally. Detailed formula and the conduct are provided at below.

To conduct the measurement, first the researchers approached interviewees participated in the research to weigh the scale of the performance and resource of each adaptation approach. The performance variable i.e. effectiveness, and resources variables i.e. time, cost, human resources are given scales of 1 to 10. 10 is most flexible, and 1 is least flexible (see Table 21). For example:

- ✓ for the variable of time, the scale of 1 indicates the longest time span of adaptation, while 10 means the shortest time span;
- ✓ for the variable of cost, the scale of 1 indicates the adaptation is the most costly which is the least flexible solution, and 10 means the adaptation costs the least;
- ✓ for the variable of HR requirement, the scale of 1 indicates the highest demand for technical and business expertise who are required to participate in the adaptation, while 10 means the demand for human resource is the least; and
- ✓ for the variable of effectiveness, the scale of 10 means the result of the adaptation can mostly satisfy the business requirement, while 1 indicates the result can barely accommodate business need.

As the impact of adaptation could be two directions – either positive impact or negative impact – the implication variable is given scales of -5 to 5. The least flexible level is -5 that causes most negative effect, while the most flexible level is +5 that causes most positive effect on organisations.

Then the contextual variables i.e. urgency, financial strength, expertise availability, and criticality are given scales of 1-5. 1 is the least risky and 5 is the most risky (see Table 21). For example:

- ✓ for the variable of urgency, the scale of 1 indicates the business need is the least urgently required, while 5 means the business need is the most urgently required;

- ✓ for the variable of financial strength, the scale of 1 means the organisation has the most financial support for adaptation, while 5 indicates that the organisation is under the most pressure for finance and the budget for adaptation is the tightest. It is noted that the financial strength varies from time to time, therefore for procrastinated solutions, the organisational financial strength may be different from the time when the adaptation solution is proposed;

- ✓ for the variable of expertise availability, the scale 1 indicates that most of the required expertise are available, while 5 means required human resource for adaptation is least available. However it is noted that as different adaptation solution may require different specialists, HR availability varies respectively; and

- ✓ for the variable of criticality, the scale 1 here indicates the business need is the least important, while 5 means the business need is the highly important.

| | Most flexible Solution | Least flexible Solution | | | Organisational Risk (least risky) | Organisational Risk (most risky) |
|---|---|---|---|---|---|---|
| Scales | 10 (+5 for implication measurement) | 1 (-5 for implication measurement) | | | 1 | 5 |
| Time | shortest | longest | <> | urgency | least urgent | most urgent |
| Cost | least expensive | most expensive | <> | financial strength | most sufficient | least sufficient |
| HR requirement | least number of people and expertise invo | most number of people and expertise invo | <> | expertise | most available | least available |

| | | | | | | |
|---|---|---|---|---|---|---|
| | lved | lved | | | | |
| Effectiveness | most effective | least effective | <> | criticality | least critical | most critical |
| Implication | most positive impact | most negative impact | | | | |

**Table 21 Scales for the measurement of flexibility and risk**

The actual flexibility level of each adaptation solution is determined by adding up all flexibility variables.

*(Actual Flexibility = Time + Cost + HR requirement + Effectiveness + Implication)*

The highest figure means highest flexibility level. However, the flexibility is not the only concern for selecting various adaptation approaches. Organisations shall weigh on balance with criticality, urgency, financial strength and available expertise (see Figure 9) to determine the contextual flexibility level of adaptation. It is suggested by the researcher that it would be ideal to evaluate the contextual flexibility level by a formula that factors in the performance expected and resource required for adaptation, and organisational conditions that the adaptation is subject to. However, the researcher reckons that it is still an early stage to create a formula to approximate the contextual flexibility level. In spite of that, the study shows that the three organisations did weigh on balance of performance and cost with criticality, urgency, financial strength and available expertise when making decision on the selection of adaptation solutions. In order to facilitate the comparison of flexibility level of the adaptation solution and balance with the risk indicators, a table (see **Table 22**) is drawn at the end of each mini case to present the flexibility level of time, cost, HR, effectiveness and implication, and the risk level of associated risks, and then the final column demonstrates the overall flexibility level of adaptation by adding up all flexibility variables.

| | | | |
|---|---|---|---|
| | Flexibility measurement | | Risk level |

| Adaptation solutions | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

**Table 22 Flexibility and risk level of adaptation**

## 6.3 Machine Company

### 6.3.1 Machine company background

Machine, located at Shanghai, China, is a subsidiary company of a US based company (Machine Global). Machine Global has over 150-year history of innovative and successful operations. Machine Global is engaged in two principle businesses: sewing machine manufacturing and retailing. Machine Global is a global retailer of not just sewing products, but a wide range of consumer products for the home. Machine Global remains the leading manufacturer and marketeer of sewing machines worldwide, and is one of the most widely recognized and established brands in the world. Machine Global's distribution network spans over 190 countries, including developed, developing and emerging economies. This network consists of over 1,300 retail stores operated by the company and its affiliates, approximately 58,200 outlets operated by independent dealers and mass merchants, and over 12,000 direct sales agents.

As a matter of fact, Machine was split into two companies in 2002: Machine (using the original company name) for manufacturing industrial sewing machine, the other one – Machine Retailing – dedicated for retailing home sewing machines, while previously these two business functions were performed by Machine. These two companies are still working at the same place as before.

Machine started to implement SAP system since 1999. Its SAP system went live in October 2000. SAP modules implemented are FI, CO, MM, SD and PP. There are no other information systems implemented except a very few number of Microsoft Access database applications. As a small sized company, Machine's business processes are not very complicated. Therefore, a vanilla SAP system approach was adopted as the implementation strategy. Machine did not heavily customise the SAP system as it believed that it would degrade the system efficiency and cause future maintenance problems.

Machine is a small sized company, which employs around 200 employees. Machine has a very small Information Systems department comprising 5 staff; one MIS manager, two are in charge of technical infrastructure, and the other two are junior staff dealing with day-to-day helpdesk function and other administration duties. None of these five MIS people participated in the initial ES implementation. All staff in the SAP implementation team had left the company. The culture of the company human resource policy is to "find, employ and use straightaway". Training is considered as an excessive cost rather than an investment, especially where SAP training is very expensive at local. Being a small sized organisation, the budget for MIS function is low and Machine has limited amount of system support. Therefore Machine prefers to hire external consultant or party/vendor to provide timely solutions as employing a qualified internal SAP specialist is considered too costly. The internal IT staff especially MIS manager would participate in the whole process of ongoing system change implementation in order to learn as much about SAP system as possible. As a matter of fact, all system ongoing changes and enhancements were provided by external consultants from Hand Enterprise Solutions (Hand Consulting). Machine choosing Hand Consulting as its major solution provider / supporter was because as the provider of initial SAP system implementation, Hand Consulting had been very familiar with Machine's business operation. Machine was satisfied with the previous services including the system implementation provided by Hand Consulting. Moreover, the average price per man/day charged by the Hand Consulting was RMB4,000 or USD500 which is lower than half of the price charged by SAP and other world-leading consultancy firms.

### 6.3.2 Ongoing changes

#### 6.3.2.1 Establishing cost centre

In SAP system, each account has a particular function e.g. salary payment. For example, one account holds salary information of all employees within a particular unit (a company, a department, or a defined group); if Machine wanted to categorise this information under each department, without the introduction of cost centre, multiple accounts are required to be set, e.g. account number 4601001 for salary details of MIS department, 4601002 for personnel department etc. Therefore the number of accounts equals to the number of particular functions multiplied by the number of costing units. Previously Machine adopted a simple accounting structure. A small number of business functions had multiple accounts for different units. At the end of the financial year of 2002, Machine needed a more detailed and categorised financial report. Also

Machine wanted to improve the accuracy and efficiency of their financial reporting operation. However previous setting of account structure did not support this requirement. This need for a detailed functional financial management was regarded as a medium urgent and medium critical level of request.

To solve this, there were two approaches on the table, either setting up multiple accounts for each particular accounting function or as being informed by the consultancy firm, introducing cost centre – a function already built in the SAP system. Setting up multiple accounts was a ***technical workaround*** as it would be a massive workload to set up multiple accounts for each function accordingly and it would be difficult to conduct statistic analysis and generate cross-department reports which would require some new developments. In addition, running report based on multiple accounts setting would be time consuming. The MIS department chose a ***technical adaptation*** approach to set up the cost centre within the SAP. By setting up the cost centres, accounting staff can use current financial reports with little adaptation on them and most of reports can adopt built-in reports within SAP. Moreover, the most important concern is as the IS manager points out "by reconfiguring the system, we shall worry little about future system maintenance because we are reconfiguring the built-in configuration table and not doing something out of SAP. Because this approach would allow us to use as many built-in reports as possible, we shall not worry about future system upgrading." However, cost centre configuration required competent IT people to conduct the system change, while for adopting multiple account approach, Machine could use their internal IT staff to carry out the system adaptation, which could reduce the total cost for system adaptation. Notwithstanding, the need for an effective solution outweighed other concerns of performance measurement and resources required (see Table 23 and Table 24).

Due to lack of competent internal staff for setting up cost centre within SAP, Machine decided to hire a consultant from Hand Consulting to implement this change. The decision was made based on consideration of human resource capability, cost, and the capability and credibility of consultancy firm. The work was done in two stages: the consultant switched on the cost centre options in the configuration tables and developed specific reports required by Machine, and the internal IT staff created cost centres accounts for each individual unit. From the perspective of cost minimisation, historical accounting items were not required to be allocated under each cost centre. It reduced massive amount of work and time, but it did confine the company to getting detailed financial report and analysis for the previous years and comparing them with subsequent years. In total it took about 2 days to complete the implementation satisfactorily and had no disruption on business operation.

<table>
<tr><td>Business context</td><td colspan="2">Improve functional costing efficiency and accuracy<br>Improve operation for financial reporting for each operation unit and financial analysis and statistics<br>Sub-units of each major function not specified</td></tr>
<tr><td>Nature of business change<br>Level</td><td colspan="2"><br>Operational</td></tr>
<tr><td>Technical context</td><td colspan="2">SAP FI with built-in cost centre functionality</td></tr>
<tr><td>Adaptation tactics</td><td>Technical adaptation</td><td>Technical workaround</td></tr>
<tr><td>Solution (adaptation activities)</td><td>System exploitation<br>Minor reconfiguration<br>System tailoring<br>No conversion of historical data<br>Minimal report adaptation on existing reports and built-in reports</td><td>System tailoring<br>Creating substantially new accounts for new costing units<br>Report adaptation on existing reports<br>New reports development</td></tr>
</table>

| | | |
|---|---|---|
| Cost (Time) | 2 days | (E) Longer, 3 weeks |
| Cost (Monetary) | RMB8,000 consultancy cost<br>(E[1]) RMB800 internal cost | (E) RMB4,000 |
| Human resource required/involved | 1 external IT professional / consultant (2 man-days)<br>2 internal IT staff (4 man-days) | (E) Internal IT staff (20 man-days) |
| Effectiveness | The business need fully satisfied<br>Difficult to compare statistics with historical data | Difficult to collect statistics and developing extra management reports<br>The efficiency and accuracy for financial analysis and statistics compromised<br>Running statistic is time-consuming<br>Difficult to compare statistics with historical data |
| Implications | No major impact on system upgrading | Some maintenance effort on newly developed reports |

**Table 23 A summary of cost centre reconfiguration (Case Machine 1)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Cost centre configuration | 9 | 8 | 5 | 9 | 0 | 31 | | 3 | 2 | 2 | 4 |
| Setup multiple account | 8 | 9 | 8 | 4 | -1 | 28 | | | | 1 | |

**Table 24 Flexibility and risk level of adaptation for Case Machine 1**

#### 6.3.2.2 Changing fix assets depreciation rate

The accounting regulation in China about fix assets depreciation was changed by the end of year 2002. Previously, according to the accounting regulation, fix assets cannot be depreciated to lower than 10% of the original value. The depreciation limit was set in the SAP system. However, Machine is an American company. No such restriction on depreciation in America, Machine needed to adjust the figure manually in order to produce a financial report suitable for its American HQ and accounting system. The

[1] Estimated figure

depreciation rule was changed in 2003, which imposed no restriction on depreciation limits. In spite of that the business change was originated from the governmental regulation change, it was not considered as a critical matter as Machine can continually adopt their existing method to cope with it. However, Machine senior management has required MIS function and accounting function to make the necessary change ASAP in order to align with the American HQ's accounting practice.

Machine decided a ***technical adaptation*** approach. A SAP finance module consultant from Hand Consulting was employed to change the setting of the depreciation in the configuration table. The work included defining the new methods of depreciation by changing the depreciation rate and period (one method was specially defined for the residual fix assets depreciation), clearing the depreciated part of assets, converting the residual fix assets into new assets, disposing these converted assets with the new method of depreciation (those assets would be completely depreciated in a very short period of time e.g. 1 year or 6 months). All new fix assets would be depreciated by the new method of depreciation. The major work was to convert and dispose old fix assets. The total work took about 4 man-days to complete, and had no particular disruption on business operation. Average cost per man-day charged by Hand Consulting was RMB4,000 or USD500. One accounting manager and one internal IT staff were involved in the project to assist the consultant's job. The reason to opt for external consultant was because the lack of internal expertise in SAP FI module. Alternatively, Machine could still rely on its accounting staff and internal IT staff to handle the change of accounting regulation by manually altering the accounting figures every three months for asset depreciation. It was a ***business workaround*** approach. The business workaround approach reduced the need for a system change by sacrificing operational efficiency. However, it requires the accounting manager to adjust accounting figures first and then pass it to the IS manager so that he could make the final amendment in the system. Adopting this approach could seriously cause business disruption and operational efficiency as the accounting manager and the IS manager would be occupied to deal with asset depreciation. Moreover, as the accounting manager stressed that "currently we are processing fixed assets depreciation every three months. By reconfiguring the system, the depreciation would be automated. It would allow us to choose whatever depreciation period – 3 monthly or even every day. The financial report would be real-time and more accurate. If we reduce the cycle of processing depreciation (when employing manual method), it would add more workload on us." The IS manager expressed that by reconfiguring the system, the data stored in the system would be more consistent than before. Therefore, there will be little impact on future system upgrading and adding more functionality.

| | | |
|---|---|---|
| Business context | Accounting regulation changed<br>Previously accounting figure adjusted manually to suit the needs of the HQ | |
| Nature of business change<br>*Level* | *Operational* | |
| Technical context | SAP FI | |
| Adaptation tactics | Technical adaptation | Business workaround |
| Solution (adaptation activities) | System exploitation<br>Reconfiguration<br>Adjust accounting figures accordingly | Business adaptation<br>Amending accounting figures manually |
| Cost (Time) | 4 days | 2 days every three months |
| Cost (Monetary) | RMB16,000 consultancy cost<br>internal cost estimated at RMB1,600 | No system adaptation cost, however consume internal cost estimated at RMB800 every 3 months |
| Human resource required/involved | 1 external IT professional / consultant (4 man-days)<br>1 internal IT staff (4 man-days)<br>1 accounting manager (4 man-days) | 1 internal IT staff (2 man-days)<br>1 accounting manager (2 man-days) |

| | | |
|---|---|---|
| Effectiveness | The business need fully achieved<br>No extra admin work<br>No disruption on operation<br>More accurate financial report<br>Real-time financial info on fixed assets | The business need can be achieved but operational efficiency is compromised<br>Extra admin work (3 days every processing cycle – currently 3 months)<br>Some disruption on operation<br>Human error may occur when alter the accounting figure<br>Report is not real time |
| Implication | No impact on system upgrading and extension | Some data cleaning required when system upgrades and extension |

**Table 25 A summary of change of fix assets depreciation rate (Case Machine 2)**

| | Flexibility measurement | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | Urg. | Financial strength | Expertise Availability | Crit. |
| Reconfiguring the depreciation method | 8 | 7 | 7 | 10 | 0 | 32 | 4 | 4 | 3 | 3 |
| Amending accounting figures manually | 7 | 8 | 8 | 5 | -2 | 26 | | | 2 | |

**Table 26 Flexibility and risk level of adaptation for Case Machine 2**

#### 6.3.2.3 Organisational structure change

In year 2002, Machine made a strategic manoeuvre by reconstructing its organisation in order to align with the business allocation of Machine Global and clarify responsibilities. The senior management both from Machine and Machine Global regarded this as a highly critical and urgent matter for their business. Previously, there were two business scopes within the company; one responsible for manufacturing industrial sewing machines and the other one dedicated to retailing home sewing machines. Previously although these two business functions were centralised within one company, Machine's retailing sales director and general manager were reporting to different superiors at Machine Global Headquarters and even there were two sets of business performance reports; one for retailing and one for manufacturing.

Machine knew that the organisational structure change would require a considerable amount of work in changing its adopting SAP system. Machine wanted the change on their SAP system could fully match new business operational requirements, and its implementation could be done swiftly in order to reduce the disruption on business operation. As always, from the cost minimisation perspective, Machine did not want the historical data to be converted and categorised under each company, which would save quite a lot of time and amount of work. Machine conducted business analysis for several weeks at first to find out new system requirements for both companies especially the new retailing company. The sales function was very simple before as 95% of products were sold abroad. Although 5% of products were sold by retailing, these records had been manually adapted to fit into the SAP system. As current setting of SAP system were implemented and configured towards the needs for the manufacturing operation, Machine found out that there would be very little new requirements for the manufacturing company. Being separated from the previous company, the retailing company needed to introduce a variety of sales methods (e.g. consignment sale, mail order) and accounting methods (e.g. instalment, pre-payment) for the retailing operation. Therefore, major requirements were within the sales function and financial and accounting function of the retailing company. The MIS department knew that the SAP system did support this kind of organisational structure change by setting up different company codes for these two companies. Machine decided to set up two new company codes for these two companies in order to separate the business operation clearly from the previous. Therefore, a ***technical adaptation*** approach was adopted.

Splitting the company into two in the system was not a simple task. It was not much different from creating the configuration for a new company. For the manufacturing company, it was copying the old setting under an according company code. Major work was done for the retailing company like configuration and report development as its business was totally different from before. There were lot of new reports required by the retailing company. For achieve this strategic change, sufficient budget was allocated. As before, Machine still had a problem with the competence of their internal IT people. Hereby, with sufficient financial support, Machine employed 5 consultants (2 SD consultants, 2 FI consultants, 1 MM consultant and 1 report developer) from Hand Consulting to implement the change. Total time spend was 2 months and it cost more than 70 man-days of external consultancy. Internal staff involved in the implementation were two accounting managers, the sales manager, the IS manager and one IT staff were involved. The change has been successfully implemented and caused no disruption on the business operation although some work had to put on hold until the change was completed. It was because staff still could use the old system (old company code) to perform their day-to-day tasks. When the new company codes were setup, they can perform their operation under the new company code, and gradually close the recorded transaction under the old company code. The configuration and development was done in the development system which would not affect current operation.

| Business context | Dividing the company into two |
|---|---|

| | |
|---|---|
| Nature of business change<br>*Level* | *Strategic* |
| Technical context | SAP FI, SD, MM |
| Adaptation tactics | Technical adaptation |
| Solution (Adaptation activities) | System exploitation<br>Heavy configuration<br>Configuration for the manufacturing company the same way as before<br>New configuration for the retailing company<br>System tailoring<br>Heavy report development and adaptation<br>Screen adjustment |
| Cost (Time) | 2 months |
| Cost (Monetary) | RMB280,000 consultancy cost<br>Internal cost estimated at RMB40,000 |
| Human resource required/involved | 5 external IT professionals / consultants (70 man-days)<br>2 accounting managers (30 man-days)<br>1 sales manager (20 man-days)<br>1 IS manager (30 man-days)<br>1 IT staff (60 man-days) |
| Effectiveness | Business needs fully satisfied |
| Implication | No impact on system upgrading and extension |

**Table 27 A summary of organisational structure change (Case Machine 3)**

| | Flexibility measurement | | | | | | | Risk Level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Reconfiguration | 4 | 5 | 3 | 8 | 0 | 20 | | 4 | 1 | 1 | 5 |

**Table 28 Flexibility and risk level of adaptation for Case Machine 3**

#### 6.3.2.4 Improving inspection and quality control

In October 2003, Machine decided to improve and automate its inspection and quality control (IQC) process as the production output had been doubled since the establishment of the company. Previously Machine used the SAP MM module to perform some of the functionalities for IQC. Being limited by the functionality built in the MM module, Machine was unable to conduct advanced quality management method efficiently and effectively. The statistics on quality records was conducted and updated every three months. The MIS manager regarded the previous solution for IQC was a kind of "work-around" that required a great deal of administrative work. The administrative work was sufficient to support IQC when the production output was low. While the output increased, it required an IT solution to automate some of the processes to improve the efficiency. The functionality required included displaying the product specification when keying in the product type, automatically determining if products would be exempted from inspection (certain rules needed to be applied such as if the product or part of certain specification has passed inspection consecutively for 6 times, it would be exempted from future inspection), and printing out inspection sheets and reports. After a brief discussion with the consultancy firm, Machine was told that this functionality could be achieved by implementing a new SAP QM (quality management) module or developing a satellite application on top of current adopting SAP system. The former option was recommended by the consultancy firm as the QM module would provide much more functionalities (although some of them were not needed at that time) and cause no integration problems. This approach was regarded as a ***technical banking*** approach that could enable Machine to adopt other quality management processes in the future when their business expanded. However, as the IQC process was fairy simple, Machine decided not to purchase the QM (quality management) module from the SAP that could provide much more functionalities than Machine actually needed. Machine thought it was a waste of money to purchase this module especially the financial strength was limited. Moreover, the expenditure of software acquisition and implementation would be much higher than developing a bespoke application like this. The MIS team also tried to find out if there was any ready-made "plug-in" (another ***technical adaptation*** method) in the market. There were some third party "plug-in" but neither of them can fully meet their requirement. Moreover the MIS manager was worried about maintenance issue if adopting the third party solution. However, the MIS manager commented that "the quality management is far from mature and sophisticated at the moment. The add-on is only a little step towards the perfection of the management. When the business moves on, it will be inevitable to introduce more sophisticated method for quality management. Until that time, the implementation of the QM module will be imperative rather than optional. Some problems will emerge if merging the old data in the be-spoke system to the new QM module. But now we are constrained by the financial capacity and emerging business needs."

Hence, Machine hired Hand Consulting to embark on the development, as it was considered more sensible to use the consultants from Hand Consulting who were very familiar with the business processes of Machine's and its SAP system than to hire other consultants who would require spending sometime to get familiar with. The MIS manager was very involved in the whole process of development, as he had got lots of experiences and knowledge from past system changes. This development was conducted by consultants and the MIS manager. The detail requirements were provided by the IQC staff. The MIS manager also acted as a messenger between the IQC staff and consultants to facilitate the communication. Technical compatibility and "business compatibility" (termed by the MIS manager) were carefully considered during the design stage. The concern about the technical compatibility included the data communication between the new application and the SAP MM module, while the business compatibility concerned the integration of IQC process with other business processes mainly material management processes and how to correct records when data entry was wrong. It took 1 consultant nearly 3 weeks to complete. The project was considered successful as the time of quality inspection for each piece of product was reduced from 56 minutes to 40 minutes initially. Machine inspects 120 pieces of product every day. In total, it saved 32 hours of work load every day. The application also dramatically increased the number of pieces exempted from quality inspection. Moreover, Machine was very pleased with the savings on developing the functionality. The total cost was about RMB48,000, equal to just one tenth of the SAP QM module implementation cost.

| Business context | Automating product inspection and quality control | | |
|---|---|---|---|
| Nature of business change *Level* | *Operational* | | |
| Technical context | SAP MM with a spreadsheet for record administration | | |
| Adaptation tactics | Technical adaptation | Technical banking | Technical workaround |
| Solution (Adaptation activities) *n* | System tailoring<br>Engage a third party consultancy firm to develop a bespoke program based on SAP MM | System extension<br>Implement SAP QM | System extension<br>Implement 3rd party bolt-on solution |
| Cost (Time) | 3 weeks | 2 months | 2 weeks |
| Cost (Monetary) | RMB48,000 consultancy cost<br>Internal cost estimated around RMB 9,000 | Total cost including consultancy and software license around RMB500,000<br>Internal cost | Consultancy and software license fee around RMB200,000<br>Internal cost estimated around RMB 6,000 |
| Human resource required/involved | 1 external consultant (21 man-days)<br>1 IS manager (15 man-days)<br>2 IQC staff (25 m | 2 external consultants (120 man-days)<br>2 IQC staff (60 man-days)<br>1 IS manager (25 man-days) | 1 external consultant (14 man-days)<br>2 IQC staff (10 man-days)<br>1 IS manager (5 man-days) |

| | | | |
|---|---|---|---|
| | an-days) | | |
| Effectiveness | Business performance improved dramatically<br>Business need fully satisfied | More functionalities (some not actually needed) built-in<br>Business need fully satisfied<br>Business performance improved | Business needs partially satisfied |
| Implication | Problems of data merge when implementing SAP QM<br>No impact of integration on system upgrades and enhancements | No integration problem<br>No impact on system upgrades and enhancements<br>Built-in functionality in SAP QM could be used for future business needs | Maintenance problem when system upgrades |

**Table 29 A summary of quality control automation (Case Machine 4)**

| | Flexibility measurement | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | Urg. | Financial strength | Expertise Availability | Crit. |
| Bespoke application development | 8 | 5 | 7 | 10 | -2 | **28** | 3 | 4 | 4 | 3 |
| Acquire QM module | 5 | 1 | 2 | 10 | 2 | 20 | | | 2 | |
| Acquire 3rd party solution | 8 | 5 | 6 | 6 | -4 | 21 | | | 2 | |

**Table 30 Flexibility and risk level of adaptation for Case Machine 4**

#### 6.3.2.5 New inventory report

The accounting people had been using 4 separate reports to collect statistics of items in the stock that were moved within 90 days, between 90 and 180 days, between 180 and 360 days, and not moved at all within 360 days, and the value of these items. Each type of report was set up by configuration to reflect each particular period during the implementation of the SAP MM module, as they were standard reports built in the SAP system. The accounting people required a comprehensive report that would consist of statistics information of these 4 periods and other specific information. This report would also be used as a reference by auditors. Another reason for the request of the comprehensive report was to improve the system operating efficiency as generating and printing out these reports would utilise considerable system resource, which would slow down the whole system operation.

As it was not an urgent matter as described by the accounting staff, the project was decided to take a ***procrastination*** approach to put on hold for about 3 months until IS staff completed some pressing jobs and became available. At the mean time, the accounting staff were told to export data into Microsoft Excel from these separate reports and generate reports with required format every month. This approach was initially considered as an alternative ***business workaround*** approach if the company decided not to go ahead with the new request. After 3 month on hold, Machine took a ***technical adaptation*** approach. Machine employed Hand Consulting to develop this report. It took nearly 5 months to complete since the change request was submitted in October 2002. The project was successful and had no disruption on daily business operation. The accounting supervisor admitted that it was not very difficult project, but the actual developing time did span considerably long time (nearly 2 months) to complete. She commented that "as it was not an urgent business needs, the company did not push the consultancy firm too hard; another reason was that a junior consultant was assigned for this development. Because of the lack of experience, the consultant did waste some time. The major lag was caused by the attempt to communicate the specification between the consultant and the accounting staff. At the beginning of the project, the consultant started to look at standard reports built-in the SAP system and associated settings. When the consultant found one similar to our requirement, which was the case here, he passed this report to us and asked us how to customise this report. The accounting staff made suggestion and amended the specification. Before it went back to the consultant, it needed to be approved by the finance director. The iterative process (designing – refining – approving) consumed a great deal of time." As commented by the accounting supervisor, the actual development might just take about 1 week; most of time was consumed during the process of analysis and approval; it would save a lot of time and effort if the specification were well thought at the first place. She also added that "if the MIS staff and also the accounting staff were familiar with the built-in standard reports, it should have been studied beforehand to provide more detailed specification".

| | | |
|---|---|---|
| Business context | Requiring a comprehensive report for inventory<br>Improving efficiency of report generation<br>However the change request nor regarded as urgent matter | |
| Nature of business change<br>*Level* | *Operational* | |
| Technical context | SAP MM, FI, standard built-in report | |
| Adaptation tactics | Procrastination/<br>Technical adaptation | Business workaround |
| Solution (adaptation activities) | System exploitation<br>Minor configuration<br>System tailoring<br>Report adaptation | Manual intervention<br>Export data into spreadsheet |
| Cost (Time) | (procrastination 3 months)<br>2 months | 1 day every 3 months |
| Cost (Monetary) | RMB 10,000 consultancy cost<br>Internal cost estimated around RMB4,000 | Internal cost around RMB500 every 3 months |
| Human resource required/involved | 1 junior consultant (7 man-days)<br>2 accounting staff (15 man-days)<br>1 finance director (3 man-hours)<br>1 IT staff (5 man-days) | 1 accounting staff<br>1 IT staff |
| Effectiveness | A comprehensive report f | Operational efficiency wa |

| | | |
|---|---|---|
| | or inventory was not required urgently<br>Business needs satisfied | s compromised<br>Extra admin work required (2 day every 3 months) |
| Implication | None | Recurring cost |

**Table 31 A summary of new inventory report development (Case Machine 5)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Exporting data | 10 | 8 | 8 | 5 | -3 | **28** | | 1 | 4 | 2 | 1 |
| Procrastination /Report development | 4<br>(6)[2] | 6 | 6 | 10 | 0 | 26<br>(28)[2] | | | 4 | 3 | |

**Table 32 Flexibility and risk level of adaptation for Case Machine 5**

[2] Time valuation figure in bracket indicates the actual level of flexibility without considering procrastination.

### 6.3.2.6 Introducing depreciation preparation

SAP system provides some standard depreciation methods. These methods adopted were relatively simple, e.g. for age depreciation or linear depreciation, depreciation value would spread evenly over a pre-determined period. The new accounting regulation introduced by the government later in 2002 provides a more flexible way of depreciation. Organisations are allowed to change their depreciation methods over certain period of time, but it requires organisations to recalculate the value of fixed assets periodically, or called "depreciation preparation" (The calculated value of the fixed assets will be the starting value for the next period of depreciation.)

[2] Time valuation figure in bracket indicates the actual level of flexibility without considering procrastination.

With SAP system, adopting the new depreciation regulation will cause inconsistence of subsidiary ledger and general ledger. Machine had requested a new development for this functionality to automate the depreciation process, there was no answer from consultancy firm. The current solution was a ***business workaround*** to manually adjust figures in the fixed asset module. However, the workload is heavy if adjusting the records manually. Machine performs depreciation preparation annually (there is no defined period for depreciation preparation in the new accounting regulation). It took one staff about 2 weeks to complete the task with support from accounting manager and IS manager. The Accounting Manager commented that Machine was a relatively small company; for some bigger organisations, it was needed to perform the task in a shorter cycle e.g. every month, and there were more variety of fixed assets and depreciation approaches, which means it would take considerable more man/day to perform this task.

| | |
|---|---|
| Business context | Changing accounting regulation for depreciation rules |
| Nature of business change *Level* | *Operational* |
| Technical context | SAP FI |
| Adaptation tactics | Business adaptation |
| Solution (adaptation activities) | Manual intervention<br>Manually adjust figures in the fixed asset module |
| Cost (Time) | 2 weeks annually |
| Cost (Monetary) | Internal cost at RMB5,000 |
| Human resource required/involved | 1 accounting staff (14 man-days)<br>1 accounting manager (1 man-day)<br>1 IT manager (2 man-day) |
| Effectiveness | Business needs not satisfied<br>manually adjust figures in the fixed asset module |
| Implication | No implication on system maintenance<br>Data could be inconsistent across the SAP system |

**Table 33 A summary of depreciation preparation change (Case Machine 6)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Manual adjustment | 10 | 6 | 9 | 2 | -3 | 24 | | 3 | 4 | 2 | 3 |

**Table 34 Flexibility and risk level of adaptation for Case Machine 6**

#### 6.3.2.7 Automating invoice numbering and printing

SAP system generates a number for each invoice. In western countries, it is a common practice to use this number as the invoice number. But this number is not a valid number as an invoice number in China. Invoice number is a VAT number generated by an invoicing software supplied by the governmental tax authority. Machine proposed to interface with this invoicing software with SAP so that VAT number can be automatically fed into the SAP system and the invoice can be printed out straightaway from the SAP system. However, the MIS people found out that it is impossible to interface with this invoicing software as it was a DOS based application and no interface was provided by this software. However, Machine had been informed by the tax authority that a new version of invoicing software would come out and allow organisations to interface it with their computer systems. Despite that, the tax authority did not give a specific date when it would be available. Moreover, SAP China had released some news in China that they had been working with Chinese Tax Authority to amend its invoicing functionality in the FI and comply with the tax regulation. The mixed messages made Machine to decide that it was more sensible to take the ***procrastination*** approach and put on hold the change request of automating invoice numbering and printing and wait for further information from China Tax Authority and SAP China about their new development. The MIS manager commented "SAP and

China Tax Authority have not been working together very well. Some part of SAP FI does not fully comply with Chinese accounting regulations. Therefore, we have to use third party applications commissioned by China Tax Authority. We are happier to adopt this functionality from SAP rather than any third party vendor as we have paid license fee to SAP. It should come with any SAP legal patch or upgrades." For the time being, Machine decided to adopt a ***business workaround*** approach that accountants have to manually input invoicing details into the software for printing and input VAT numbers back into a particularly field in the SAP system.

| | | | |
|---|---|---|---|
| Business context | Automating invoice generation | | |
| Nature of business change<br>*Level* | *Operational* | | |
| Technical context | SAP FI<br>Third party accounting software supplied by the government<br>SAP China and Chinese tax authority both announced their plan to develop new invoicing application | | |
| Adaptation tactics | Business workaround | Procrastination / Technical adaptation | Procrastination / Technical adaptation |
| Solution (adaptation activities) | Manual input VAT number into SAP system. | System extension<br>Replace current invoicing software with a new one<br>Create interface between SAP and the invoicing software | System exploitation<br>Upgrade SAP FI with new patches on invoicing |
| Cost (Time) | n/a | Procrastination time estimated 12 months<br>(E) medium | Procrastination time estimated 12 months<br>(E) medium |
| Cost (Monetary) | Internal cost of 1 accounting staff performing the input | (E) medium | (E) low |
| Human resource required/involved | 1 accounting staff | External consultant<br>1 accounting manager<br>1 MIS manager | External consultant<br>1 accounting manager<br>1 MIS manager |
| Effectiveness | Business need not satisfied<br>Extra admin work required to input a | Business need could be fully satisfied | Business need could be fully satisfied |

| | | | |
|---|---|---|---|
| | ccounting figure to the SAP system | | |
| Implication | No impact on system maintenance | Fixing the interface might be needed when system upgrade | No impact on system maintenance Upgrading could fix other problems in accounting |

**Table 35 A summary of automating invoice generation (Case Machine 7)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Manual input | 10 | 8 | 9 | 4 | 0 | **31** | | 3 | 3 | 1 | 3 |
| Procrastination/ acquire govnt. software | 3 (7)$^2$ | 6 | 7 | 10 | -2 | 24 (28)$^2$ | | | 4 | 1 | |
| Procrastination/ upgrade SAP FI | 3 (8)$^2$ | 8 | 7 | 10 | 2 | **30** (**35**)$^2$ | | | | 1 | |

**Table 36 Flexibility and risk level of adaptation for Case Machine 7**

### 6.3.3 Summary of Activities of Machine

This section presents the summary of seven adaptation responses towards business needs during the post-implementation stage of ES adoption in Machine.

| Description of business needs | Type of business needs | Tactics | Solution | Time | Cost | Human resource | Implication on business | Implication on system maintenance |
|---|---|---|---|---|---|---|---|---|
| Establishing cost centre | Operational | Technical adaptation | System exploitation<br>Configuration<br>System tailoring<br>No conversion of historical data<br>Report development (minimal adaptation on existing reports, use built-in report) | 2 days | RMB8,000 external consultancy cost<br>internal cost estimated at RMB800 | 1 external IT professional / consultant (2 man-days)<br>2 internal IT staff (4 man-days) | The business need fully satisfied<br>Difficult to compare statistics with historical data | No major impact on system maintenance |
| | | Technical workaround | System tailoring<br>Creating new accounts for new costing units (configuration)<br>Report development (major adaptation on existing reports, new reports needed) | (E) Longer, 3 weeks | Internal cost estimated at RMB4,000 | (E) Internal IT staff (20 man-days) | Difficult to collect statistics and developing extra management reports<br>The efficiency and accuracy for financial analysis and statistics compromised<br>Running statistic is time-consuming<br>Difficult to compare statistics with historical data | Some maintenance effort on newly developed reports |
| Changing fix assets depreciation rate | Operational | Technical adaptation | System exploitation<br>Reconfiguration<br>Adjust accounting figures accordingly | 2 days | RMB16,000 consultancy cost<br>internal cost estimated at RMB1,600 | 1 external IT professional / consultant (4 man-days)<br>1 internal IT staff (4 man-days)<br>1 accounting manager (4 man-days) | The business need fully achieved<br>No extra admin work<br>No disruption on operation<br>More accurate financial report<br>Real-time financial info on fixed assets | No impact on system upgrading and extension |
| | | Business workaround | Business adaptation<br>Amending accounting figures manually | 2 days every three months | No system adaptation cost, however consume internal cost estimated at RMB800 every 3 months | 1 internal IT staff (2 man-days)<br>1 accounting manager (2 man-days) | The business need can be achieved but operational efficiency is compromised<br>Extra admin work (3 days every processing cycle – currently 3 months)<br>Some disruption on operation<br>Human error may occur when alter the accounting figure<br>Report is not real time | Some data cleaning required when system upgrades and extension |
| Separating one company into t | Strategic | Technical adaptation | System exploitation<br>Reconfiguration | 2 months | RMB280,000 consultancy cost | 5 external IT professionals / consu | Business needs fully satisfied | No impact on system upgrading and extension |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| wo | | | Configure the system for the manufacturing company the same way as before<br>New configuration for the retail company<br>System tailoring<br>Report development<br>Screen adjustment | | Internal cost estimated at RMB40,000 | ltants (70 man-days)<br>2 accounting managers (30 man-days)<br>1 sales manager (20 man-days)<br>1 IS manager (30 man-days)<br>1 IT staff (60 man-days) | | |
| Improving IQC process | Operational | Technical adaptation | System tailoring<br>Engage a third party consultancy firm to develop a bespoke program based on SAP MM | 3 weeks | RMB48,000 consultancy cost<br>Internal cost estimated around RMB 9,000 | 1 external consultant (21 man-days)<br>1 IS manager (15 man-days)<br>2 IQC staff (25 man-days) | Business performance improved dramatically<br>Business need fully satisfied<br>Built-in functionality in SAP QM could be used for future business needs | Problems of data merge when implementing SAP QM<br>No impact of integration on system upgrades and enhancements |
| | | Technical banking | Implement SAP QM<br>Data merge | 2 months | Total cost including consultancy and software license around RMB500,000<br>Internal cost | 2 external consultants (120 man-days)<br>2 IQC staff (60 man-days)<br>1 IS manager (25 man-days) | More functionalities (some not actually needed) built-in<br>Business need fully satisfied<br>Business performance improved | No integration problem<br>No impact on system upgrades and enhancements |
| | | Technical adaptation | Implement 3rd party solution | 2 weeks | Consultancy and software license fee around RMB200,000<br>Internal cost estimated around RMB 6,000 | 1 external consultant (14 man-days)<br>2 IQC staff (10 man-days)<br>1 IS manager (5 man-days) | Business needs partially satisfied | Maintenance problem when system upgrades |
| New inventory report | Operational | Procrastination<br>Technical adaptation | System exploitation<br>Configuration<br>System tailoring<br>Report adaptation | (procrastination 3 months)<br>2 months | RMB 10,000 consultancy cost<br>Internal cost estimated around RMB4,000 | 1 junior consultant (7 man-days)<br>2 accounting staff (15 man-days)<br>1 finance director (3 man-hours)<br>1 IT staff (5 man-days) | A comprehensive report for inventory was not required urgently<br>Business needs satisfied | No major implication on system maintenance |
| | | Business workaround | Manual intervention<br>Export data into spreadsheet | 1 day every 3 months | Internal cost around RMB500 every 3 months | 1 accounting staff<br>1 IT staff | Operational efficiency was compromised<br>Extra admin work required (2 day every 3 months) | Recurring cost |
| Changing depreciation pr | Operational | Business adaptation | Manual intervention<br>Manually adjust figures in the | 2 weeks annually | Internal cost at RMB5,000 | 1 accounting staff (14 man-days) | Business needs not satisfied<br>manually adjust figures in the fi | No implication on system maintenance |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| eparation | | | fixed asset module | | | 1 accounting manager (1 man-day)<br>1 IT manager (2 man-day) | xed asset module | Data could be inconsistent across the SAP system |
| Automating invoice numbering and printing | Operational | Business workaround | Manual input VAT number into SAP system | n/a | Internal cost of 1 accounting staff performing the input | 1 accounting staff | Business need not satisfied<br>Extra admin work required to input accounting figure to the SAP system | No impact on system maintenance |
| | | Procrastination / Technical adaptation | System extension<br>Replace current invoicing software with a new one<br>Create interface between SAP and the invoicing software | Procrastination time estimated 12 months<br>(E) medium | (E) medium | External consultant<br>1 accounting manager<br>1 MIS manager | Business need could be fully satisfied | Fixing the interface might be needed when system upgrade |
| | | Procrastination / Technical adaptation | System exploitation<br>Upgrade SAP FI with new patches on invoicing | Procrastination time estimated 12 months<br>(E) medium | (E) low | External consultant<br>1 accounting manager<br>1 MIS manager | Business need could be fully satisfied | No impact on system maintenance<br>Upgrading could fix other problems in accounting |

**Table 37 ES responses to business needs in Machine (alternative approaches in yellow cells)**

## 6.4 Brewery

### 6.4.1 Brewery background

Brewery is a UK subsidiary of an international brewing group which can trace its history back to the 19th Century. The group is now the fifth largest brewing group in the world. The Brewing Group wants to become market leader in all markets and market segments where it operates by establishing majority shareholdings or partnerships. The Brewing Group's strong portfolio of global, regional and national beer brands appeals to a broad diversity of tastes, personalities and lifestyles, and ensures growth in all segments of the beer market. The portfolio is constantly strengthened through a clear branding strategy, with its major brand as the leading international premium beer, supported by regional brands.

The primary focus of the Brewing Group is the production, sale and marketing of beer, with secondary activities in soft drink and water production. Its three key markets are Western Europe, Eastern Europe and Asia. Brewery is first and foremost a brewer, although it does offer a full drinks service to pubs, clubs and restaurants throughout the UK. This means that the company delivers wines, spirits and soft drinks alongside its beer products.

Brewery has 2 major sites, 16 depots and 18 locations in the UK. Brewery decided to implement the SAP system in a "big bang" approach because Brewery being a company of such size, each functional area has its own legacy systems, they could not contemplate maintaining a little system and creating interfaces and turning it all off. The implementation of SAP was viewed as a benefit driven project that would get rid of legacy applications and legacy reporting systems that had a lot of trouble of maintenance and enhancement. Although the implementation team tried to get the business to see the potential with SAP, they did not see the need to have it in the first place. The implementation actually ended up with a quite heavily bespoken SAP implementation.

The SAP system was implemented in late 1999. The system went live in 18 months with 1300 users in June 2001. Major modules implemented are FI, CO, COPA, SD, MM, service management. The telesales module was developed with its SAP system implementation consulting firm. The IT function was born out of the implementation project. The existing IT function includes the IT service department headed by the IT Director for IT infrastructure and business solution team headed by the Business Strategy Director for supporting SAP implementation, developing changes and new elements of SAP. Despite the initial "big bang" approach selected for the SAP system implementation, Brewery ended up with a quite heavily bespoken SAP implementation and did not do any sort of business process re-engineering. It was because users were quite happy with the legacy systems that were tailored to how users wanted them to work. Therefore, Brewery actually manipulated the SAP to mimic the existing system in order to keep the same process flow.

The initial implementation of SAP was not seen as a benefit driven project but a way of making an investment that has been needed for a long time to get out of the problem.

After the initial implementation, the challenge Brewery was facing was to exploit that investment and try to see some more benefits from it. The Business Strategy Director pointed out "it would've made a significant investment in SAP when it's trying to use it better and by using it better ... that philosophy extends to both the business and to the systems ... I moved to be a more of a general strategic role rather than a technology driven role, trying to see what other opportunity that exists by having a fresh pair of eyes looking at piece of the areas". Therefore, one of the approaches adopted was to take out the legacy systems and replace with SAP solutions over time in order to cut the cost within the IT arena and improve the efficiency and integration. Another approach was to seek new opportunities and introduce new way of working to get business to see the potential of SAP. The Business Strategy Director admitted that there was a great deal of naivety about building solutions with users demand. He further commented "... we have now earned enough of a relationship with the business to actually challenge them now on new processes rather than just amending the solution". As a matter of fact, Brewery is trying to take out bespoken SAP application and standardise back to standard SAP. The IT director commented "... why spend all this time and effort when a financial transaction is a financial transaction ... the customisation should be at the customer contact end". Business Strategy Director commented "they couldn't see the value of technology in helping themselves ... they are much more aware now of what is possible and then mainly that is because that we tried to do the classic things; we implemented SAP and then we got on and started to take the business and show them what is possible with SAP. But at the time the business was still a little bit of wary of technology, and I think wary from a point of view that it is costly to implement, it takes time. And if it is going to be costly to implement, I got to come up with, the business got to come up with bit benefits for why it should, and they were not prepared to commit to that size of benefit to make that level of investment." The overall IT/IS strategy was to do smaller, tactical development, surround the solution, to demonstrate a little bit to the business how useful the current solution is.

At the same time, the IT department was bombarded with a great number of change requests from the business. In 2003, there were over 320 change requests from the business for anything from minor modifications to complete new elements. About 200 were delivered and 100 were rejected. The IT department has established a well structured process for change requests so that they can be properly dealt with by limited resources Brewery had. A 3 year plan for major projects was made and revised every year. Dealing with ongoing system changes seems a big challenge for the business and IT function. Furthermore, it was even complicated by the consideration of Brewery global HQs of rolling out standard solution to its regional organisations.

### 6.4.2 Ongoing system changes

#### 6.4.2.1 Replacing legacy warehouse management system for the wine and spirit distribution operation

Brewery operates in wine and spirit which was not part of its core business and was quite different from the reset of its business. Wine and spirit operation started as a value-added service to support Brewery's core brand. With year-on-year growth rate of 40%, wine and spirit operation suddenly became a very big part of Brewery's business.

The wine and spirit depot had a DOS based warehouse management system (WMS) – OPUS whereas local depots did not. Being a DOS based system, OPUS was very old and obsolete, and the support from the software vendor was very poor as the vendor of OPUS did not have the knowledge in house to support it properly. Hence, the inflexibility of OPUS did not allow Brewery to introduce new ways of operation. Moreover, the interfaces between OPUS and SAP caused many problems. One of the business solutions managers stated that "even OPUS interfaces with SAP, it needs some system to facilitate the interfaces, which gives additional touch points that things could go wrong". Introducing an SAP solution for warehouse management would limit risks as the SAP is integrated or at least the SAP application has internal interfaces. Brewery also got people who had the skills of SAP; most of its major IT/IS staff had received training at SAP academy for various applications. The cons of keeping on using OPUS and the pros of introducing an SAP solution for warehouse management instigated the move to SAP WMS. Therefore, the decision was made to replace OPUS with an SAP system solution as a strategy from the IT department. Despite that upgrading to the SAP WMS was an IT driven project because the support for OPUS was falling over, the IT department did realise that the new WMS would bring more business benefits and operational flexibility to the warehouse management. The business solutions manager indicated "... I was very pleased as the manager at that time, because I saw the inflexibility of the system; we lived with it (OPUS) for such a long time, we really need to do something new in order to be able to do other ways of working…".

Albeit the IT department decided to opt for an SAP solution and use standard functionality as much as possible, it faced several options:

1. implementing an SAP Inventory Management (IM) module, a ***technical workaround*** approach;
2. implementing an SAP lean WMS, a ***technical workaround*** approach;
3. implementing an SAP full WMS module in its main warehouse, a ***technical banking*** approach;
4. implementing an SAP full WMS module across all distribution function, a ***technical banking*** approach; and
5. developing as-is solution in house based on SD module, a ***technical adaptation*** approach.

Another concern was that how the implementation of the chosen SAP solution would affect the current and future operation of retail depots.

The option of in-house development for an as-is solution was first abandoned. It was because:

1. Brewery felt that its IT staff was not mature enough to handle the development on its own although since the implementation of SAP, Brewery had own staff to be trained in the SAP academy to be qualified SAP developer and users.
2. Brewery did not want to employ an IT integrator or external expertise to carry on the project as an in-house development would take longer time to complete.

3. Albeit an in-house solution might meet existing business requirements, it might constrain the distribution function in the future for any enhancement and extension. Brewery felt that an SAP solution could reduce the total time of implementation within the function and achieve better integration with other modules.
4. Moreover, Brewery had a plan to continuously improve its warehouse management and introduce new operation like bulk pick, new KPI reporting, retail depot management etc. These functionalities could be achieved by an SAP WM solution. Therefore, an in-house development solution did not align with its overall business plan and IS plan. It would be much more costly to change from the in-house development to start to implement an SAP WM solution.

SAP IM is a powerfully effective solution that provides macro-level control of inventory. Generally it works best in small facilities with low levels of inventory, simple material handling processes, and low-volume activity. SAP IM offers the benefit of seamless integration with other SAP modules. SAP WMS solution provides micro-level control of the processes, which was intended for larger, faster, more complex, high-volume operations with widespread automation and critical traceability and/or visibility needs. SAP WMS is not able to achieve the seamless integration that the SAP IM is capable of. SAP WMS can also operate as a stand-alone decentralised system that is independent of a central ES. The benefit of decentralised system is that down time on the core system will not affect the WMS. It also allows leveraging new SAP releases even if the core system is on an older release. Moreover, additional warehouses can be added into the system without affecting the core system. Functionality wise, SAP WMS provides control of the processes involved in moving materials with a warehousing and storage facility, as well as a real-time view of inventory based on its actually physical movement. It goes deeper into the supply chain to enable granular traceability and control. Another option was to implement Lean WM that requires fewer configurations than full warehouse management, yet still reduces the number of steps in the process by enabling warehouse personnel to use transfer orders as pick lists. Lean warehouse management, however, does not provide inventory management functionality beyond the storage location level, and it lacks other optimisation opportunities such as additional strategies and options for picking, packing, and bin-level accuracy. Lean WMS runs on SD and does not require configuring the full WM module for it to work.

After defining its current and future operational processes requirements and associated resources needs, an IM solution was quickly dropped out due to the following reasons:

1. Brewery is running a complex and high-volume distribution operation where SAP IM is not designed to suitable for this capacity. Its functionality is limited to simple material handling processes.
2. Brewery was going to continuously improve its warehouse management that required a powerful system to accommodate newly introduced operation like bulk pick, new KPI reporting etc. All these required a system to provide micro-level control of material movement.
3. Retail depots have no Warehouse Management functionality. Lean WM had not been implemented within retail due to resources. It has not been deemed by

the business to have a high enough priority so the IT resources have been assigned to more strategically important projects. Despite that, lean WM system was considered to be implemented at retail depots the next year as part of Brewery's IS plan. Implementing SAP WM allowed Brewery to require less effort to configure lean WM and integrate lean WM system better.

4. Moreover, there was a concern whether lean WM system was able to fit the operation requirement at the retail depots. Implementing WM system allowed Brewery great flexibility if Brewery decided to drop the plan of implementing lean WM and extend the WMS to retail depots.
5. Although implementing IM requires less resources and training needs, cost was not a top agenda and major concern for Brewery.

Implementing lean WM within its mother depot had its advantage that it could be quickly spread the implementation towards the retail depots. The overall cost without major development could be far less than a full WMS. Lean WMS was dropped out finally due to the major concerns of its lack of feature function to accommodate complex distribution processes. With a lean WMS, Brewery had to rely on other mechanisms to conduct complex statistics report and manage its distribution processes or even changing some of its innovative processes which was not plausible for Brewery's warehouse management.

Furthermore, during the decision making process for selecting suitable solution for wine and sprit operation, Brewery realised that if the wine and sprit operation would be properly solved, it would have great impact on the warehouse management process.

Therefore, Brewery went through a process to see if adopting WMS would also generate benefit for any existing unsolved business needs and any conceivable future business needs relating to warehouse management. By doing so, Brewery conducted a two stage review. In the first stage, all existing business change requests were brought together and identified whether they would be supported by the new WMS. The first stage review outlined a number of existing change requests that could be solved by the SAP WMS which included bulk pick operation and discrepancy management etc. Estimated cost and impact were also assessed. This helped Brewery to prioritise the system change tasks for supporting existing business change request and make its IT plan. The second review was to assess the built-in capacity of WMS to seek any opportunity for future business improvement and discover potential business needs in the future. One of the issues came out of the second stage review was the support of local depot warehouse management. The implementation of SAP WMS made it possible to support local depots' distribution processes by either expanding the WMS to local depots or adopting the lean WMS.

A project team overall comprised 6 staff from business solution (IT department), 6 from sales department and warehouse who were involved in testing and developing training materials. Two consultants with background of ABAP programming were also employed for the upgrading project. The SAP WMS went live within 6 months in June 2002. As the SAP WMS was developed for as-is operational environment, the upgrading to SAP WMS actually had little knock on effect.

| | |
|---|---|
| Business context | Replace legacy warehouse system for mother depot<br>Improve business efficiency of warehouse management for wine and spirit operati |

| | | | | | |
|---|---|---|---|---|---|
| | on<br>Allow flexibility to introduce new operation in the future | | | | |
| Nature of business change<br>*Level* | *Strategic* | | | | |
| Technical context | OPUS, a DOS based warehouse management system<br>Interface between OPUS and SAP<br>SAP SD | | | | |
| Adaptation tactics | Technical banking | Technical workaround | Technical workaround | Technical banking | Technical adaptation |
| Solution (adaptation activities) | System extension<br>Acquire full WM in the mother depot | System extension<br>Acquire lean WMS in the mother depot | System extension<br>Acquire SAP IM | System extension<br>Acquire full WMS across all distribution function | System extension<br>Developing as-is solution in house based on SD module |
| Cost (Time) | 6 months | Estimated around 3 months | Estimated around 3 months | Estimated around 12 months | Estimated around 10 months |
| Cost (Monetary) | High | Low | Low | Very high | Medium |
| Human resource required/involved | 6 IT staff<br>6 sales dept staff<br>2 consultants | Less staff from IT and business functions<br>Less consultants | Less staff from IT and business functions<br>Less consultants | More staff from IT and business functions<br>More external consultants | 5-6 IT staff<br>5-6 staff from the business<br>2 consultants |
| Effectiveness | Better traceability and control<br>Little disruption<br>Business needs fully achieved<br>No seamless integration | Better traceability<br>Business needs not fully achieved<br>May change some innovative processes<br>Rely on other mechanisms for reporting and managing the distribution<br>No inventory management functionality<br>Cannot support all business needs at the main warehouse<br>No seamless integration | Not suitable for high volume activity and complex material handling<br>Business needs not fully achieved<br>Seamless integration | Better traceability<br>Business needs fully achieved<br>No seamless integration | Business needs fully achievable<br>Integration could be a problem |

| | | | | | |
|---|---|---|---|---|---|
| Implication | Stand along system so the down time of the core system will not affect the WM<br>Can add additional warehouse without affect the core<br>Allow future enhancement and extension for business changes<br>Require less effort to configure lean WMS at retail depots in the future | Constraint on future operation<br>Can quickly spread to the retail depots | No implication on system maintenance<br>Lack of extensibility to support future business needs | Stand along system so the down time of the core system will not affect the WM<br>Can add additional warehouse without affect the core<br>Allow future enhancement and extension for business changes | Constraint on future operation<br>Not align with the overall business plan and IS plan |

**Table 38 A summary of replacing legacy warehouse management system (Case Brewery 1)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Full WMS in the mother depot | 4 | 3 | 4 | 10 | 4 | 25 | | 4 | 1 | 2 | 5 |
| Lean WMS in the mother depot | 7 | 7 | 7 | 7 | 0 | **28** | | | | 2 | |
| SAP IM | 7 | 7 | 7 | 4 | -1 | 24 | | | | 2 | |
| Full WM across all distribution function | 1 | 2 | 1 | 10 | 5 | 19 | | | | 3 | |
| In-house development on SD module | 2 | 5 | 4 | 10 | -2 | 19 | | | | 1 | |

**Table 39 Flexibility and risk level of adaptation for Case Brewery 1**

#### 6.4.2.2 Introducing bulk pick operation for wine and spirit operation

Wine and spirit operation was a 'mothered' operation, as the contract director pointed out, i.e. all stock is held in one designated depot and picked for each customers there; it is then onward shipped to a depot for delivery onto customer; single bottles as well as full cases are picked, which is a level of complexity that is not handled at local depots; individual bottles of wine and/or spirits will be combined into a plain brown box for customer orders and then shipped to local depots. In order to improve efficiency and accuracy, a new process – bulk pick was proposed in June 2001 that mother depot would pick some items singularly and some in partial bulk, so local depots would break down the delivery into individual orders. Due to the complexity of the operation, the wine and spirit processes did not quite fit with the operating parameters setup in the SAP and OPUS for a normal depot site.

Although this proposal received great support from the contract director and other senior management, Brewery decided not to pursue this proposal until a later stage. For the time being, all depots had to operate by existing method. The decision to ***procrastinate*** the operational change was due to following reasons:

1. The existing warehouse management system – OPUS was obsolete and inflexible to support new operational need;
2. The support from the software vendor of OPUS was very poor as the vendor of OPUS did not have the knowledge in house;
3. The new SAP based WMS was planed to be implemented at the beginning of year 2002. It would enable Brewery to build a new SAP solution within the new WMS to facilitate different type of picking operation;
4. A standard and consistent platform of SAP was more welcomed by Brewery, as the risks and cost of interfacing other systems are limited, and so as of the future maintenance;

5. Brewery not only had well experienced staff in distribution operation, also had very well trained IT staff for the SAP system.

The bulk pick project started right after the completion of the new WMS. Bulk pick programme development is a ***technical adaptation*** and was seen as a part of WMS in fact. It was just changing how the packing program worked in order to facilitate different type of working. It was a 6 month project and went live in September 2003. A project team from business solution (IT department) and stock experts was established to look at the business case and feasibility, followed by an implementation group which handled both the systems changes from an IT perspective and training roll-out for new processes.

Brewery went through 4 stages as guided by SAP methodology: blue printing the solution, testing and the business simulation, training and roll-out. Although bulk pick project was not viewed technically as a significant piece of work, it had lots of implication on retail depots and caused a lots of change management issues. It is because the change of the packing process had shifted a lot of responsibilities from the mother depot to the retail depot; retail depots are not onward shipping depots only but also depots to check the delivery from the mother depot, break it down to individual orders and label them up, which requires a lot of buy-in from the retail depot. One of the business solution managers pointed out that "the upgrading to new WMS actually didn't affect the way of working at retail depot as it is still operating as before; big change was bulk pick because it offered us a new way of working which affected our retail depots".

| | | |
|---|---|---|
| Business context | Introduce bulk pick operation in the mother depot | |
| Nature of business change<br>*Level* | *Operational* | |
| Technical context | OPUS (legacy WMS)<br>SAP WMS to be implemented | |
| Adaptation tactics | Inaction | Procrastination / Technical adaptation |
| Solution (adaptation activities) | Inaction / waiting for the completion of new SAP WMS | System tailoring<br>Workflow programming developed in house based on SAP WMS |
| Cost (Time) | 8 months in waiting | (Procrastination 8 months)<br>6 months |
| Cost (Monetary) | None | Medium |
| Human resource required/involved | None | 3 IT staff |
| Effectiveness | Business needs not achieved | Business needs fully satisfied |
| Implication | OPUS is not able to interface with new WMS.<br>Lack of support for OPUS vendor | Little implication on system maintenance |

**Table 40 A summary of developing bulk pick operation (Case Brewery 2)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Inaction | 10 | 10 | 10 | 3 | -4 | **29** | | 2 | 2 | 1 | 3 |
| Procrastination/ In-house development | 2<br>(6)[2] | 5 | 7 | 10 | -1 | 23<br>(27)[2] | | | 2 | 1 | |

**Table 41 Flexibility and risk level of adaptation for Case Brewery 2**

### 6.4.2.3 Improving KPI reporting application for supply chain management

Brewery wanted to improve the way of measuring KPIs (Key Performance Indicators) using data in the SAP. Brewery had legacy system called GATS, which was fed from the SAP ERP suite, came out with some statistics and KPI report, which actually weren't accurate because the way of interpreting the information had lots of fundamental flaws. The information GATS wanted wasn't the same as the SAP system collected.

Brewery did not opt for modifying the GATS, as it was not their system and Brewery had no expert to read the code to understand the system. Moreover a standard consistent SAP platform was advocated as the group's IT strategy. Brewery decided to have an SAP solution build upon the SAP business warehouse suite that took information directly out of SAP, which was much more accurate and more detailed and much better management information. Business warehouse suite was a ***technical adaptation*** approach and selecting it was based on the fact that SAP ERP is good for day-to-day operational reporting, while as for management information reporting, SAP business warehouse is the solution. Beside the advantage of using BW for management information reporting, building the KPI reporting on SAP ERP could slow down the operation at other heavy processing business functions e.g. telesales, especially at the end of financial period.

Although Brewery had the SAP business warehouse for a long time (it went live at the same time as the SAP system), an SAP system solution for supply chain KPI reporting was left behind. Being a big organisation, Brewery had its own IT planning. New system development projects had to be prioritised due to the criticality of the organisational needs and resource availability. GATS had been the only tool that the depots had been using for a long time and feel comfortable with, although GATS did not produce accurate report for the supply chain management, developing a new reporting application to replace it was not viewed as emergent. Moreover, the IT department considered that developing this application had to align with the overall IT/IS plan due to limited resource available within the organisation. The development was ***procrastinated*** and started in May 2003. A specific outbound service level cube was built where KPI reports were generated.

Brewery went through a long and painful process to get rid of GATS reporting. The development took a year to complete and involved three staff; one from the business, one from the business solutions team, and one external consultant. It was because the build-in logic was agreed definition with the business and also the customers. Furthermore, the culture shift was the difficult part of the process, because the staff knew and understood it and all the operational functions were comfortable with GATS reporting. "They had a lot of faith in GATS rightly or wrongly", as the business solution manager pointed out. This sort of culture shift move using that type of information opposed to what operational functions already knew took some time. The contract director indicated that "… as this had been the 'gospel' in terms of reporting and information for many years, it was a slow process to wean people off that reporting tool and onto the new one". The new reporting system, being more accurate was portraying performance in a less favourable light than GATS, and so obviously was not popular to begin with, and the results were heavily challenged.

| | |
|---|---|
| Business context | Improve the way of measuring KPIs |
| Nature of business change<br><br>*Level* | <br><br>*Operational* |
| Technical context | GATS (legacy system)<br>SAP ERP suite<br>SAP Business Warehouse<br>SAP standard platform advocated |

| | KPI reporting not prioritised as emergent | | |
|---|---|---|---|
| Adaptation tactics | Inaction | Procrastination/ Technical adaptation | Procrastination/ Technical workaround |
| Solution (adaptation activities) | Inaction / to be align with IS planning | System extension<br>Developing a KPI reporting application in-house based on SAP business warehouse | System extension<br>Developing a KPI reporting application in-house based on SAP ERP |
| Cost (Time) | None | 12 months (Procrastination 12 months) | Estimated around 12 months (Procrastination 12 months) |
| Cost (Monetary) | None | Medium | Medium |
| Human resource required/involved | None | 1 staff from the business<br>1 IT staff<br>1 external consultant | 1 staff from the business<br>1 IT staff<br>1 external consultant |
| Effectiveness | Inaccurate KPI reports<br>End users feel more comfortable of using the legacy application | Business needs fully achieved | Business requirement is partially achieved |
| Implication | Maintenance on GATs is a problem | None | Slow down the operation at other processing heavy business functions |

**Table 42 A summary of developing SCM KPI reporting (Case Brewery 3)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Inaction | 10 | 10 | 10 | 3 | -3 | **30** | | 2 | 4 | 1 | 2 |
| Procrastination/ In-house development on SAP BW | 1 (3)[2] | 5 | 8 | 10 | 0 | **24 (26)[2]** | | | 3 | 3 | |
| Procrastination/ In house development on SAP ERP | 1 (3)[2] | 5 | 8 | 7 | -2 | 19 (21)[2] | | | 3 | 3 | |

**Table 43 Flexibility and risk level of adaptation for Case Brewery 3**

### 6.4.2.4 New supplier performance report

Brewery takes products from other brewers into its distribution network for onward delivery to pub companies and retail chains. A major customer wanted Brewery to report on supplier performance that show whether the supplier was failed on delivery into Brewery's depots and a link between that, and where Brewery's depots fail to deliver to their outlets. It was a contractual requirement, but the detail of that was not specified. The aim of the report was to identify a chain of events of supply delivery failure. The report would help the customer company to identify these suppliers which were actually their suppliers, who failed on delivery, and manage them accordingly.

The original request came in around August 2003. The contract director indicated "... it sounds a reasonable request; but it seemed to be struggling immensely to connect it all together in a usable way; get this information out in a user-friendly format has been impossible". The analysis conducted by Brewery IT department revealed that rather to adapt their own SAP system, it would be ideal to adopt a ***technical adaptation*** solution that it would be to have its suppliers' system setup in the exact same way of its customer's setup in that the suppliers' system would have a delivery time window setup, so that Brewery could access that information online and go to POD (Proof of Delivery) to close purchase orders. However, the complication of delivery (each supplier delivers into 15 of Brewery's depots and each delivery has a different data and time) was not supported by the suppliers' systems. The information recorded in Brewery's SAP system was the date of raising purchasing orders and good receipt time which always lagged behind the actual delivery time. Moreover, it could also lead to some alteration on Brewery's own SAP system. An alternative ***technical adaptation*** solution proposed was to bespoke the transaction to record actual arrival time.

Technically it was not a big piece of work. However it would require extra staff to input these data into the SAP system. The project was not prioritised as the IT steering committee decided to look at the cost and consider if it was really worth that amount of money, or ask the customer to make contribution towards that.

The IT department opted for a ***business workaround*** solution to meet this customer contractual requirement. Some manual intervention was involved, where making calls to the depot to inquire the date and time of delivery. Although the report was not so accurate, Brewery managed to comply with this contractual requirement as it was not specified. However, the customer became very irritate as Brewery failed or procrastinate to delivery quality report for this requirement. The contract director commented "that report now shows some intrinsic problem; how we track our products through supply chain, which is pretty major issue to be discovered; I think we actually missed an opportunity that not just fulfil the customer need but pick up something could be much more beneficial for our own business as well".

| | | | |
|---|---|---|---|
| Business context | A major customer wanted Brewery to report on supplier performance<br>Not regarded as an critical request | | |
| Nature of business change<br>*Level* | <br>*Operational* | | |
| Technical context | SAP SD and WMS | | |
| Adaptation tactics | Business workaround | Technical adaptation | Technical adaptation |
| Solution (adaptation activities) | Manual intervention<br>Record date and time of delivery manually | System tailoring<br>Setup the supplier's system in the exact same way of Brewery's customer's system<br>Brewery's SAP mi | System tailoring<br>In-house development (bespoke the transaction)<br>Report development |

| | | | |
|---|---|---|---|
| | | ght need to be altered. | |
| Cost (Time) | 2 weeks | Very long | 3 months (E) |
| Cost (Monetary) | Small cost on internal training / instruction | Suppliers had to bear high cost of reconfiguration / redevelopment of their own system<br>Brewery had to bear high cost of reconfiguration / redevelopment of its SAP system. | Medium |
| Human resource required/involved | 1 IT staff<br>1 managerial staff from the warehouse | 1 senior manager needs to be involved in communicating between the suppliers and the customers | 2 IT staff<br>1 managerial staff from the warehouse |
| Effectiveness | Inaccurate report<br>Irritate customers<br>Business needs not achieved<br>Extra admin work required | Accurate report<br>Business needs fully achieved<br>Satisfied customers | Business needs fully achieved<br>Some extra admin work required<br>Satisfied customer<br>Business operation efficiency compromised |
| Implication | Irritated customer | Need to maintain the link between suppliers' systems and the customer's system | Minimal maintenance work required |

**Table 44 A summary of developing supplier performance report (Case Brewery 4)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. Level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Business workaround | 9 | 9 | 9 | 5 | -2 | 30 | | 4 | 4 | 1 | 2 |
| Re-setup supplier's system | 2 | 10 | 6 | 10 | -2 | 26 | | | | 2 | |
| In house development | 6 | 5 | 7 | 10 | -1 | 27 | | | | 2 | |

**Table 45 Flexibility and risk level of adaptation for Case Brewery 4**

#### 6.4.2.5 Change of discrepancy management process

There was a process change in terms of how stock loss is attributed to a particular depot opposed to another one, if there is a movement between two. Previously, for example, if wine and spirit products left the Birmingham depot and go to the London depot, the London depot would blind book it and assume everything is OK; any loss at London happened would appear on London budget; then the London depot sends cross charge back to Birmingham depot, which was mutually agreed; therefore, the cost of that loss would automatically go to Birmingham even it was not their fault. "Clearly it was not logical", commented the contract director.

An improved discrepancy management solution was proposed. It involves changing the retail depot's operational processes and amending the mutual agreement between the mother depot and retail depot; the retail depot would check the stock transaction order (STO) delivered from the mother depot and took in what they are received if the delivery is correct; if not the cost of loss would send back to the mother depot.

Although the sketch of the proposal came in quite early in 2002, it was ***procrastinated*** due to following reasons:

1. the logic of discrepancy management was established on the processes of distribution. The business solution team realised that because the bulk pick project would change a lot of the operation of distribution, the discrepancy management change had to be procrastinated until the bulk pick project was successfully realised;

2. the discrepancy management change would require a system solution that would be build upon the WMS and bulk pick programme. None of both were finished at that point.

The project started in March 2003 and had not finished by the last visit by the researcher. It was estimated to complete the project within 6 months. The project involved the same team of bulk pick project, and the national inventory team in each region were used to help to develop the processes associated with and communication and setup a logical agreement between depots.

| | | |
|---|---|---|
| Business context | Improving discrepancy management<br>The logic of discrepancy management was not clear due to the change of distribution processes | |
| Nature of business change<br>*Level* | *Operational* | |
| Technical context | SAP WMS, SD<br>A new bulk pick solution to be implemented | |
| Adaptation tactics | Inaction / waiting for the realisation of WMS and bulk pick module | Procrastination / Technical adaptation |
| Solution (adaptation activities) | Inaction | System tailoring<br>In house workflow development |
| Cost (Time) | None | (E) 6 months<br>(Procrastination 12 months) |
| Cost (Monetary) | None | (E) Medium |
| Human resource required/involved | None | (E) 3 IS staff and National inventory team |
| Effectiveness | Business needs not achieved<br>Business logic criticised by end users and management team | (E) business needs fully achieved<br>Business efficiency improved |
| Implication | None | Some maintenance work required when system upgrades or extends |

**Table 46 A summary of changing discrepancy management process (Case Brewery 5)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. Level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Inaction | 10 | 10 | 10 | 1 | 0 | **31** | | 1 | 2 | 1 | 1 |
| Procrastination/ In house development | 2 (5)[2] | 6 | 6 | 10 | -2 | **22 (25)[2]** | | | 2 | 3 | |

**Table 47 Flexibility and risk level of adaptation for Case Brewery 5**

#### 6.4.2.6 Introducing the packing operation for the promotional scheme

Brewery provides a variety of discount offers to its clients, e.g. buy-5-and-get-1-free. In the case of buy-5-and-get-1-free offer, if a customer bought 5 bottles of wine, the using packing programme generates two separate lines; one line of 5 bottles and the other line of 1 free stock. Therefore, picking confirmation note would show picking 6 individual bottles and put them into one box rather than pick a whole box of 6 bottles. Moreover, the bottle picking and box picking operation is operated in different areas and by different staff. There was further complication in the packing operation for commercial reasons, where some of wine and spirits were called case product that can only ordered in cases albeit each case has 6 bottles. The distribution staff would like to see a system solution that could merge purchased bottles and free bottles together and separate again in the delivery note to show purchased items and free items so that Brewery's customers could understand they are actually receiving promotions. A right system solution could improve the efficiency of packing operation immensely. The business solution manager commented "… I just did some analysis; … in one period, they picked 38,000 single bottle, but if we have the solution for this, it would be equivalent to around 7000 cases, which is much cheaper way of working; we can't realise the efficiency and productivity level without a right solution for this".

However, Brewery was unable to implement a system solution for packing operation for promotion items. It was because

1. The SAP WMS application was just completed its implementation, there were still teething problems in terms of familiarisation of the new application and also new process introduced in the mother depot and retail depot;
2. Picking confirmation program (PCK) and proof of delivery (POD) program were bespoken for as-is situation not to-be. Packing operation for promotional items was not considered during the design and development; and
3. The picking confirmation was a complicated replication through the supply chain and was not very stable. The business solution manager admitted that there was something wrong with that programme. However, because it was not a standard functionality but a bespoke application and actually one application consultant changed the code, SAP did not support the development Brewery did.

Although the IT department and the business solution team reckoned that the ideal way to solve this problem was to implement lean WMS or full WMS within the retail depot (a ***technical banking*** solution) so that the pick confirmation transaction bespoken would be taken away and move back to standard functionality which would allow the packing programme to work correctly. Nevertheless, the IT department decided to ***procrastinate*** acquiring the lean WMS or full WMS module from SAP for the retail depots due to following considerations:

1. Considering the investment on existing WMS build upon the SAP SD module, and it could meet most operational needs;

2. Considering the cost of acquiring new SAP WMS module at retail depots might not be worthwhile purely for the packing operations for promotional items;
3. Brewery at the moment was in change freeze and waiting for the pan-European platform directed by the Group. If there would be a standard WMS on the platform, Brewery could use it instead of running its own WMS system.

Instead, the IT department tried many ways of ***business workaround*** e.g. new pricing condition (showing a discounted price rather than one free bottle). But these workarounds were rejected from a commercial point of view because the sales team and the customers wanted to see a free stock not cheaper price. Therefore, a right system solution should not only satisfy the requirement from the requesting functions, also satisfy the customers and affected functions. Hence, Wine and Spirit operation still continued as-is without making any operational efficiency in the promotion area.

| | | | |
|---|---|---|---|
| Business context | Introducing the packing operation for the promotional scheme | | |
| Nature of business change<br>*Level* | *Operational* | | |
| Technical context | SAP WMS just completed<br>SAP SD<br>Picking confirmation programme is not very stable<br>Change freeze period | | |
| Adaptation tactics | Inaction/ Change freeze period | Procrastination/ Technical banking | Business workaround |
| Solution (adaptation activities) | Inaction | System extension<br>Acquire SAP WMS at retail depot<br>Remove bespoke PCK and POD programme | Business intervention<br>Change pricing condition<br>Persuasion on the sales team and the customer |
| Cost (Time) | None | Medium, 5 months | Short |
| Cost (Monetary) | None | High | Low |
| Human resource required/involved | None | 3 IS staff<br>3 staff from the busi | 1 IS staff<br>1 staff from the sale |

| | | | |
|---|---|---|---|
| | | ness | s team<br>1 senior manager |
| Effectiveness | Business needs not achieved | Business needs fully achieved | Business needs compromised<br>Unsatisfied sales team and customer |
| Implication | SAP does not support current picking confirmation programming, so it could have some problems of maintenance | Some maintenance effort required<br>More functionalities built in for future business needs | None |

**Table 48 A summary of introducing packing operation (Case Brewery 6)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. Level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Inaction | 10 | 10 | 10 | 2 | -3 | 29 | | 4 | 4 | 1 | 2 |
| Procrastination/ Acquire SAP WMS at retail depot | 1 $(6)^2$ | 3 | 6 | 10 | 2 | 22 $(27)^2$ | | | 4 | 3 | |
| Business workaround | 8 | 8 | 8 | 1 | 0 | 25 | | | 4 | 2 | |

**Table 49 Flexibility and risk level of adaptation for Case Brewery 6**

### 6.4.3 Summary of Activities of Brewery

This section presents the summary of six adaptation responses towards business needs during the post-implementation stage of ES adoption in Brewery.

| Description of business needs | Type of business needs | Tactics | Solution | Time | Cost | Human resource | Implication on business | Implication on system maintenance |
|---|---|---|---|---|---|---|---|---|
| Replace legacy warehouse system for mother depot | Strategic | Technical banking | System extension<br>Acquire full WM in the mother depot | 6 months | High | 6 IT staff<br>6 sales dept staff<br>2 consultants | Better traceability and control<br>Little disruption<br>Business needs fully achieved<br>No seamless integration | Stand along system so the down time of the core system will not affect the WM<br>Can add additional warehouse without affect the core<br>Allow future enhancement and extension for business changes<br>Require less effort to configure lean WMS at retail depots in the future |
| | | Technical workaround | System extension<br>Acquire lean WMS in the mother depot | Estimated around 3 months | Low | Less staff from IT and business functions<br>Less consultants | Better traceability<br>Business needs not fully achieved<br>May change some innovative processes<br>Rely on other mechanisms for reporting and managing the distribution<br>No inventory management functionality<br>Cannot support all business needs at the main warehouse<br>No seamless integration | Constraint on future operation<br>Can quickly spread to the retail depots |
| | | Technical workaround | System extension<br>Acquire SAP IM | Estimated around 3 months | Low | Less staff from IT and business functions<br>Less consultants | Not suitable for high volume activity and complex material handling<br>Business needs not fully achieved<br>Seamless integration | No implication on system maintenance<br>Lack of extensibility to support future business needs |
| | | Technical banking | System extension<br>Acquire full WMS across all distribution function | Estimated around 12 months | Very high | More staff from IT and business functions<br>More external consultants | Better traceability<br>Business needs fully achieved<br>No seamless integration | Stand along system so the down time of the core system will not affect the WM<br>Can add additional warehouse without affect the core<br>Allow future enhancement and extension for business changes |
| | | Technical adaptation | System extension<br>Developing as-is solution in house based on SD module | Estimated around 10 months | Medium | 5-6 IT staff<br>5-6 staff from the business<br>2 consultants | Integration could be a problem<br>Business needs fully achievable | Constraint on future operation<br>Not align with the overall business plan and IS plan |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Introduce bulk pick operation in the mother depot | Operational | Inaction | Inaction | 9 months | None | None | Business needs not achieved | OPUS is not be able to interface with new WMS.<br>Lack of support for OPUS vendor |
| | | Procrastination /Technical adaptation | System tailoring<br>Workflow programming developed in house based on SAP WMS | Procrastination 8 months | Medium | 3 IT staff | Some changes on business operation<br>Business needs fully satisfied | Little implication on system maintenance |
| Improve the way of measuring KPIs | Operational | Inaction | Inaction | None | None | None | Inaccurate KPI reports<br>End users feel more comfortable of using the legacy application | Maintenance on GATs is a problem |
| | | Procrastination/ Technical adaptation | System tailoring<br>Developing in-house based on SAP business warehouse | (Procrastination 12 months) | High | 1 staff from the business<br>1 IT staff<br>1 external consultant | Business needs fully achieved | None |
| | | Procrastination/ Technical workaround | System tailoring<br>Developing in-house based on SAP ERP | Estimated around 12 months (Procrastination 12 months) | High | 1 staff from the business<br>1 IT staff<br>1 external consultant | Business requirement partially achieved | Little maintenance effort required<br>Slow down the operation at other processing heavy business functions |
| New report on supplier performance | Operational | Business workaround | Manual intervention<br>Record date and time of delivery manually | 2 weeks | Small cost on internal training / instruction | 1 IT staff<br>1 managerial staff from the warehouse | Inaccurate report<br>Irritate customers<br>Business needs not achieved<br>Extra admin work required | Irritated customer |
| | | Technical adaptation | System tailoring<br>Setup the supplier's system in the exact same way of Brewery's customer's system<br>Brewery's SAP might need to be altered. | Very long | Suppliers had to bear high cost of reconfiguration / redevelopment of their own system<br>Brewery had to bear high cost of reconfiguration / redevelopment of i | 1 senior manager needs to be involved in communicating between the suppliers and the customers | Accurate report<br>Business needs fully achieved<br>Satisfied customers | Need to maintain the link between suppliers' systems and the customer's system |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | ts SAP system. | | | |
| | | Technical workaround | System tailoring<br>In-house development (bespoke the transaction) | (E) 3 months | Medium | 2 IT staff<br>1 managerial staff from the warehouse | Business needs fully achieved<br>Some extra admin work required<br>Satisfied customer<br>Business operation efficiency compromised | Minimal maintenance work required |
| Improving discrepancy management | Operational | Inaction | Inaction | None | None | None | Business needs not achieved<br>Business logic criticised by end users and management team | None |
| | | Procrastination/ Technical adaptation | System tailoring<br>In house workflow development | (E) 6 months (Procrastination 12 months) | (E) Medium | (E) 3 IS staff and National inventory team | (E) business needs fully achieved<br>Business efficiency improved | Some maintenance work required when system upgrades or extends |
| Introducing the packing operation for the promotional scheme | Operational | Inaction | Inaction | None | None | None | Business needs not achieved | SAP does not support current picking confirmation programming, so it could have some problems of maintenance |
| | | Procrastination/ Technical adaptation | System extension<br>Acquire SAP WMS at retail depot<br>Remove bespoke PCK and POD programme | Medium 5 months (procrastination time unknown) | High | 3 IS staff<br>3 staff from the business | Business needs fully achieved | Some maintenance effort required<br>More functionalities built in |
| | | Business workaround | Business intervention<br>Change pricing condition<br>Persuasion on the sales team and the customer | Shorter | Low | 1 IS staff<br>1 staff from the sales team<br>1 senior manager | Business needs compromised<br>Unsatisfied sales team and customer | None |

**Table 50 ES responses to business needs in Brewery**

## 6.5 Charity

### 6.5.1 Charity Background

Charity, founded in early 19th century, has over 180 years of history for saving lives at sea. It provides, on call, the 24-hour lifeboat search and rescue service to 50 miles out from the coast of the United Kingdom and the Republic of Ireland, and a beach lifeguard service on 57 beaches in the south west of England. There are 232 lifeboat stations strategically placed around the UK and Republic of Ireland with an active fleet of 307 lifeboats backed by a relief fleet of 113. Since it was founded, Charity has saved over 134,000 lives. Saving lives at sea costs a great deal of money. But being a charity organisation, Charity continuously relies on voluntary contributions and bequests to pay the bills. Clearly, the better the organisation becomes at fund-raising, administration, procurement and other operational activities the greater its income and the further its budgets will stretch. In the autumn of 1999, Charity decided to overhaul its information management systems as part of a broader strategy to modernise its business methods and deliver a better service within an SAP environment. Up to 1999, Charity had made extensive use of both package and in-house developed applications running on Data General equipment. However these applications were not well integrated and formal support for them was terminated at the end of 2000. There were also parts of the business that were still using paper systems.

Yet over the years Charity had grown into the equivalent of a medium-sized business, with administrative challenges to match. It employs 850 staff, with 400 people in their headquarters in south west of the UK, a further 100 at the Inshore Lifeboat Centre in middle west of the UK, 16 staff, with additional help from a varying number of part-timers, at the Fulfilment Centre and the rest spread across the country in regional offices, divisional bases and lifeboat stations. On top of this there were considerable logistics requirements geared to keeping boats and buildings in good order. What was needed was a charity-wide information system that could handle everything from monthly accounts, funds collection and individual expenses claims to sourcing spare parts and materials.

In short, Charity needed a sophisticated IT infrastructure that could look after finances, HR administration, supply chain management and every other aspect of running a countrywide organisation. It opted for an SAP environment and needed expert help to design and implement a new infrastructure. The timeframe was desperately short – a matter of months. Charity selected a major consultancy firm as its SAP implementation partner as the consultancy firm offered a broad range of services available and promised a committed long-term relationship.

Despite the complexities, with the support from the consultancy firm, Charity achieved a rapid implementation. The SAP system (version 4.5B) project went live in two phases at the beginning of April and June 2000. The Charisma system went live at the end of June 2000. However the result of the implementation was not as good as the organisation expected. Some modules even ended up reimplementation. It was because before the implementation, Charity did not have any formal documented processes, and in lots of functional areas, there were role based manual which did not really cover the whole processes. As the Business Process Project Manager commented that "it was never part of the Charity's culture to have documented processes – it was always done on trust and the way people wanted to work and people worked in their own little areas in their own little way". Due to the tight time on implementation, the business team borrowed some in the software to form their BPPs – Business Planning Processes. However, they were not agreed across all users.

The IS function consists of total 11 staff which are split into 3 teams; one team of logistics looks after MM, SD, PP and PS modules, one team looks after HR and Finance and one technical team consists 3 people. At the top level, there is the steering committee whose role is to define the forward strategy for SAP and to liaise different functions for cross-function changes. However the steering committee does not perform as well as expected, pointed out by the MIS manager. The members of the steering committee are the business owners of the modules. These business owners also normally chair their functional area user group. Within each function, the business owners authorise and approve change to their modules. The recent IS strategy is "to help the Charity in pursuit of its objectives, providing cost-effective information systems and technology".

### 6.5.2 Ongoing system changes

#### 6.5.2.1 New competence-based training scheme

Lifeboat men and women are volunteers. There is a full-time mechanic in each all-weather lifeboat crew. There are more than 4,600 volunteer crew members of Charity throughout the country, including over 300 women. Before they can go out and crew boats, all crew members have to have certain competences. Organising crew members' competence records is a massive administrative work due to the large number of crew members and the complexity of employment procedures (Charity has a peculiarity that some full-time staff might be volunteers, which causes the complication). Previously, all these records were kept on a manually basis. In year 2001, Charity decided to get some computer assistance for competence-based training (CoBT) and introduce a new competence-based training system because

1. Charity wanted to improve the management efficiency of competence-based training;
2. Charity felt that the new SAP HR system would enable them to build a new system that could exchange employee information with the HR module; and
3. Charity thought there would be some government legislation that would force them down that route.

Charity wanted a solution not only to administer the competences of staff, but also deliver the training itself. Moreover, the new solution was expected to expand to beach lifeguards and shore helpers. By a quick investigation about available solutions from SAP and third party offers, there were several options available to Charity:

1. Procrastinate and adopt standard Learning Solution from SAP;
2. Using standard SAP HR module with some manual intervention;
3. Acquiring a separate system by a system integrator partner;

4. Procrastinate until upgrading of SAP R/3 4.7 version. Because the major complication of the development was due to the multiple contracts while the adopting version SAP 4.5B did not really support that functionality.
5. Developing in house as an extension based on existing SAP HR module;
6. Developing an extension based on existing SAP HR module with a system integrator partner;

Charity wanted a closely integrated solution with its SAP HR module. When the project was initiated, SAP did not have a Leaning Solution. Charity was informed by SAP AG that the Learning Solution would come out the next year. With SAP Learning Solution would deliver knowledge throughout the organisation, with learning paths tailored to each user's knowledge needs and personal learning style. SAP Learning Solution would deliver customized, collaborative learning to employees, partners, and customers. It would enable an organisation to structure, deliver, test, and track learning information. Users can select sources, review training histories, and transfer qualifications and test results to different organizations within the company. By adopting the standard SAP Learning Solution, Charity would not be worried about the integration and interchanging data with SAP HR. Although the Leaning Solution seemed a better fit than standard SAP, it still appeared on the surface to lack some of the functions required and could not meet all its business requirements. Moreover, the SAP Learning Solution did not come cheap. An SAP Learning Solution license was estimated about £300K. Plus the cost of external support, hardware cost and internal support, the total cost would amount around £400K.

Standard SAP HR module would provide some functionality that was needed to support competence-based training by using extra fields created. It was not able to support the complication of business needs. The implemented HR module (version 4.5) did not support multiple contracts, which was one of the factors that complicated the operation. Some manual intervention was definitely required. The IS manager felt that using standard HR module with heavy manual intervention would not meet the initiative of this project which was to computerise and automate the operation of competence-based training and certainly would not meet governmental legislation in the future. Moreover, although creating some fields to record competence of staff did not require a great deal of effort, it would require considerable training across the function. The training would include not only using the standard HR module to record staff competence, and also how to input payroll, how to extract data from the HR module and analyse data and create report in Microsoft Excel etc. The SAP Applications Manager points out that "it seems pointless to do some changes in SAP and end it up with heavy manual intervention again. Our users would be happier to get trained and it could reduce their workload to some degree. Otherwise, it was more acceptable to continue using the old application."

Choosing a separate system had to weigh, on balance, the complexity of doing so. If Charity acquired a bespoken third party competence-based training solution, they probably had to replicate all of their HR data in that system, it's very unlikely that Charity was going to build links that would be complicated. In addition, that was an overhead because of double data entry, replicating information, payroll coming out of SAP etc. Charity felt that "whilst competence-based training is a complex solution in the SAP environment, separating it off into another system may be even more complicated. It might have a WYSWYG looking feel, because SAP was not the most user-friendly system, but the reality is that there were other technical complications – probably users aren't that worried about but from an IT perspective we have to be. So there's no immediate thing with that."

Charity did consider the possibility of procrastinating the development and waiting for the new version of SAP 4.7 that would support multiple contracts and positions that caused most of the problems and difficulties not only in competence-based training function and also across the whole HR function. Charity did not opt for procrastination for new version of SAP because

1. Despite Charity was informed by SAP AG of future development in SAP, Charity felt it might take a while for the new version to mature and could not guarantee to meet most of the business requirements of competence-based training;
2. Charity felt that the new governmental legislation was going to come out soon. Therefore the need for the solution was urgent;
3. There was no formal and well-defined and written business process in place before and even after the initial implementation of SAP, especially in HR function. Charity wanted to take this opportunity to consolidate its business processes in its HR function and improve efficiency and effectiveness of competence-based training scheme. Previous manual operation was regarded "sloppy" and inaccurate. Therefore, the improvement for competence-based training was planned in its 3-year IS and business plan. Although Charity had no objection that it would review the requirements against SAP 4.7 and other solution like SAP Learning Solution,

Charity was determined to automate and improve the operation for competence-based training. The IS function admitted that the future change for the adoption of new solution like SAP 4.7 and Learning Solution would be likely to have a big impact on competence-based training, and effectively would end up doing quite a lot of new work.

Developing in house as an extension based on existing SAP HR module required competent staff to undertake the development. However, Charity did lack of these staff to support development. All people who were involved in initial implementation of SAP HR module had all left Charity. The SAP Application Manager indicated "at the time of the developments, Charity did not have the maturity or staff to take on this level of development, we would not be able to develop the solution in-house and the costs would be significantly lower. Today we tend to undertake these developments using our own staff and will use contractors to backfill my team, if necessary. If contract staff are used then the costs is typically £325 per day." Therefore, Charity decided to work with a system integrator to develop an extension based on the SAP HR. The system integrator (Diagonal) selected had been provide ABAP development during the initial SAP implementation. Charity knew Diagonal had capable staff and it offered a low risk solution. Charity's own IS staff were also involved in order to acquire knowledge of system development. A bespoke competence-based training system was ABAP code and was linked to and closely integrated with SAP HR system. Competence-based training was developed with a member of the HR team actually handling processes and implementation.

The development of competence-based training took place in two stages. Phase 1 was 6 months. 2 internal staff full-time (one SAP team and one business, and around 2 months during the phase, additional user time was required) were involved. Phase 2 was 4-5 weeks, so it wasn't long development times. Again one IS staff member full time and one business user were involved in the project. The external costs were approximately 100K for both phases. The Business Process Manager commented "Generally development in SAP isn't that long. The software tools that you ride are very good. They're very mature, if you have good programming staff, development times can be quite quick."

The result of development was regarded successful. Some training for end-users on using the competence-based training was required. The Business Process Project Manager stated "... because it's bespoke code, because it impacts HR data which has to be right for things such as the payroll, the end user has to be very competent in knowing the implications of entering a date for example, if they delimit somebody and say that this person is finished being this volunteer, there may be some implications to the payroll systems – because it's integrated we can't escape that. We've had to use weightings against members of staff to say this is their primary position, this is their secondary and this is their third – effectively, they've got multiple contracts, and 4.5B doesn't really support that functionality so we've had to use work-around to try and obtain that."

| | |
|---|---|
| Business context | Improve the management efficiency of competence-based training<br>Governmental legislation pressure<br>No formal and well-defined and written business process in place before and even after the initial implementation of SAP HR |
| Nature of business change<br>*Level* | <br>*Operational* |

| Technical context | SAP HR, FI<br>SAP learning solution to be available in 12 months<br>A new version of SAP to be available in 16 months | | | | | |
|---|---|---|---|---|---|---|
| Adaptation tactics | Technical adaptation | Technical workaround | Technical adaptation | Technical adaptation | Procrastination/ Technical workaround | Procrastination/ Technical banking |
| Solution (adaptation activities) | System extension<br><br>Developing an extension based on SAP HR with the external party ERP programming | System tailoring<br><br>Creating fields on SAP HR<br>Report development | System extension<br><br>Acquiring a separate system by an external party<br>Build link between the third party solution and SAP<br>Heavy replication all HR data | System extension<br><br>Developing in house as an extension based on SAP HR | System extension<br><br>Adopt SAP Learning solution | System extension<br><br>Upgrade to SAP v4.7<br>And build a application on SAP HR |
| Cost (Time) | Long (7 months) | Very short | Long | Long | Long (Procrastination 12 months) | Medium (Procrastination 16 months) |
| Cost (Monetary) | High<br>GBP 200K | Low | High | Medium | Very high (E) GBP300K on license<br>GBP 400K overall | High |
| Human resource required/involved | 1 HR staff<br>2 IT staff<br>2 external developer | 1 IT staff<br>1 HR staff | 2 IT staff<br>2 HR staff<br>External developers | IT staff<br>HR staff | 2 IT staff<br>3 HR staff<br>1 consultant | 3 IT staff<br>3 HR staff<br>1 HR manager<br>1 consultant |
| Effectiveness | Business needs fully achieved | Business need not achieved<br>Heavy extra work load / admin required | Better screen display and user friendly<br>Business needs almost achieved<br>Double data entry | Business needs fully achieved | Lack some of the functionalities required | Might not meet the deadline of new government legislation<br>The system might not be mature enough |
| Implication | Some implication on maintenance | No implication on maintenance<br>Heavy manual intervention and increased workload<br>Would not meet governmental legislation in the future | Some maintenance effort on the link between the application and SAP<br>Integration problems | Some implication on maintenance | No integration problem<br>No implication on maintenance | Minimal maintenance<br>The new version may take time to mature<br>The new version offers more functionalities |

**Table 51 A summary of introducing new competence-based training scheme (Case Charity 1)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Develop an extension on SAP H | 3 | 3 | 5 | 10 | -1 | 20 | | 4 | 2 | 3 | 4 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R with 3rd party | | | | | | | | | | | |
| Creating fields in SAP HR | 9 | 7 | 9 | 3 | -4 | 24 | | | | 3 | |
| Acquire a separate system by a 3rd party | 3 | 3 | 8 | 8 | -3 | 19 | | | | 3 | |
| Develop in-house on SAP HR | 3 | 5 | 5 | 10 | -1 | 22 | | | | 1 | |
| Procrastinate/ acquire SAP learning solution | 1 $(2)^2$ | 1 | 5 | 7 | 0 | 14 $(15)^2$ | | | 2 | 2 | |
| Procrastinate/ Upgrade to SAP 4.7 | 1 $(1)^2$ | 3 | 4 | 8 | 3 | 19 $(19)^2$ | | | 2 | 2 | |

**Table 52 Flexibility and risk level of adaptation for Case Charity 1**

### 6.5.2.2 Introducing SAP Payroll

The HR department in Charity have diverse practices within the function. The function did not have standardised procedure within the area. The SAP Application Manager indicated that "Charity didn't have clear business processes. Many were made up during the process of the implementation, some of which were fine and correct, some of which were somewhere off the mark". There were about 6 teams within the HR function. They have all recruited people in a different way and manage their salaries in a different way. The business processes within the HR department were different from one team to another. Despite during the implementation of SAP HR module, the implementation team tried and did a gallant job of trying to standardise the processes, the reality was that they had such different procedures across the department. The implementation of SAP HR was regarded as "imperfection" and "failure", pointed out by the Business Process Manager, which caused problems in the introduction of Payroll application.

Charity has two international payrolls effectively including payroll for the United Kingdom and the Republic of Ireland, which has an important distinction in locations and currency etc. Previously Charity did not do payroll in-house. The payroll function is outsourced and Charity had a UK and an Irish external third party providers for payroll function and conducting the payroll. The problems, particular with the Irish payroll, were there was not "so much necessarily" a system that actually processes around it. The external payroll service provider took data and specific formats, and ship payslips back to Charity. Moreover, the external service provider had an old DOS-based system and Charity's payroll staff could not get the interface to SAP system to work. Charity had to send the payroll work down the line to the external service provider. Therefore, there was a security problem that some of the communication between the external company and Charity broke down and packages were lost and damaged. The experience of using the external third party provider was "dreadful", as described by the Business Process Manager. Moreover, the problems in payroll operation also affect the efficiency of business operation in other areas. Therefore, it was quickly that Charity decided to bring the payroll function in-house.

Subsequently Charity decided to use SAP Payroll to pay UK and Irish staff. The project was planned to be initiated in 2000 for UK part and in 2001 for Irish part after the implementation of SAP HR. One approach was certainly use SAP payroll. The other one was to find a third party solution to support UK and Irish payroll function. However it was quickly dropped as Charity was licensed to use the Payroll functionality and it did not make any cost effective sense to look at third party solutions. However, when Payroll was being implemented, it was discovered very quickly that the HR system – and the data in the HR system in particular – was not up to date and was not accurate. Charity found that they were unable to pay people effectively because of the inaccuracy of data. The major issue highlighted was the quality of data of HR which led to a further project to improve the HR system. Problems also occurred in other functional areas in the HR department. Therefore, Charity decided to put on hold the implementation of SAP Payroll and instead launch a "getting well" programme which led to a nearly re-implementation of SAP HR. One of the key programmes was to tighten up the procedures in the HR function, which had received lots of resistance from the HR function during the original implementation previously. The HR staff did not actually buy into it and put lots of resource to it. So the data got more and more out of date.

The "getting well" programme was a continuous project. It was not only an IT project but a project of management practice. All business processes in the HR department were being standardised, so there could be a consistency of business operation across the HR function. It did improve the quality of data and data consistency. It took more than four months to literally shut down the HR department, tighten up procedures in HR and fix some information in the system. Then Charity reassessed the condition of implementing SAP Payroll and gave a go-ahead for the SAP Payroll.

The SAP Payroll implementation was contracted out to external consultancy firm as Charity did not have any in-house expertise as all key users had left. Besides the external consultants, the payroll team comprises 3 staff from HR and 2 IT staff from IT. For the UK payroll, it did not take that long. It was a few weeks to get it up and running as the "getting well" programme was more effective. The Irish took a lot longer. Primarily, the data in the system was very poor by the time of doing it. So with SAP Payroll, it has problem with the data already existed on the system. There had been a big data cleaning exercise. It took 9 months for Irish payroll from getting it to the point where it worked perfectly. Another reason was because there were not lots of people working full time on it.

The SAP Application Manager indicated "because the poor initial implementation of SAP HR and data cleanup, it impacts significantly. If you were just a new customer, and just install HR and UK and Irish payroll, you had a team with it, you would achieve it significantly quicker and less costly." He furthered "without re-implementing the SAP HR, we can never achieve that. The implementation of SAP Payroll would certainly take longer because of different ways of business practice across the HR department. It could end up a chaos later on especially we want to add more functionalities that are HR related due to dirty data accumulated over the time."

| | | | |
|---|---|---|---|
| Business context | Improve UK and Irish payroll operation<br>Bring payroll function in house<br>No standardised procedure and processes in HR | | |
| Nature of business change<br>*Level* | *Operational* | | |
| Technical context | SAP HR<br>SAP HR implementation was not successful<br>Poor quality of HR data<br>External DOS based system held by third party Payroll service provider<br>"Getting well" programme | | |
| Adaptation tactics | Inaction | Procrastination/ Technical adaptation | Procrastination/ Technical adaptation |
| Solution (adaptation ac | Inaction<br>Waiting for the comp | System extension<br>Implement SAP Pa | System extension<br>Implement third pa |

| | | | |
|---|---|---|---|
| tivities) | letion of the getting-well programme | yroll | rty solution of payroll |
| Cost (Time) | None | Very Long<br>4 weeks (UK payroll)<br>9 months (Irish payroll)<br>(Procrastination 12 months) | Very Long<br>(Procrastination 12 months) |
| Cost (Monetary) | None | Medium | High |
| Human resource required/involved | None | 2 IT staff<br>3 HR staff | 2 IT staff<br>3 HR staff |
| Effectiveness | Business needs not achieved | Business needs fully achieved | Business needs fully achieved |
| Implication | None<br>The poor payroll operation could affect the business operation in other areas | Minimal maintenance effort | Some maintenance effort required |

**Table 53 A summary of implementing payroll (Case Charity 2)**

| | Flexibility measurement | | | | | | | Risk level | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time | Cost | HR | Effective-ness | Implica-tion | Flex. Level | | Urg. | Financial strength | Expertise Availability | Crit. |
| Inaction | 10 | 10 | 10 | 1 | -5 | **26** | | 3 | 2 | 1 | 4 |
| Procrastination/ Implement SAP payroll | 1 $(3)^2$ | 6 | 7 | 10 | 0 | **24** **$(26)^2$** | | | 2 | 2 | |
| Procrastination/ 3rd party payroll solution | 1 $(2)^2$ | 3 | 7 | 10 | -2 | 19 $(20)^2$ | | | 2 | 2 | |

**Table 54 Flexibility and risk level of adaptation for Case Charity 2**

### 6.5.3 Summary of Activities of Charity

This section presents the summary of two adaptation response towards business needs during the post-implementation stage of ES adoption in Charity.

| Description of business needs | Type of business needs | Tactics | Solution | Time | Cost | Human resource | Implication on business | Implication on system maintenance |
|---|---|---|---|---|---|---|---|---|
| Improve the management efficiency of competence-based training | Operational | Technical adaptation | System extension<br>Developing an extension based on SAP HR with the external party<br>ERP programming | Long (7 months | High<br>GBP 200K | 1 HR staff<br>2 IT staff<br>2 external developer | Business needs fully achieved | Some implication on maintenance |
| | | Technical workaround | System tailoring<br>Creating fields on SAP HR<br>Manual input | Very short | Low | 1 IT staff<br>1 HR staff | Business need not achieved<br>Heavy extra work load / admin required | No implication on maintenance<br>Heavy manual intervention and increased workload Would not meet governmental legislation in the future |
| | | Technical adaptation | System extension<br>Acquiring a separate system by an external party<br>Build link between the third party solution and SAP<br>Replicate all HR data | Long | High | 2 IT staff<br>2 HR staff<br>External developers | Better screen display and user friendly<br>Business needs almost achieved<br>Double data entry | Some maintenance effort on the link between the application and SAP<br>Integration problems |
| | | Technical adaptation | System extension<br>Developing in house as an extension based on SAP HR | Long | Medium | IT staff<br>HR staff | Business needs fully achieved | Some implication on maintenance |
| | | Procrastination/Technical workaround | System extension<br>Adopt SAP Learning solution | Long (Procrastination 12 months) | Very high (E) GBP300K on license<br>GBP 400K overall | 2 IT staff<br>3 HR staff<br>1 consultant | Lack some of the functionalities required | No integration problem<br>No implication on maintenance |
| | | Procrastination/ Technical banking | System extension<br>Upgrade to SAP v4.7<br>And build a application on SAP HR | Medium (Procrastination 16 months) | High | 3 IT staff<br>3 HR staff<br>1 HR manager<br>1 consultant | Might not meet the deadline of new government legislation<br>The system might not be mature enough | Minimal maintenance<br>The new version may take time to mature<br>The new version offers more functionalities |
| Improve UK and Irish payroll operation | Operational | Inaction | Inaction<br>Waiting for the completion of the getting-well programme | None | None | None | Business needs not achieved | None<br>The poor payroll operation could affect the business operation in other areas |
| | | Procrastination/ Technical adaptation | System extension<br>Implement SAP Payroll | Very Long<br>4 weeks (UK payroll)<br>9 months (Irish payroll)<br>(Procrastination 12 mon | Medium | 2 IT staff<br>3 HR staff | Business needs fully achieved | Minimal maintenance effort |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | ths) | | | | |
| | | Procrastination/ Technical adaptation | System extension Implement third party solution of payroll | Very Long (Procrastination 12 months) | High | 2 IT staff<br>3 HR staff | Business needs fully achieved | Some maintenance effort required |

**Table 55 ES responses to business needs in Charity**

## 6.6 Summary

In this chapter, a model of tactical ES adaptation for ongoing business changes has been developed from three organisations' ES post-implementation experiences. This model presents the process of how organisations use their adopting ESs to support ongoing business changes. The following table presents the summary of all 15 adaptation responses towards business needs during the post-implementation stage of ES adoption in the three organisations investigated. In this table, key concepts and measurement of flexibility and risk are presented in a summarised format. The next Chapter will present the findings and discussions based on the evidences found in the multiple case studies.

<table>
<tr><th rowspan="2">CASE</th><th rowspan="2">Details of adaptation activities</th><th rowspan="2">Major adaptation activities on ES</th><th>TC</th><th>AD</th><th colspan="6">Flexibility measurement</th><th rowspan="2"></th><th colspan="4">Risk level</th></tr>
<tr><th></th><th></th><th>TI</th><th>CO</th><th>HR</th><th>EF</th><th>IM</th><th>FL</th><th>UR</th><th>FS</th><th>EA</th><th>CR</th></tr>
<tr><td rowspan="2">Case Machine 1<br>Establishing cost centre</td><td>Minor reconfiguration<br>No conversion of historical data<br>Minimal report adaptation on existing reports and built-in reports</td><td>Reconfiguration<br>Report development</td><td>TA</td><td>Sep<br>ST</td><td>9</td><td>8</td><td>5</td><td>9</td><td>0</td><td>31</td><td rowspan="8"></td><td rowspan="2">3</td><td rowspan="2">2</td><td>2</td><td rowspan="2">4</td></tr>
<tr><td>Creating substantially new accounts for new costing units in the configuration table<br>Report adaptation on existing reports<br>New reports development</td><td>Reconfiguration<br>Report development</td><td>TW</td><td>ST</td><td>8</td><td>9</td><td>8</td><td>4</td><td>-1</td><td>28</td><td>1</td></tr>
<tr><td rowspan="2">Case Machine 2<br>Changing the fix asset depreciation rate</td><td>Reconfiguration<br>Adjusting accounting figures accordingly</td><td>Reconfiguration</td><td>TA</td><td>Sep</td><td>8</td><td>7</td><td>7</td><td>10</td><td>0</td><td>32</td><td rowspan="2">4</td><td rowspan="2">4</td><td>3</td><td rowspan="2">3</td></tr>
<tr><td>Amending accounting figures manually</td><td>/</td><td>BA</td><td>/</td><td>7</td><td>8</td><td>8</td><td>5</td><td>-2</td><td>26</td><td>2</td></tr>
<tr><td>Case Machine 3<br>Organisational restructuring</td><td>Heavy configuration<br>Configuration for the manufacturing company the same way as before<br>New configuration for the retail company<br>Heavy report development and adaptation<br>Screen adjustment</td><td>Reconfiguration<br>Report development<br>Screen adjustment</td><td>TA</td><td>Sep<br>ST</td><td>4</td><td>5</td><td>3</td><td>8</td><td>0</td><td>20</td><td>4</td><td>1</td><td>1</td><td>5</td></tr>
<tr><td rowspan="3">Case Machine 4<br>Improving IQC</td><td>Engage a third party consultancy firm to develop a bespoke program based on SAP MM</td><td>ERP secondary development</td><td>TA</td><td>ST</td><td>8</td><td>5</td><td>7</td><td>10</td><td>-2</td><td>28</td><td rowspan="3">3</td><td rowspan="3">4</td><td>4</td><td rowspan="3">3</td></tr>
<tr><td>Implement SAP QM</td><td>Implement a vendor solution</td><td>TB</td><td>SEt</td><td>5</td><td>1</td><td>2</td><td>10</td><td>2</td><td>20</td><td>2</td></tr>
<tr><td>Implement 3rd party bolt-on solution</td><td>Implementing a 3rd party solution</td><td>TW</td><td>SEt</td><td>8</td><td>5</td><td>6</td><td>6</td><td>-4</td><td>21</td><td>2</td></tr>
</table>

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case Machine 5 New inventory report | Export data into spreadsheet | / | BA | / | 10 | 8 | 8 | 5 | -3 | **28** | | 1 | 4 | 2 | 1 |
| | Procrastination/ Minor configuration Report adaptation | Reconfiguration Report development | PN TA | SEp ST | 4 (6) | 6 | 6 | 10 | 0 | 26 (28) | | | 4 | 3 | |
| Case Machine 6 Introducing depreciation preparation | Manually adjust figures in the fixed asset module | / | BA | / | 10 | 6 | 9 | 2 | -3 | **24** | | 3 | 4 | 2 | 3 |
| Case Machine 7 Automating invoicing | Manual input VAT number into SAP system. | / | BA | / | 10 | 8 | 9 | 4 | 0 | **31** | | 3 | 3 | 1 | 3 |
| | Procrastination/ Replace current invoicing software with a new one Create interface between SAP and the invoicing software | Implement a 3rd party solution | PN TA | SEt | 3 (7) | 6 | 7 | 10 | -2 | 24 (28) | | | 4 | 1 | |
| | Procrastination/ Upgrade SAP FI with new patches on invoicing | Legal patch upgrade | PN TA | SEp | 3 (8) | 8 | 7 | 10 | 2 | **30 (35)** | | | | 1 | |
| Case Brewery 1 Replacing WMS | Acquire full WM in the mother depot | Implement a vendor solution | TB | SEt | 4 | 3 | 4 | 10 | 4 | 25 | | 4 | 1 | 2 | 5 |
| | Acquire lean WMS in the mother depot | Implement a vendor solution | TW | SEt | 7 | 7 | 7 | 7 | 0 | **28** | | | | 2 | |
| | Acquire SAP IM | Implement a vendor solution | TW | SEt | 7 | 7 | 7 | 4 | -1 | 24 | | | | 2 | |
| | Acquire full WMS across all distribution function | Implement a vendor solution | TB | SEt | 1 | 2 | 1 | 10 | 5 | 19 | | | | 3 | |
| | Developing as-is solution in house based on SD module | ERP secondary development | TA | SEt | 2 | 5 | 4 | 10 | -2 | 19 | | | | 1 | |
| Case Brewery 2 Bulk pick operation | Inaction / waiting for the completion of new SAP WMS | / | IA | / | 10 | 10 | 10 | 3 | -4 | **29** | | 2 | 2 | 1 | 3 |
| | Procrastination/ Workflow programming developed in house based on SAP WMS | ERP secondary development | PN TA | ST | 2 (6) | 5 | 7 | 10 | -1 | 23 (27) | | | 2 | 1 | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case Brewery 3<br>KPI reporting | Inaction / to be align with IS planning | / | IA | / | 10 | 10 | 10 | 3 | -3 | **30** | | 2 | 4 | 1 | 2 |
| | Procrastination/<br>Developing a KPI reporting application in-house based on SAP business warehouse | ERP secondary development<br>Report development | PN<br>TA | SEt | 1 (3) | 5 | 8 | 10 | 0 | **24 (26)** | | | 3 | 3 | |
| | Procrastination/<br>Developing a KPI reporting application in-house based on SAP ERP | ERP secondary development<br>Report development | PN<br>TW | SEt | 1 (3) | 5 | 8 | 7 | -2 | 19 (21) | | | 3 | 3 | |
| Case Brewery 4<br>Supplier performance report | Record date and time of delivery manually | / | BA | / | 9 | 9 | 9 | 5 | -2 | **30** | | 4 | 4 | 1 | 2 |
| | Setup the supplier's system in the exact same way of Brewery's customer's system Brewery's SAP might need to be altered. | Modifying external party's IS | TA | ST | 2 | 10 | 6 | 10 | -2 | 26 | | | | 2 | |
| | In-house development (bespoke the transaction)<br>Report development | ERP secondary development | TA | ST | 6 | 5 | 7 | 10 | -1 | 27 | | | | 2 | |
| Case Brewery 5<br>Discrepancy management process | Inaction | / | IA | / | 10 | 10 | 10 | 1 | 0 | **31** | | 1 | 2 | 1 | 1 |
| | Procrastination/<br>In house workflow development | ERP secondary development | PN<br>TA | ST | 2 (5) | 6 | 6 | 10 | -2 | **22 (25)** | | | 2 | 3 | |
| Case Brewery 6<br>Packing operation for the promotional scheme | Inaction | / | IA | / | 10 | 10 | 10 | 2 | -3 | **29** | | 4 | 4 | 1 | 2 |
| | Procrastination/<br>Acquire SAP WMS at retail depot<br>Remove bespoke PCK and POD programme | Implement a vendor solution | PN<br>TB | SEt | 1 (6) | 3 | 6 | 10 | 2 | 22 (27) | | | 4 | 3 | |
| | Change pricing condition<br>Persuasion on the sales team and the customer | / | BA | / | 8 | 8 | 8 | 1 | 0 | 25 | | | 4 | 2 | |
| Case Charity 1<br>CBT scheme | Developing an extension based on SAP HR with the external party<br>ERP programming | ERP secondary development | TA | SEt | 3 | 3 | 5 | 10 | -1 | 20 | | 4 | 2 | 3 | 4 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Creating fields on SAP HR<br>Report development | Screen masks<br>Report development | TW | ST | 9 | 7 | 9 | 3 | -4 | **24** | | | | 3 | |
| | Acquiring a separate system by an external party<br>Build link between the third party solution and SAP<br>Heavy replication all HR data | Implement a 3rd party solution | TA | SEt | 3 | 3 | 8 | 8 | -3 | 19 | | | | 3 | |
| | Developing in house as an extension based on SAP HR | ERP secondary development | TA | SEt | 3 | 5 | 5 | 10 | -1 | 22 | | | | 1 | |
| | Procrastination/<br>Adopt SAP Learning solution | Implement a vendor solution | PN<br>TW | SEt | 1 (2) | 1 | 5 | 7 | 0 | 14<br>(15) | | | 2 | 2 | |
| | Procrastination/<br>Upgrade to SAP v4.7<br>And build a application on SAP HR | ES upgrade<br>ERP secondary development | PN<br>TB | SEt | 1 (1) | 3 | 4 | 8 | 3 | 19<br>(19) | | | 2 | 2 | |
| Case Charity 2<br>Payroll operation | Inaction<br>Waiting for the completion of the getting-well programme | / | IA | / | 10 | 10 | 10 | 1 | -5 | **26** | | 3 | 2 | 1 | 4 |
| | Procrastination/<br>Implement SAP Payroll | Implement a vendor solution | PN<br>TA | SEt | 1 (3) | 6 | 7 | 10 | 0 | **24**<br>**(26)** | | | 2 | 2 | |
| | Procrastination/<br>Implement third party solution of payroll | Implement a 3rd party solution | PN<br>TA | SEt | 1 (2) | 3 | 7 | 10 | -2 | 19<br>(20) | | | 2 | 2 | |

Note: TC – adaptation tactics; AD – adaptation solution; TI – time; UR – urgency; CO – cost; FS – financial strength; HR – human resource; EA – expertise availability; EF – effectiveness; CR – criticality; IM – implication; FL – flexibility; TA – technical adaptation; TW – technical workaround; TB – technical banking; IA – inaction; BA – business workaround; PN – procrastination; SEp – system exploitation; SEt – system extension; ST – system tailoring

* Highlighted section indicates the adaptation solution was adopted or to be adopted.

**Table 56 Case study summary**

# CHAPTER 7

# Findings and Discussions

## 7.1 Introduction

In Chapter 6, a model of tactical ES adaptation for ongoing business changes has been developed from three organisations' ES post-implementation experience. This provides a theoretical framework to answer the research question of this investigation: "How organisations adapt ISs/ESs to support business flexibility?" This chapter presents the findings and discussions based on the evidences found in the research and the model developed through the study. First, it recognises that the business environment is becoming more and more volatile and systems flexibility is an important feature of information systems to cope with ongoing business changes. Despite that, however, few can provide a definition of what IT flexibility means for their organisation and an appropriate method to deal with their IT system flexibly when business changes. Second, the research finds that ESs are viewed as a more flexible technology than other technologies. With ESs, a number of technical adaptation methods can be employed to support ongoing business changes. Moreover, the distinctive features of ESs allow ES adoption organisations to be more responsive to deal with business needs. These features encompass a). pre-packaged nature of ESs that provide built-in functionality ready in use for the future, b). the standardisation nature that helps organisation to obtain more external support, c). the long term bonding with ES vendors that helps to realise the benefit of continuous functionality development and maintain integrity of adopting ESs. Third, it is found that optimal flexibility is the optimal goal for organisations to support ongoing business needs. The optimal flexibility is a trade off between organisational situations and technical conditions and a portfolio of alternative solutions. It is argued that the most cost-effective solution and the best fit to the original business request may not be desired by organisations for the optimal flexibility. Fourth, the multidimensional features of ES support for ongoing business changes are discussed. It presents the impact of ES on different nature of business changes, i.e. strategic changes and operational changes. Following that, the six adaptation tactics identified during the investigation are described. The impact of these six adaptation tactics is discussed. Finally it illustrates the cost, time spending and resource implication of adaptation activities. It argues that the complexity of adaptation can be indicated in several aspects:

a). the nature of adaptation activities, b). extensiveness of ES adaptation – the level of usage of system adaptation, c). the number of different adaptation type used. Usually a system adaptation is a combination of several adaptation types, d). the degree of conversion and replication in data.

## 7.2 Flexibility is an Important Capability of Information Systems

Three organisations investigated in this study all confirm that flexibility is an important capability for an information system to cope with ongoing business changes. The MIS manager from Machine pointed out:

"First we view flexibility is an important feature for our company to respond business uncertainties and to become competitive. As the information system is becoming more and more integrated into the business operation, a flexible information system is desired to solve ongoing business needs quickly and effectively. An information system shall not drag business behind."

He furthered:

"Being a small organisation, we do not have a very complicated IT infrastructure compared with other larger organisations. Being small, we are more agile and flexible than those large companies, which is such a good weapon to compete with them in the business. However, we also need a flexible system to support our ongoing business needs as we are in short of resources either in money or right people."

Although the three organisations investigated in this research are different in size and in different industry sector, all of them state that the business environment is becoming more and more volatile and put lots of pressure on their adopting IT systems. Adopting ESs is their original will to solve the problems of legacy systems and tackle further organisational changes. The Business Strategy Director from Brewery stated:

"We were tempted by the standardisation provided by SAP so that we are able to take out the problematic legacy systems and replace them with SAP solutions. We were also tempted by the great functionalities and capabilities supported by SAP so that we would be able to handle our future business needs and introduce new way of working."

The common concern found in the case study organisations is that despite IT flexibility is much desired trait, few can provide a definition of what IT flexibility means for their organisation and an appropriate method to deal with their IT system flexibly when business changes. This finding is not surprising as the term of flexibility has been used ubiquitously and its meaning has been defined in various forms (Evans 1991; Harrison et al. 2000) and IT flexibility for ongoing organisational changes are less known due to lack of research in IT maintenance. Therefore, "for most managers the attainment of flexibility is a gut feeling" (Golden 1997). Upton (1994) points out that such confusion and ambiguity about the concept of flexibility seriously inhibits its effective management. Especially in IT management, the great importance of IT maintenance indicated by various academics such as Glass and Vessey (1999), Takang and Grubb (1996) and Lientz et al. (1978) has call for a framework for researchers and practitioners to understand IS flexibility. Figure 9 depicts a tactical model to support ongoing business changes. The following sections discuss how organisations can achieve optimal flexibility with their adopting ESs.

## 7.3 Organisations View ESs as a More Flexible Technology Compared with Other Technologies

The study of the post-implementation experience of ES use in the three organisations demonstrates that ES is regarded as a more flexible technology than previous IT solutions, which is commented by the three interviewed organisations. The finding is contradictory to some literature of ESs that comprises full of negative voices and concerns of inflexibility of ESs (Davenport 2000; Markus and Tannis 2000; Bylinsky 1999; Cameron 1998; Ni and Kawalek 2001).

Through the analysis of interview data and the literature on ES tailoring and maintenance (e.g. Nah et al. 2001; Brehm et al 2000; Ng 2001), a number of technical adaptation methods used for supporting ongoing business changes are identified:

- Reconfiguration, setting of parameters or tables to enable/disable different processes and functions in ES;
- User interface tuning, creating of new user interface for input and output of data;
- Extended report development, programming of extended data output and reporting options;
- ERP development/programming, developing new workflow, or additional functions based on implemented ES modules;
- Legal patch upgrades, incorporating regular ES patches sent by ES vendors;
- ES version upgrades, implementing a new ES version provided by ES;
- Acquire a new ES vendor's module or license, purchasing and implementing a new application module provided by ES vendor;
- Acquire a third party software, purchasing and implementing a new application module from a third party software vendor; and
- Reset external business partner's ES to align with own adopting ESs.

These adaptation activities (Table 57) identified here are different from the literature on ES tailoring types described in the literature, as the study and the analysis is conduced not from a technical system maintenance and tailoring perspective, but from a perspective of system adaptation to support ongoing business changes. It is also found that in the study, the activity of user interface tuning is not specifically mentioned by the three organisations. However, it is assumed that this activity is not a significant adaptation task and can be involved in all major system adaptation development and acquisition.

| Adaptation methods | Participants | | | | | Found in cases studied |
|---|---|---|---|---|---|---|
| | Adopter | Vendor | 3rd party software vendor | 3rd party support | External business partner | |
| Reconfiguration | X | | | X | | Case Machine 1, 2, 3, 5<br>Case Charity 1 |
| User interface tuning | X | | | X | | |
| Extended reporting | X | | | X | | Case Machine 1, 3 |
| ERP programming | X | | | X | | Case Machine 4<br>Case Brewery 1, 2, 3, 4, 5<br>Case Charity 1 |
| Legal patch upgrades | X | X | | X | | Case Machine 7 |
| ES version upgrades | X | X | | X | | Case Charity 1 |
| Acquire a new ES vendor's module or license | | X | | X | | Case Machine 4, 5<br>Case Brewery 1, 6<br>Case Charity 1, 2 |
| Acquire a 3rd party software | | | X | X | | Case Machine 4, 7<br>Case Charity 2 |
| Reset external business partner's ES to align | | | | | X | Case Brewery 4 |

**Table 57 Adaptation types for supporting ongoing business changes**

The research shows that ESs offer ES adoption organisations more mechanism of system adaptation and support than other type of ISs due to its unique characteristics and capabilities:

### 7.3.1 Pre-packaged software provide built-in capacity ready to use

ES is a pre-packaged solution that comprises a repository of function model, process model and information flow model that captures all semantics in the business processes, business objects and organisation model (Buck-Emden and Galimow 1996;

Curren and Keller 1998). This implies that each ES package comprises a great deal of functionalities that organisations can adopt to suit their specific needs. The configuration capability is a unique feature of ES that can provide ES adopting organisation a low resource consuming and high performance delivering solution for their specific business needs within the capacity. It is found that in the three organisations that reconfiguration is on the top of the list of choices for adaptation if the function can satisfactorily meet new business needs. Compared with other adaptation methods, reconfiguration solution costs significant lower, can be completed in a short time, is less demanding for competent IT people, and has minimal implication on future system maintenance. Brehm, Heinzl and Markus (2000) also present the similar statement on the impact of ES adaptation methods. It is noted in the research that the low cost of reconfiguration is due to the reason that ES organisations have paid premium upfront for extra functionalities that are not used in their initial ES implementation. As a matter of fact, all the three organisations view ES adoption is to bank extra capabilities for their future use. As the Business Strategy Director at Brewery pointed out SAP is a significant investment and ES adoption organisations will want to maximise their benefits through utilization of its potential.

### 7.3.2 Standardisation helps organisation to get more external support

It is noted that ES adopting organisation can approach three major external parties (ES vendor, 3rd party software vendor and 3rd party consultancy firm) for support for system adaptation. The standard platform of ESs and development tools provided by ES vendors allow 3rd party software vendor to develop common surrounding applications. $3^{rd}$ party software is becoming an option for organisation for system extension. Moreover, opting for $3^{rd}$ party solution reduce the time for development and implementation and also mitigate the need for organisations to employ competent staff compared with the need for in-house development, which is demonstrated in Case Machine 4, Case Machine 7, and Case Charity 2. However, interfacing and integrating the $3^{rd}$ party solution with ES are very much concerned.

The nature of standardisation of ESs also allows consultants to share and communicate knowledge in ESs. Even ES adopting organisation can send their staff to education institution (e.g. SAP academy) established by ES vendors to be trained and become a "consultant". This means ES specialists are easier to find than with a proprietary system. In Table 57, it shows that external consultancy support can get involved all technical adaptation of organisation's own ESs. Using third party consultants is widely accepted especially by small organisations where IT department budget is not enough to hire full time expensive ES specialists. IT staff in the IT function is only to look after daily system operation and support rather than complicated system development and tailoring work. The IS manager from Machine stated "We are quite happy to have external consultants to support our major development. Although their daily rate is high, comparing with the cost of their full time employment, we prefer to contract out rather than employ in. As a relatively small firm, our IS budget is tight. If there are no constant major development projects, we cannot afford having full time ES specialist." However, maintaining a good relationship with consultancy firm is very important for future development. Machine has been using a consultancy firm who were involved in their initial SAP implementation so the consultants would be able to have a better knowledge of Machine's business operation and system settings. Using people intimately familiar with the installation had the great advantage of efficiency, especially when problem is specific to the organisations (Hirt and Swanson 2001). The study shows that all three organisations have been using external consultancy for support to some extend. Small firm (Machine) and high turnover IT personnel organisation (Charity) intend to hire external consultants to compensate the scarcity of competent ES specialist. Large firm (Brewery) requires external consultants for their special knowledge or to support system adaptation when in a shortage of IS staff.

It is interesting to find that with the standard platform, ES adopting organisations may be able to request external business partner to reset their IT systems to fit with their own ESs (see Case Brewery 4). It is difficult to achieve when both sides adopt proprietary technology in their IT system. The standard platform has made it possible.

### 7.3.3 Vendor's support is critical for benefit realisation

A critical issue raised by some academics (Markus et al 2000) is that of ES vendor lock-in problem after initial system implementation. However, it is found in the three organisations that continuous ES vendor support is important for their future system adaptation especially when organisations intend to maintain the integrity of adopting ESs. ES vendors provide three types of support; legal patch application, ES new version upgrades, and new solutions and new development. Legal patch application is a free support provided regularly by ES vendors to correct errors in ESs. It may help organisations to achieve some functionality that was not offered or not be able to develop due to the errors in ESs (see Case Machine 7). It is cheaper and faster solution and has literally nil impact on the maintenance of ES self. ES new version upgrades can provide extra functions in a new version of ES and improve the efficiency of the system. However, it is very costly and needs a high level of attention of senior management. Moreover, ES version upgrades is normally driven by a technical maintenance perspective rather than a business perspective. Any system adaptation that requires the support of an ES version upgrade may need to spend considerable amount of time in waiting. Therefore, organisations would normally employ other adaptation method to support ongoing business needs unless the business requirement is not urgent. ES vendors are continuingly developing new functions to better their services and profit margin either through a new version or a completely new application module. ES adopting organisation may use this as their advantage to reduce the cost of the development and most importantly the risk of the new application development. They can rely on the extensive knowledge and experience of ES vendor to develop a mature application. ES vendors would normally invite major organisation to participate in their study and development in a new business solution.

## 7.4 Optimal Flexibility is the Optimal Goal for Organisations to Support Ongoing Business Needs

The three cases under study demonstrate tremendous detail pertinent to ES's capability of supporting ongoing business changes during ES post-implementation period. From the experience of using ES to support ongoing business changes, a significant lesson is learned that achieving flexibility is not merely an IS technical issue, but a systematic concern. Organisations need to assess their organisational conditions and evaluate the effect and the cost of attaining flexibility, and trade off between them in order to achieve optimal flexibility. It is argued that the most cost-effective solution and the best fit to the original business request may not be desired by organisations for the optimal flexibility. Achieving business flexibility is more an organisational issue rather than merely a technical issue. The researcher uses the phrase of "optimal flexibility" to describe the best outcomes the organisations could achieve with ESs for ongoing business changes, given its organisational situations and technical conditions, compared with a portfolio of alternative solutions, and measured against the metrics of the effect, implication and costs of adaptation. The concept of "optimal flexibility" is similar to the term of "optimal success" defined by Markus and Tanis (2000) that is used to measure the success of ES projects against a portfolio of similar projects, early operational, and longer business term metrics. It is not necessary that optimal flexibility shall fully satisfy original change request. Even the responding system adaptation solution leads to a result of 100% effectiveness as specified may be classified as inflexible. The goal for flexible adaptation varies according to different organisational situations that include criticality of the business changes, urgency for achieving business needs, financial strength and expertise availability. Organisations shall weigh on balance not only among the effect of adaptation, the implication on organisations, and the cost required, but also among the flexibility that could be achieved and the flexibility that is desired due to different organisational and technical conditions. By that, organisation is able to select the optimal flexible solution to respond to various business changes.

Optimal flexibility can be achieved through two level of assessment: 1) actual flexibility assessment and 2) contextual flexibility assessment. The two level assessments for flexible adaptation involve the systematic identification and valuation of the risk and feasibility for attaining flexibility. Organisations normally seek flexibility by assessing actual flexibility by comparing criteria of performance outcomes and resource outcomes of a portfolio of adaptation solutions and trade-off between the criteria. As a rule, flexibility means that the performance criteria are supposed to be maximised and the resource criteria are supposed to be minimized. The actual flexibility assessment is similar towards some stage of most of performance assessment and risk analysis such as Chapman's SCERT (synergistic contingency evaluation and review technique) (Klein, Powell and Chapman 1994). The first level of flexibility assessment gives a clear picture of the effectiveness and the impact as a result of the adaptive transition, and the capital, time and expertise required to support such activities. This level of understanding about flexibility aligns with the traditional view on flexibility in the literature – flexibility is a combination of maximised performance expected and minimised resources required or in a simple form of expression – the most cost-effective (Slack 1983; Evans 1991; Upton 1994; Volberda 1996). Organisations may trade off between these criteria for most cost-effective solution.

However, the investigation of post-implementation ESs support for ongoing business changes in three organisations demonstrates that the desire for flexibility may vary due to various organisational conditions and nature of uncertainties. Although actual flexibility assessment is important for organisations to understand the extent of capability of change, there is a downside to rely solely upon performance and resource evaluation. The problem is that it does not recognise the contextual environment or the organisational capacity to which the flexibility is subject. Offering too much flexibility in a dimension where it is not desired is a waste of resources and may not satisfy the criteria that are aimed for. In other words, faster, cheaper and better is not always the correct direction that organisational should pursue for flexibility. The contextual flexibility assessment helps organisations to identify key areas that should be focused on for adaptation, so that organisations can weigh on balance to decide the optimal flexible solution. As a matter of fact, the second level of assessment for flexibility evaluates the risk of attaining best outcomes by measuring key criteria of flexibility mentioned in the first level of flexibility assessment against the capacity or conditions for adaptation including criticality, urgency, financial strength and expertise availability. The contextual flexibility assessment is still based on subjective perception and judgement. However a more accurate mathematic formula is recommended to be developed in the later research.

For example, the research in the three organisations demonstrates a number of instances that decisions for adaptation were made in favour of contextual flexibility even though other adaptation methods were more cost-effective based on the measurement developed in this research. These instances include Case Brewery 1 (6.4.2.1 Replacing legacy warehouse management system), Case Charity 1 (6.5.2.1 New competence-based training scheme).

In Case Brewery 1, full WMS implementation in the mother depot was only ranked as the third most flexible solution among all six adaptation solutions, while implementing lean WMS in the mother depot was regarded the most flexibility solution without considering the organisational conditions. Lean WMS implementation outperformed other solution in time, cost and HR requirement. However the effectiveness of it was not as much satisfactory as three of other solutions. Despite that, full WMS implementation in the mother depot was selected because:

- Replacing legacy warehouse system was regarded as a most critical project for Brewery business operation (which is ranked 1, see Table 39). Full WMS implementation in the mother depot could meet most of business requirements than lean WMS implementation;
- Full WMS implementation cost significantly more than lean WMS implementation, however, Brewery allocated sufficient budget for this project due to the criticality. Therefore, the cost concern became less significant.
- Similar consideration occurred in HR requirements. Full WMS implementation required higher level of skilled IT personnel. However, this became a less significant concern for Brewery due to sufficient IT human force that Brewery had been building since the initial implementation of SAP ("most of its major IT/IS staff had received training at SAP academy for various applications") and sufficient budget that could bring competent external consultants to support the implementation.

Therefore, by weighing the organisational conditions, full WMS implementation in the mother depot demonstrated the most suitable solution despite it required more cost, longer time and more expertise and competent IT persons to complete the project.

In Case Charity 1, the advantage of the solution of developing an extension on SAP HR with a third party integrator outweighed its disadvantages in cost, time and HR requirement. Creating fields in SAP HR was a low cost and low effective solution for meeting the needs of competence-based training scheme. However, the strong finance support decreases the vantage of its low expenditure of adaptation. Finally, the result of choosing this adaptation solution could barely meet the most of business requirement for CoBT training and it could cause future governmental legislation problem. For the solution of developing in house on SAP HR had the similar results in performance and cost. However, developing an extension on SAP HR with a third party did help Charity to solve the crisis in its lack of competent personnel to support the development. Therefore, by balancing the organisational risk and adaptation capabilities, developing in house on SAP HR with a third party integrator stood out among all possible solutions.

It is evident that to achieve optimal flexibility management shall balance the capability of adaptation and the capacity for adaptation. Here, the capability of adaptation refers to the performance outcome and the resource acquirement for adaptation, while the capacity for adaptation refers to organisational conditions for adaptation. Volberda (1999) argues that flexibility is associated with the controllability of the organisation and the control capacity of management. The controllability of the organisation is defined as the adequacy of organisational conditions, while the control capacity of management is defined as the performing capabilities of the management to exercise the control. He furthers that the flexibility is the interactive balance between these two elements. More controllability does not compensate for less capacity. Similarly, the "optimal flexibility" calls for the balance of capabilities that the adaptation can perform and the control capacity that organisations can offer. The decision for adaptation needs to assess the performing capability of the adaptation (actual flexibility assessment) and organisational capacity of adaptation (contextual flexibility assessment) in order to find a most realistic solution. Similar to Volberda (1999)'s argument for flexibility, capability of adaptation has to fit within the capacity for adaptation. Otherwise, chaos may happen. Therefore, optimal flexibility can be named as the most realistic flexibility. Moreover, the two stage flexibility assessment can help organisations to identify their weakest dimensions and strongest dimensions so that organisations can concentrate on what is most important for adaptation. Lack of focus is also a problem for flexibility mentioned (Das and Elango 1995, Ozer 2002). ES is considered as a more flexible system solution (Davenport 2000). With overwhelming options, it is difficult to make decision, thereby becoming a potential liability. The two stage assessment for flexibility can assist organisations to understand the elements of capability and capacity to make a realistic decision for adaptation.

## 7.5 The Multidimensional Features of ES Support for Ongoing Business Changes

Business is fundamentally concerned with and driven by changes. How organisations use their adopting ES to support ongoing business changes? The three cases provide great details of the decision making process for selecting appropriate solution for supporting ongoing business changes. As seen in the study, an appropriate solution for business changes is a balance between organisational capacity and adaptation capability. Moreover, the desire for flexibility could vary due to various organisational conditions and nature of uncertainties. Through the model, multidimensional features of ES support for ongoing business changes are identified.

### 7.5.1 The impact of ES on different nature of business changes

As seen in the model, the decision making process is triggered by the emerging business needs. However these business needs are different in nature. In Chapter 2, environmental uncertainties are classified as strategic and operational, where the former one manifests major transformation of organisations and the later one expresses minor shift to deal with day-to-day business needs. How organisations response to different nature of business changes? The study in the three organisations illustrates two strategic changes and thirteen operational changes. However, it is found in the study that criticality level of operational change varies dramatically and although some operational changes are classified as operational change, they appear very important. The research shows that the critical levels of both strategic changes were scored at 5 (most critical or risky), while for operational changes the critical levels vary between 1 to 4. Therefore the researcher believes the criticality level is a better way to classify the nature of business changes. Based on the evidences from the experience of ES post-implementation support for ongoing business changes studied in the three organisations, three features are identified for the impact on different nature of business changes:

1) technical adaptation and technical banking solutions are usually adopted for high critical business changes;
2) the resource readiness for supporting business changes varies due to the nature of business requirements;
3) high critical business changes do not necessarily result in a high cost adaptation solution and the cost of adaptation depends on the actual adaptation solution.

First, as defined, strategic changes are more critical to affected organisations than operational changes. Therefore, high level of effectiveness for adaptation is expected and required when selecting adaptation solutions for strategic changes or high critical business changes. For operational changes or low critical changes, the desire for adaptation effectiveness is usually low. From the experience of ES post-implementation support for ongoing business changes, it appears that technical adaptation and technical banking solutions are usually adopted to respond strategic or high critical business changes. It is because technical adaptation is a passive adaptation tactic that aims to alter IT systems to fully satisfy business change requirements, while technical banking extends the technical adaptation tactic which would build more capacity and functionality in advance for future business needs. For operational changes or low critical changes, organisations may carefully balance the organisation capacity and adaptation capability to select a most appropriate solution. When it is necessary, organisation may try to not directly satisfy low critical business needs, even ignore them or procrastinate the adaptation.

Second, supporting resource is not really a concern when considering adaptation solution for high critical changes especially for large organisations. When the business requirement is critically important towards affected organisations, organisations are willing to allocate adequate resource to support the adaptation. Compromising the highly critical business change to save the adaptation cost is not preferred unless there is no suitable solution to meet the business change requirements (e.g. Case Charity 2). With low critical business requirements, the decision for choosing adaptation solution is more based on how to better use existing resource to achieve reasonably better result. Hence, the resource preparedness for supporting high critical changes is better.

Moreover, it is also interesting to find that high critical business changes do not necessarily result in a high cost adaptation solution. The resource requirement is more associated with the actual adaptation solution rather than the criticality level of business changes. This is because organisations may take different tactical and technical approaches to respond business requirements, which leads to different adaptation solutions that have different cost implications. For example, the cost requirement is low when taking inaction and business workaround tactics. Furthermore, with ES, reconfiguration is usually considered as a more cost-saving and less impact solution than other technical development solutions (Brehm, Heinzl and Markus 2000).

### 7.5.2 The six adaptation tactics

The most significant lesson is learnt from this study is the tactical approaches that organisations may adopt to achieve optimal flexibility. The model (Figure 9) demonstrates that by identifying environmental uncertainties and assessing the performance and resources for a portfolio of adaptation solutions against organisational capacity and conditions, organisations can opt for an adaptation tactic that could generate most benefits. In this model, it shows that adaptation tactics are different from adaptation activities where adaptation tactics are tactical level of decisions that define the demand for change and adaptation activities are process-oriented which describe the operational tasks of the change. Adaptation tactics characterise management's intervention for providing solutions to the environmental requirements. In Chapter 2, tactical dimension is classified as defensive and offensive. Tactical adaptation is not new. It has been discussed in the literature of manufacture flexibility (Gerwin 1993). Gerwin (1993) identified four generic strategies for coping environmental uncertainties: adaptation, redefinition, banking and reduction. Established on Gerwin's (1993) work on manufacture flexibility, the sense of tactical dimension discussed in Chapter 2 and the research findings in the three investigated organisations, six adaptation tactics are identified. They are technical adaptation, technical banking, technical workaround, business workaround, procrastination and inaction. Table 58 illustrates the intention of adaptation tactics and their impact on the original business requirements. The detail definitions of these six adaptation tactics are provided in Chapter 6. Table 59 to Table 64 illustrate adaptation tactics proposed or adopted in all cases and associated resource requirement and performance outcome. The research shows that these six generic adaptation tactics have different resource requirement and performance outcome.

| Tactics | Intention | Impact on the original business needs |
|---|---|---|
| Technical banking | Offensive | Extend |
| Technical adaptation | Defensive | Follow |
| Technical workaround | Offensive | Reduce |
| Business workaround | Offensive | Redefine |
| Procrastination | Offensive | Delay |
| Inaction | Offensive | Ignore |

**Table 58 Intention dimension of adaptation tactics**

### 7.5.2.1 Technical adaptation tactic

| **Tactic: Technical adaptation** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Proposed and adopted in the cases** | **Adaptation solution** | **Major adaptation activities** | **Type of adaptation** | **Time** | **Cost** | **HR** | **Effectiveness** | **Implication** |
| Case Machine 1: establishing cost centre | Establishing cost centre | Reconfiguration<br>Report development | System exploitation<br>System tailoring | 9 | 8 | 5 | 9 | 0 |
| Case Machine 2: changing fix assets depreciation rate | Reconfiguring the depreciation method | Reconfiguration | System exploitation | 8 | 7 | 7 | 10 | 0 |
| Case Machine 3: changing organisational structure | Configuring two companies | Reconfiguration<br>Report development<br>Screen adjustment | System exploitation<br>System tailoring | 4 | 5 | 3 | 8 | 0 |
| Case Machine 4: improving inspection and quality control | Developing a bespoke program based on SAP MM | ERP secondary development | System tailoring | 8 | 5 | 7 | 10 | -2 |
| Case Machine 5: creating new inventory report | Inventory reporting configuration and development (Procrastinated) | Reconfiguration<br>Report development | System exploitation<br>System tailoring | 4 (6)[2] | 6 | 6 | 10 | 0 |
| Case Machine 7: automating invoice numbering and printing<br>* either of the two technical adaptation solutions would | Replacing with a 3rd party invoicing software (Procrastinated) | Implement a 3rd party solution | System extension | 3 (7)[2] | 6 | 7 | 10 | -2 |
| | Upgrading FI with new patches on invoicing (Procrastinated) | Legal patch upgrade | System exploitation | 3 (8)[2] | 8 | 7 | 10 | 2 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| be adopted in a later stage | | | | | | | | |
| Case Brewery 1: replacing legacy WMS for the wine and spirit distribution operation | Developing as-is solution based on SAP SD | ERP secondary development | System extension | 2 | 5 | 4 | 10 | -2 |
| Case Brewery 2: introducing bulk pick operation | In-house development of workflow programming on SAP WMS (Procrastinated) | ERP secondary development | System tailoring | 2 (6)[2] | 5 | 7 | 10 | -1 |
| Case Brewery 3: improving KPI reporting for SCM | Developing a KPI reporting application in-house based on SAP business warehouse (Procrastinated) | ERP secondary development Report development | System extension | 1 (3)[2] | 4 | 8 | 10 | 0 |
| Case Brewery 4: new supplier performance report | Bespeaking the transaction | ERP secondary development | System tailoring | 6 | 5 | 7 | 10 | -1 |
| | Setting up external party's IS | Modifying external party's IS | System tailoring | 2 | 10 | 6 | 10 | -2 |
| Case Brewery 5: change of discrepancy management process | In-house development (workflow programming) (Procrastinated) | ERP secondary development | System tailoring | 2 (5)[2] | 6 | 6 | 10 | -2 |
| Case Charity 1: new CBT scheme | Engaging a third party to develop an extension on SAP HR | ERP secondary development | System extension | 3 | 3 | 5 | 10 | -1 |
| | Acquiring a separate system offered by a third party | Implement a 3rd party solution | System extension | 3 | 3 | 8 | 8 | -3 |
| | In-house development on SAP HR | ERP secondary development | System extension | 3 | 5 | 5 | 10 | -1 |
| Case Charity 2: improving payroll operation | Adopting SAP payroll (Procrastinated) | Implement a vendor solution | System extension | 1 (3)[2] | 6 | 7 | 10 | 0 |
| | Acquiring a 3rd party payroll solution (Procrastinated) | Implement a 3rd party solution | System extension | 1 (2)[2] | 3 | 7 | 10 | -2 |

**Table 59 Technical adaptation tactics proposed and adopted in the cases**

(The adaptation tactics adopted or adopted in procrastination are highlighted.)

[2] Time valuation figure in bracket indicates the actual level of flexibility without considering procrastination.

Technical adaptation is a common and natural response to business changes. Table 59 demonstrates that among all fifteen business changes studied in the three organisations, only two business changes (Case Machine 6 and Case Brewery 6) were not proposed with a technical adaptation solution (in Case Machine 6, a technical adaptation solution was not available; while in Case Brewery 6, a technical banking solution was proposed). Eleven out of fifteen business changes were chosen to adopt a technical adaptation solution (including procrastinated technical adaptation solution). It indicates that the technical adaptation tactic is widely accepted and a preferred path for organisations to respond to changing business environment. With the technical adaptation tactic, the adaptation solution follows what business has come to expect IT systems to achieve. Gerwin (1993) indicates that adaptation is a defensive and passive response to organisational environment. Here, technical adaptation is a passive adaptation approach, the main goal of which is to alter IT systems to fully satisfy business change requirements. Therefore, the expected effectiveness of adaptation is high. In Table 59, it demonstrates that the effectiveness level of technical adaptation solutions are ranging from 7 to 10 (10 is the most effective) and most of them are scored at 10. Technical adaptation is a suitable tactic when the criticality level of business change is high which requires high level of effectiveness for system change (this will be discussed in detail in later section in this chapter). The studies shows that for business changes with the criticality level between 3-5, organisations adopted the technical adaptation tactic or technical banking tactic (for Case Machine 6, there was no suitable technical solution available, therefore a business workaround approach was adopted). It illustrates that a technical solution is a preferred method for organisations to satisfy important business change requirements.

In order to maximise the effectiveness that the businesses desire, it requires technical flexibility and matching resources to back the adaptation. Depending on the actual adaptation solution and activities, the associated cost and requirement for technical adaptation vary. The research shows that technical adaptation usually requires higher level of resources in order to achieve best fit than technical workaround and business workaround tactics. It is because that technical workaround and business workaround approaches reduce the need to achieve best fit for the business problem by offering an alternative solution that compromises the business requirement. For example, in Case Machine 1 cost centre reset, the solution of reconfiguration (a technical adaptation approach) required high level of qualified specialist than the solution of setting up multiple account (a technical workaround approach). Another example, in Case Brewery 1 replacing warehouse management system, the approach of developing as-is solution based on SD module (a technical adaptation approach) would be more time consuming, more costly and more demanding for qualified personnel to support the adaptation than other two technical workaround approaches.

The research identifies seven types of technical adaptation activities for the technical adaptation solutions. They are reconfiguration, report development, screen adjustment, ERP secondary development, implementation of a third party solution, implementation of a vendor solution, legal patch upgrade. These types of technical adaptation activities can be grouped into three categories: technical exploitation, technical tailoring and technical extension. System exploitation is to exploit built-in capacity provided by a given ES. This has two meanings. First, organisations may switch on built-in functionalities in the ES package by setting the parameters in the configuration table. Second, ES continuously offer free support to ES adoption organisations to correct design errors and build new functionalities into ESs by issuing legal patch upgrades (Ng 2001; Markus et al. 2000). Although ES legal patches are provided after the initial implementation, they are considered as built-in capacity as the acquisition of ES is not only to acquire a piece of software its own but also the service and support from the vendor which are included in the original purchase price or license fee. However, adopting legal patch upgrade has to align with ES vendor development schedule. The research demonstrates that using the built-in features in ES would massively reduce the cost and effort for system adaptation than other technical adaptation methods. Brehm, Heinzl and Markus (2000) measure the impact of ES tailoring and state that configuration is the least risky. For legal patch upgrade, the study shows the effort demanding is low which is contradictory Ng's (2001)'s conclusion that legal patch upgrade is almost as effort demanding as user enhancement requested change. However, as Ng (2001) states that the effort for legal patch upgrades depend on the level of customisation of existing ES module effected. Moreover, the research only managed to capture one legal patch upgrades case. The analysis result for legal patch upgrades is not conclusive due to lack of sufficient data. System tailoring refers to minor or less significant technical adaptation work other than reconfiguration and legal patch upgrades. It encompasses technical adaptation activities such as report adaptation/ development, interface development, screen adjustment, minor development and programming of additional functions. While system extension is major adaptation work that extends the boundary of the existing ES functions. The system extension may include acquisition of an application module from the ES vendor, adoption of a 3rd party solution/ module, a major ES application development and ES upgrades. The research shows that system extension is the most resource demanding. It requires high cost and resources to implement the new acquisition or ES upgrades, and also attracts attention from senior management to support the implementation.

#### 7.5.2.2 Technical banking tactic

| Tactic: Technical banking | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Proposed and adopted in the cases** | **Adaptation solution** | **Major adaptation activities** | **Time** | **Cost** | **HR** | **Effectiveness** | **Implication** |
| Case Machine 4: improving inspection and quality control | Adopting SAP QM | Implement a vendor solution | 5 | 1 | 2 | 10 | 2 |
| Case Brewery 1: replacing legacy WMS for the wine and spirit distribution operation | Implementing full WM in the mother depot | Implement a vendor solution | 4 | 3 | 4 | 10 | 4 |
| | Implementing full WMS across all distribution function | Implement a vendor solution | 1 | 2 | 1 | 10 | 5 |
| Case Brewery 6: introducing the packing operation for the promotional scheme | Acquiring SAP WMS at retail depot (Procrastinated) | Implement a vendor solution | 1 (6)[2] | 3 | 6 | 10 | 2 |
| Case Charity 1: new CBT scheme | ES upgrade Developing an application on SAP HR (Procrastinated) | ES upgrade ERP secondary development | 1 (1)[2] | 3 | 4 | 8 | 3 |

**Table 60 Technical banking tactics proposed and adopted in the cases**

(The adaptation tactics adopted or adopted in procrastination are highlighted.)

Technical banking is an aggressive or offensive tactic where organisations may want to proactively build more system capacity for future needs instead of merely passively satisfying current business needs. Hence, technical banking tactic is an alternative approach to technical adaptation tactic to achieve maximum level of effectiveness of business change requirement. The term "banking" is coined by Gerwin (1993) to define a strategy for manufacture flexibility where flexibility can be an investment for organisations to create options for future use. Technical banking has a great impact on organisations. First, as technical banking seeks to build more functionalities and capacity in the system than what is needed for current business requirements, technical banking is more demanding for resources to support the adaptation. It is found in this research that there are 4 occurrences that technical banking tactic was proposed and 1 of which was adopted. All 4 occurrences of technical banking tactic were associated with significant requirement for monetary cost, time span for implementation and involving expertise and staff. Therefore, organisations shall prepare sufficient resource in order to support the technical banking approach.

There are two main issues when considering the technical banking tactic. First as stated above, technical banking tactic is a resource demanding approach, organisations should assess themselves to see if there are enough resources available and affordable to be employed for the adaptation. The resources refer to financial cost, time span and expertise availability. Although technical banking would bring flexibility for future business needs, organisations should evaluate whether introducing a technical banking is financially sensible. This is especially important for small-size organisations. In Case Machine 4, Machine not adopting an SAP QM module to support the IQC process was mainly because of the concern of the huge financial cost of it. Furthermore, the research shows the technical banking approach is more time consuming than other adaptation approaches. It suggests that technical banking is not a suitable way to satisfy the business needs that need to be solved urgently. Even when there are other urgent business requests need to be solved, it is not appropriate to be carried out as technical banking approach would occupy considerable amount of resources, especially for small organisations. Machine's IS manager pointed out in Case Machine 4 that one of the reasons for not adopting technical banking was the constraint on emerging system change requirements. If the technical banking was adopted, Machine had to put on hold of other business change requirements in order to concentrate their limited resources to support the SAP QM implementation. Secondly, technical banking approach requires organisations to account for future and potential "likely" business needs when considering the technical banking solution. This activates the process of identifying and discovering potential business needs. In Case Brewery 1, Brewery went through a two stage review to see how the technical banking solution would support potential business needs. The two stage review demonstrated that adopting WMS would not only solve existing business requests but also benefit them for expanding the WMS to other areas and supporting other future likely business needs. In Case Machine 4, although the MIS manager stated that adopting SAP QM could be beneficial if their business expanded in the future. However, Machine could not predict likely future business needs for quality management.

#### 7.5.2.3 Technical workaround tactic

| **Tactic: Technical workaround** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Proposed and adopted in the cases** | **Adaptation solution** | **Major adaptation activities** | **Type of adaptation** | **Time** | **Cost** | **HR** | **Effectiveness** | **Implication** |
| Case Machine 1: establishing cost centre | Setting up multiple account | Configuration Report development | System tailoring | 8 | 9 | 8 | 4 | -1 |
| Case Machine 4: improving inspection and quality control | Adopting a 3rd party bolt-on solution | Implementing a 3rd party solution | System extension | 8 | 5 | 6 | 6 | -4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Case Brewery 1: replacing legacy WMS for the wine and spirit distribution operation | Implementing lean WMS in the mother depot | Implement a vendor solution | System extension | 7 | 7 | 7 | 7 | 0 |
| | Adopting SAP IM | Implement a vendor solution | System extension | 7 | 7 | 7 | 4 | -1 |
| Case Brewery 3: improving KPI reporting for SCM | Report development on SAP ERP (Procrastinated) | ERP secondary development Report development | System tailoring | 1 (3)[2] | 4 | 8 | 7 | -2 |
| Case Charity 1: new CBT scheme | Creating fields in SAP HR | Screen masks Report development | System tailoring | 9 | 7 | 9 | 3 | -4 |
| | Adopting SAP learning solution (Procrastinated) | Implement a vendor solution | System extension | 1 (2)[2] | 1 | 5 | 7 | 0 |

**Table 61 Technical workaround tactics proposed and adopted in the cases**

(The adaptation tactics adopted or adopted in procrastination are highlighted.)

Technical workaround is an approach that offers an IT solution that manages to accommodate part of the business need. Technical workaround is a compromised solution towards business problems. Technical workaround is similar to the reduction strategy identified by Gerwin (1993). The reduction strategy reduces the need for flexibility up to a point by reducing environmental uncertainties. Similar to the reduction strategy, technical workaround reduces the need for system flexibility required by business change needs through adopting available technology to accommodate part of the business needs. Technical workaround has important implication. First, technical workaround does not aim to fully solve business needs, and the expected effectiveness is compromised. The research shows that the effectiveness level of proposed technical workaround solutions is ranging from 3 to 7. Second, technical workaround could mediate the pressure of business requirements by offering a compromised method to meet part of the business needs. Organisations are constant under pressure for business uncertainties which requires IT intensive organisations to adapt their IT system to meet their business needs (Allen and Boynton 1991). "The IT departments are bombarded by business change requests and complaints from the business units for their IT system not being flexible", stated by the MIS manager of Machine. For the IT departments themselves, they are constrained by the limited resources to cope with these business needs. One of the methods as recommended by Machine's MIS manager is to use available technology to meet part instead of full of the business needs. For example, in Case Brewery 1 replacing legacy warehouse management system for wine and spirit operation, the flexibility level of adopting the lean WMS in the mother depot was 28 – 3 points above the solution of full WMS in the mother depot. This workaround solution could mediate the pressure for an efficient warehouse management system and meet most of the business needs for wine and spirit operation with low level requirement for resources comparing to the solution of implementing full WMS in the mother depot. Due to the concern of future business expansion and needs for warehouse management function and strong support in finance and human resources, lean WMS in the mother depot was not selected. Third, technical workaround could avoid complicated technical solution that aims to fully meet business requirements. In order to fully satisfy business change requirements, organisations may have to offer a complicated technical adaptation solution. However, as stated above, organisations are constantly constrained by limited resources. Organisations must find an economical way of dealing business uncertainties. Simply satisfying what business asks could only drain the limited resources the organisations have, pointed out by the MIS manager of Machine. Technical workaround offers an option for organisations that organisations can manipulate their resources to achieve "optimal flexibility" by sacrificing the efficiency and effectiveness of the business needs. Case Brewery 1 illustrated above is a good example. Adopting lean WMS in the mother depot sacrifice some effectiveness of business needs, the resource required for this solution was massively less than the solution of adopting full WMS. In Case Charity 1 new competence-based training scheme, the solution of creating fields in SAP HR module was far less simple than other solutions and was measured as the most flexible solution.

#### 7.5.2.4 Business workaround tactic

| **Tactic: Business workaround** | | | | | | |
|---|---|---|---|---|---|---|
| **Proposed and adopted in the cases** | **Major adaptation activities** | **Time** | **Cost** | **HR** | **Effectiveness** | **Implication** |
| Case Machine 2: changing fix assets depreciation rate | Amending figures | 7 | 8 | 8 | 5 | -2 |
| Case Machine 5: creating new inventory report | Exporting data into spreadsheet | 10 | 8 | 8 | 5 | -3 |
| Case Machine 6: introducing depreciation preparation | Manually adjust figures | 10 | 6 | 9 | 2 | -3 |
| Case Machine 7: automating invoice numbering and printing | Manual input | 10 | 8 | 9 | 4 | 0 |
| Case Brewery 4: new supplier performance report | Manual input, intervention | 9 | 9 | 9 | 5 | -2 |
| Case Brewery 6: introducing the packing operation for the promotional scheme | Change pricing condition Persuasion on the sales team and the customer | 8 | 8 | 8 | 1 | 0 |

**Table 62 Business workaround tactics proposed and adopted in the cases**

(The adaptation tactics adopted or adopted in procrastination are highlighted.)

Business workaround tactic is a proactive path for organisation to solve business problems. Flexibility is normally considered as an adaptive response towards business uncertainty (Gupta and Goyal 1989, Gerwin 1993). Business workaround provides an alternative path to solve business problems. It takes off the pressure for changing adopting IT systems, but focuses on redefining the need for IT flexibility by changing the business itself. Business needs are solved by altering business processes and performing some manual intervention. Organisations proactively change business itself to match what ES can offer and encourage end users to see the benefits of changing the business rather than adjusting the IT system and accept the business workaround solution. Business workaround approach is similar to the business reengineering and/or "big bang" approach adopted in the ES initial implementation period where business is required to adapt to the best practices represented in ES packages and keep ES intact (Davenport 2000, Markus and Tanis 2000).

The research shows the effectiveness level of business workaround solutions are ranging from 1 to 5, which is much lower than other system adaptation solutions such as technical adaptation, technical banking, even technical workaround solutions. This suggests that business workaround solutions can not fully meet business requirements and would sacrifice effectiveness and efficiency of business operation. It also implies that the end users' satisfaction level is low. Therefore, organisations need to persuade end users to buy in business workaround solutions. Notwithstanding, the case study demonstrates that business workaround solutions are cost saving solutions. Overall, the time consuming, cost spending and HR requirements are much lower.

It is found in the research that business workaround were adopted in four occasions. First, business workaround is adopted as an intermediate solution when a system adaptation is uncertain. Case Machine 7 is the case. In Case Machine 7 automating invoice numbering and printing, because of the uncertainty of releasing new invoicing software either by the governmental tax authority or SAP, Machine decided to put on hold the change request of automating invoice numbering and printing and manually input invoicing details into the system instead. Second, business workaround is adopted as an intermediate solution when organisations decided to align with their IS plan and procrastinate the change of their systems. Case Machine 5 is the case. In Case Machine 5 creating new inventory report, as the business change request was not urgent, the IS department planed to procrastinate a system adaptation solution in a later date so that their IS staff completed some pressing jobs and became available. At the mean time, a simple manual intervention solution was quickly introduced to resolve the business problem although the solution sacrificed the efficiency of business operation that accounting people desired. Third, business workaround is adopted when the critical level of business needs is high and there is no available technical solution to meet the business demands, therefore, organisations have to change the business operation itself. Case Machine 6 is the case. In Case Machine 6 introducing depreciation preparation, due to the change of accounting regulation, adopting the new depreciation preparation method was critical for the business. However by consulting their external ES support firm, there was no current technical solution available to solve this problem. Therefore, Machine had to manually adjust figures in the fixed asset module even though the workload was heavy. Fourth, business workaround was considered as an appropriate solution when the business workaround solution is proven to be more cost-effective or flexible than other solutions. In Case Brewer 4 creating new supplier performance report, a manual intervention solution proved to be more cost-effective than other two technical adaptation solutions (see Table 44). Moreover, although the business change request for providing supplier performance report was urgently needed by Brewery's major customer, but not regarded as highly critical to their business as the report was not specified. Therefore a quick and cost-saving business workaround solution was selected.

#### 7.5.2.5 Procrastination tactic

| **Tactic: Procrastination** | | | |
|---|---|---|---|
| **Proposed and adopted in the cases** | **Reasons for procrastination** | **Solution adopted during procrastination (if the procrastination tactic adopted)** | **Time spend on procrastination** |
| Case Machine 5: creating new inventory report | Align with IS plan | Business workaround | 3 months |
| Case Machine 6: automating invoice numbering and printing | Align with third party solution development schedule | Business workaround | 12 months |
| | Align with ES vendor development schedule | | 12 months |
| Case Brewery 2: introducing bulk pick operation | Waiting for the realisation of pre-requisite technical condition | Inaction | 8 months |
| Case Brewery 3: improving KPI reporting for SCM | Align with IS plan | Inaction | 12 months |
| Case Brewery 5: change of discrepancy management process | Waiting for the realisation of pre-requisite technical condition<br>Waiting for the business requirement to mature | Inaction | 12 months |
| Case Brewery 6: introducing the packing operation for the promotional scheme | Align with IS plan (change freeze)<br>Waiting for the realisation of pre-requisite technical condition | Inaction | unknown |
| Case Charity 1: ne | Align with ES vendor develo | n/a | 12 months |

| | | | |
|---|---|---|---|
| w CBT scheme | pment schedule (Leaning solution) | | |
| | Align with ES vendor development schedule (new version) | | 16 months |
| Case Charity 2: improving payroll operation | Align with IS plan<br>Waiting for the realisation of pre-requisite technical condition | Inaction | 12 months |

**Table 63 Procrastination tactics proposed and adopted in the cases**

(The adaptation tactics adopted or adopted in procrastination are highlighted.)

Procrastination is a different tactic from above tactics, which aims to delay the need for IT change. The idea of procrastination approach is that if it can not be solved by now, why not put on hold the need and then solve it for a right time that an appropriate solution or sufficient resource will be available in the future. The research shows that the three studied organisations had used the procrastination tactic for five reasons; aligning with IS plan, waiting for the business requirement to mature, aligning with third party solution development schedule, aligning with ES vendor development schedule and waiting for the realisation of pre-requisite technical condition. First, planning information systems is an important task for organisations (Henderson and West 1979) and managing a portfolio of IS projects is critical for organisations to understand the demands placed on IT (Bolles 2003). All IS projects need to align with IS plan and to be prioritised according to the importance of organisational needs and resource allocation. Adopting procrastination tactic is able to mediate the pressure on limited organisations' resource on system development. In Case Machine 5 and Case Brewery 3, procrastination was adopted mainly for this reason – limited resources for IT adaptation. Second, aligning with third party solution development schedule is another reason found in the research for organisations to adopt procrastination approach. In Case Machine 7 automating the invoice numbering and printing, as the tax authority was being developing a new software for invoicing, Machine decided to wait for this software to come out and compare it with an SAP updated solution. Third, as ES is a major investment for organisations. It was found that due to the concern of future maintenance and system integration, most organisations preferred to an SAP solution to satisfy their business needs. Also ES adopting organisations are constantly in touch with ES vendors and IT consultancy firms for ES development plan undertaken by ES vendors. Therefore, when a business need can be accommodated by near future ES vendor solution, organisations may consider to procrastinate it and waiting for the issuing of the ES vendor solution. Fourth, some technical solutions can only be achieved under certain technical conditions. Therefore, organisations could choose to procrastinate the change request and wait the realisation of pre-requisite technical conditions. For example, in Brewery 5 changing discrepancy management process, because the discrepancy management change would require a system solution that would be build upon the WMS and bulk pick programme, the system adaptation had to be procrastinated until the pre-requisite technical conditions were realised. Fifth, the research shows that sometimes a business change requirement is not mature enough to initiate the development. Therefore, a logic solution is to wait until the business needs become clear. In Case Machine 5, the MIS department found that the logic of discrepancy management was established on the processes of distribution and there would be lots of change on the process of discrepancy management due to the implementation of bulk pick project. Therefore, the discrepancy management change had to be procrastinated until the bulk pick project was successfully realised.

### 7.5.2.6 Inaction tactic

| Tactic: Inaction | | |
|---|---|---|
| **Proposed and adopted in the cases** | **Reasons for inaction** | **Criticality** |
| **Case Brewery 2: introducing bulk pick operation** | Procrastination / waiting for the realisation of pre-requisite technical condition | 3 |
| **Case Brewery 3: improving KPI reporting for SCM** | Procrastination / aligning with IS plan | 2 |
| **Case Brewery 5: change of discrepancy management process** | Procrastination / waiting for the realisation of pre-requisite technical condition | 1 |
| **Case Brewery 6: introducing the packing operation for the promotional scheme** | Procrastination / aligning with IS plan (change freeze) | 2 |
| **Case Charity 2: improving payroll operation** | Procrastination / aligning with IS plan and waiting for the realisation of pre-requisite technical condition | 4 |

**Table 64 Inaction tactics proposed and adopted in the cases**

Inaction is an approach that organisations choose to totally ignore the business change requests. The research undertaken by Benamati and Lederer (1999 and 2001) demonstrates that inaction is one of the coping mechanisms for business problems. This boldly answer is normally given to any business requirement that is not significant enough or adopted to work with procrastination approach. The research shows all five occurrences of inaction approaches were adopted to work with procrastination approach. This implies that all three organisations tried to accommodate business needs and totally ignoring the business needs are not accepted. Moreover, as inaction approach does not consume any resource, it may be an ideal solution when the importance of business request is low and it is adopted with the procrastination approach.

### 7.5.3 The impact of operational solution on business flexibility

In Chapter 2, it is discussed that the organisational capability to support business flexibility is directly affected by the operational dimensions that describe the operational responses to environmental requests. As stated, the actual adaptation solution determines the resource requirement for adaptation. Operational solutions can be categories in two dimensions:

- scope, the extent to which changes are made to satisfy business requirements, or the complexity of adaptation; and
- utilisation, the method of using the resource for flexibility.

The dimension of utilisation indicates the method of using the resource for adaptation. The literature in flexibility states that flexibility is actually a resource that can be built-in, reserved in advance and utilised later when necessary (Slack 1989; Gerwin 1993; Browne et al. 1984).

Technological resource refers to the technical solutions that organisations can employ to respond to business needs. It reflects the nature of adaptation activities and how technical flexibility is employed to support business requirement. Based on the literature on flexibility, the dimension of utilisation is adapted to categories of system exploitation, system tailoring and system extension (see section 6.2). Each type of adaptation method comprises of several types of adaptation activities, which cause different level of impact. In general, it is found in the research that most of system exploitation and system tailoring solutions are less resource demanding than system extension solutions (see Table 56 and Table 65). Table 65 illustrates the impact of adaptation activities on time, cost and HR requirement summarised in the study. This fulfils with most of Brehm, Heinzl and Markus's (2000) rough indication of the effort required by different ES adaptation types. There is one exception that according to Brehm, Heinzl and Markus's (2000) indication, third party bolt-on application is ranked to cause the second lightest impact among all adaptation type. However, their indication does not include the cost of software acquisition whereas for third party bolt-on, it is the major source of spending.

In Chapter 4, the characteristics of ESs indicate a great potential of ES that organisation can utilise for future business needs. The potential of ES lies in two aspects:

1. built-in functionality through its configuration table; and
2. free support and software improvement by legal patch upgrades.

Reconfiguration is widely used by ES adopting organisations to support ongoing business needs that can be matched by build-in functionality in a given ES. It is one of the most preferred adaptation methods as the time consuming and cost spending is low. It is because organisations have pre-paid the effort through the initial implementation and the acquisition of ES package. The major cost of reconfiguration is the human resource cost. The Business Strategy Director at Brewery has pointed out several times that SAP is a significant investment and now is the time to use it better and explore its potentials. Reconfiguration is one the exploitation approach to adapt ES to support ongoing business needs. Moreover reconfiguration requires medium level of expertise who are familiar with the settings in the configuration table to conduct the adaptation. For small and inexperienced organisations, such as Machine, who lack of experienced IS staff, external consultant may be required to undertake the reconfiguration.

Legal patch upgrade is to use small support package supplied freely by ES vendors to fix bugs, enhance functionalities and add functionalities to an installed ES (Ng 2001). Like reconfiguration, legal patch upgrade is a system exploitation approach as the support is provided freely through the software licence which is acquired during the initial implementation. However, the functionality supported through legal patch upgrade is not known before hand. ES adoption organisations need to wait until the legal patch is issued. Therefore, it is not an ideal solution when a business need is urgently required. Legal patch upgrade is a short time consuming and low financial cost adaptation solution. The only cost is to have a right person to conduct the change. ES vendor usually will provide a detailed instruction when issuing a legal patch. Therefore, the HR requirement is not high.

Adopting ES is a major investment for organisations. Therefore exploiting the potential of ESs is the preferred approach to support ongoing business needs. However, due to the pre-packaged nature and best practise nature of ES, it is inevitably that the business requirement can not be supported by built-in ES applications. Therefore, organisations need to seek other avenues to solve the business problems. Two other methods of adaptation are system tailoring and system extension.

System tailoring refers to minor or less significant technical adaptation work other than reconfiguration and legal patch upgrades. Here the definition of system tailoring is classified differently from what Brehm et al (2000)'s which includes all sorts of system modification and extension activities. It encompasses technical adaptation activities such as report development, screen adjustment and minor ERP programming. The research shows that system tailoring usually does not involve high level of resource and expertise to support the change. Usually ES adopting organisation can use their internal staff to carry out the adaptation. The financial cost is low as the main cost of adaptation is personnel cost.

System extension is needed when existing ESs cannot support new business requirements and new functionalities need to be acquired or upgraded either from the ES vendor or a third party software vendor or to be developed in house. System extension is major adaptation work that extends the boundary of the existing ES functions. It usually requires high cost and resources to implement the new acquisition or ES upgrades, and also attracts attention from senior management to support the implementation. System extension include acquiring an application module from ES vendor, acquiring a software solution from 3rd party, upgrade of an adopting ES and major application development. The cost of system extension is very high as it comprised the cost of software acquisition and employing external consultation. The study shows that acquiring a vendor solution is mostly accepted by the three organisations if the price of software acquisition can be accepted compared to a 3rd party solution. The major reason is that adopting a vendor solution mitigates the concern of system integration. While due to the pre-packaged nature and best-practise of ESs, it could be mismatch between the feature provided and business requirement. For example, in Case Charity 1, SAP learning solution could not support all the business requirements for competence based training. Therefore Charity chose to develop their own with 3rd party support. Moreover, the availability and the maturity of newly ES vendor solution need to be considered if the business requirement is urgent. A 3rd party application solution is usually cheaper than an ES vendor application solution. Moreover the 3rd party software vendor usually will provide extra consultancy support for the implementation. This helps organisation to find an appropriate consultants to support the implementation.

| Adaptation method | Adaptation activities | Solution provider | Time | Cost | HR |
|---|---|---|---|---|---|
| System exploitation | Reconfiguration | ES vendor | Short | Low (HR cost) | Medium (for small organisations, external consultant support might be needed |
| | Legal patch upgrades | ES vendor | Short (need to wait until the package code to be issued) | Low (HR cost) | Low (HR requirement is not high) |
| System tailoring | Report development | Adopter | Short | Low | Medium |
| | Screen adjustment | Adopter | Short | Low | Low |
| | none-major ERP programming | Adopter | Medium | Medium | Medium |
| System extension | An application module from the ES vendor | ES vendor | Medium – Long (need to wait the issuing of new application module) | High (cost of acquiring the ES module External consultant cost) | High (usually require experienced external consultant) |
| | 3rd party bolt-on | 3rd party | Medium – Long (only implementation time) | Medium – High (software acquisition cost, Internal IT perso | Low – Medium (the 3rd party may provide support for impl |

| | | | | | |
|---|---|---|---|---|---|
| | | | | n cost, | ementing the bolt-on application) |
| | major ES application development | Adopter | Long | Medium (external consultant cost, Internal IT staff cost) | Medium – High (usually require experienced consultants) |
| | ES upgrades | ES vendor | Long (need to wait the issuing of new ES upgrades) | High (External consultant cost, Internal IT staff cost The cost of acquisition of ES upgrade) | Medium (usually require experienced consultants, and internal IT staff familiar with the customisation of the existing ES) |

**Table 65 The resource requirement of different system adaptation solution**

The research shows that the complexity of adaptation can be indicated in the following aspects:

1. the nature of adaptation activities as discussed above;
2. extensiveness of ES adaptation – the level of usage of system adaptation. The heavy usage of reconfiguration (e.g. Case Machine 3) entails more effort than a minor reconfiguration (e.g. Case Machine 1);
3. the number of different adaptation type used. Usually a system adaptation is a combination of several adaptation types. Different type of adaptation may require different level of IS staff and business operational staff to support the adaptation. Hence the number of different adaptation type used may increase the complexity of adaptation and coordination among supporting personnel. Brehm, Heinzl and Markus (2000) also indicates that "the number of different tailoring types used, which may be an indicator of tailoring complexity and is plausibly related to tailoring impact or risk";

4. the degree of conversion and replication in data. The research shows that converting historical data is one of the concerns when a solution is to replace an existing application or to build a separate application system on ES. It is a massive work to migrate data into a new system. Therefore, in order to save the time and cost of adaptation, historical data is not to be converted and replicated into the new application system. This is particularly appropriate for small organisations where budget for IS support and maintenance is low. For example, Machine did not opt for converting the historical data into the retailing company when the ES is reconfigured to have two systems for retailing operation and manufacturing operation. Moreover, the quality of data determines the complexity of data conversion. In Charity, due to the poor implementation of their ES, Charity had to running a "getting well" programme which led to a nearly re-implementation of SAP HR before the implementation of the payroll application.

## 7.6 Summary

The research shows that the business environment is becoming more and more volatile and systems flexibility is an important feature of information systems to cope with ongoing business changes. Despite that, however, few can provide a definition of what IT flexibility means for their organisation and an appropriate method to deal with their IT system flexibly when business changes.

It is also found in the research that organisations view ESs as a more flexible technology compared with other technologies. ESs are able to offer more mechanism of system adaptation and support than other type of ISs due to its unique characteristics and capabilities. These mechanisms include

- ✓ using built-in capacity and functionalities,
- ✓ obtaining more external support through 3rd party solution, external consultancy, and resetting business partner's system due to the standardised platform of ESs, and
- ✓ the long term bonding with ES vendors that helps to realise the benefit of continuous functionality development and maintain integrity of adopting ESs

A significant lesson is learned that achieving flexibility is not merely an IS technical issue, but a systematic concern. Organisations need to assess their organisational conditions and evaluate the effect and the cost of attaining flexibility, and trade off between them in order to achieve optimal flexibility. The researcher uses the phrase of "optimal flexibility" to describe the best outcomes the organisations could achieve with ESs for ongoing business changes, given its organisational situations and technical conditions, compared with a portfolio of alternative solutions, and measured against the metrics of the effect, implication and costs of adaptation and risks of urgency, criticality, financial strength and expertise availability. The goal for flexible adaptation varies according to different organisational situations that include criticality of the business changes, urgency for achieving business needs, financial strength and expertise availability. Optimal flexibility can be achieved through two level of assessment: 1) actual flexibility assessment and 2) contextual flexibility assessment. The two level assessments for flexible adaptation involve the systematic identification and valuation of the risk and feasibility for attaining flexibility.

Moreover, the multidimensional features of ES support for ongoing business changes are discussed. Three features are identified for the impact on different nature of business changes:

1. technical adaptation and technical banking solutions are usually adopted for high critical business changes;
2. the resource readiness for supporting business changes varies due to the nature of business requirements;
3. high critical business changes do not necessarily result in a high cost adaptation solution and the cost of adaptation depends on the actual adaptation solution.

The impact of these six adaptation tactics is also discussed. The research shows that these six generic adaptation tactics have different resource requirement and performance outcome. First, it is found in the research that the technical adaptation tactic is widely accepted and a preferred path for organisations to respond to changing business environment. As technical adaptation is a passive adaptation approach, the main goal of which is to alter IT systems to fully satisfy business change requirements, the expected effectiveness of adaptation is high. Technical adaptation usually requires higher level of resources in order to achieve best fit than technical workaround and business workaround tactics. Second, the adoption of technical banking tactic was associated with significant requirements for monetary cost, time span for implementation and involving expertise and staff. As technical banking tactic is a resource demanding approach, organisations should assess themselves to see if there are enough resources available and affordable to be employed for the adaptation. The time consuming nature of the technical banking approach suggests that technical banking is not a suitable way to satisfy urgent business needs. Furthermore, technical banking approach requires organisations to account for future and potential "likely" business needs when considering the technical banking solution. Third, technical workaround is a reduction strategy that reduces the need for system flexibility. As technical workaround does not aim to fully solve business needs, the expected effectiveness is compromised. However technical workaround could mediate the pressure of business requirements by offering a compromised method to meet part of the business needs. Besides technical workaround could avoid complicated technical solution that aims to fully meet business requirements, which reduce the requirement on limited resources. Fourth, business workaround approach focuses on redefining the need for IT flexibility by changing the business itself. Business needs are solved by altering business processes and performing some manual intervention. The research shows that business workaround would sacrifice effectiveness and efficiency of business operation. It also implies that the end users' satisfaction level is low. Business workaround is used in four occasions:

1. as an intermediate solution when a system adaptation is uncertain;
2. as an intermediate solution when organisations decided to align with their IS plan and procrastinate the change of their systems;
3. as an intermediate solution when the critical level of business needs is high and there is no available technical solution to meet the business demands; and
4. as an appropriate solution when the business workaround solution is proven to be more cost-effective or flexible than other solutions.

Fifth, the research shows that organisations use procrastination approach for five reasons; aligning with IS plan, waiting for the business requirement to mature, aligning with third party solution development schedule, aligning with ES vendor development schedule and waiting for the realisation of pre-requisite technical condition. The idea of procrastination approach is that if it can not be solved by now, why not put on hold the need and then solve it for a right time that an appropriate solution or sufficient resource will be available in the future. Sixth, inaction is the answer normally given to any business requirement that is not significant enough or adopted to work with procrastination approach.

Finally the cost, time spending and resource implication of adaptation activities are illustrated. It argues that the complexity of adaptation can be indicated in several aspects:

a). the nature of adaptation activities, b). extensiveness of ES adaptation – the level of usage of system adaptation, c). the number of different adaptation type used. Usually a system adaptation is a combination of several adaptation types, and d). the degree of conversion and replication in data.

# CHAPTER 8

# Conclusion

## 8.1 Introduction

This chapter presents the conclusion and contributions achieved in the research findings. It then identifies the implications of this study for ES research and ES practices. Suggestions for future research are also described. This chapter concludes with the limitations of the research.

## 8.2 Conclusions of the Research

The research is initiated with the emerging issue of IS flexibility that IS researchers and practitioners are striving hard to solve. Allen and Boynton (1991) states "the competitive business must be much more dynamic and adaptive than in the past and, for this purpose, will need the most flexible information system it can find". However, it is sometimes treated as axiomatic that modern information technology contributes to business flexibility. ISs do not necessarily assist business flexibility and can be the cause of rigidity (Davenport 2000; Allen and Boynton 1991; Lucas and Olson 1994). Theory and empirical evidence for IS flexibility for supporting ongoing business needs are much harder to find. The three studied organisations universally recognise that flexibility is an important capability of information systems in a turbulent business environment. In spite of that IT flexibility is much desired trait, few can provide a definition of what IT flexibility means for their organisation and an appropriate method to deal with their IT systems flexibly when business changes. This finding is not surprising as IT flexibility for ongoing organisational changes are less known due to lack of research in IT maintenance (Glass and Vessey 1999). Therefore, "for most managers the attainment of flexibility is a gut feeling" (Golden 1997).

This research has presented the great detail and variety of ES adaptation methods for ongoing business changes during the post-implementation stage of ES adoption. A model of tactical ES adaptation (Figure 9) is developed to assist in describing and characterising the evidence involved. Therefore, a holistic understanding of the subject is to be attained. This model is established upon Gerwin (1993)'s conceptual framework for flexibility (Figure 3). It provides a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes. With this model the research exposes a complicated decision making process for ES adaptation to support ongoing business changes and attain flexibility. It demonstrates the dynamic relationship among emerging business needs, adaptation tactics, adaptation activities, performance measurement and resource measurement, and risks concerns.

The study of the post-implementation experience of ES use in the three organisations demonstrates that ES is regarded as a more flexible technology than previous IT solutions, which is commented by the three interviewed organisations. The finding is contradictory to some literature of ESs that comprises full of negative voices and concerns of inflexibility of ESs (Davenport 2000; Markus and Tannis 2000; Bylinsky 1999; Cameron 1998; Ni and Kawalek 2001). The research shows that ESs offer ES adoption organisations more mechanism of system adaptation and support than other type of ISs due to its unique characteristics and capabilities (see Chapter 3). First, the configuration capability is a unique feature of ES that can provide ES adopting organisation a low resource consuming and high performance delivering solution for their specific business needs within the capacity. All the three organisations view ES adoption is to bank extra capabilities for their future use. Second, the standard platform of ESs and development tools provided by ES vendors allow 3rd party software vendor to develop common surrounding application. Opting for 3rd party solution reduces the time for development and implementation and also mitigates the need for organisations to employ competent staff compared with the need for in-house development. The nature of standardisation of ESs also allows consultants to share and communicate knowledge in ESs. ES specialists are easier to find than with a proprietary system. Using third party consultants is widely accepted especially by small organisations where IT department budget is not enough to hire full time expensive ES specialists. Third, it is found in the three organisations that continuous ES vendor support is important for their future system adaptation especially when organisations intend to maintain the integrity of adopting ESs. It contrasts with some academics (Markus et al 2000)'s criticism about ES vendor lock-in problem after initial system implementation. ES vendor provide three types of support; legal patch application, ES new version upgrades, and new solutions and new development. The bonding with ES vendors help organisation to receive long term benefits for future business needs and the integrity of the IS infrastructure.

A significant lesson is learned in the research that achieving flexibility is not merely an IS technical issue, but a systematic concern. This means that organisations need to assess their organisational conditions and evaluate the effect and the cost of attaining flexibility, and trade off between them in order to achieve optimal flexibility. Achieving business flexibility is more an organisational issue rather than merely a technical issue. "Optimal flexibility" is adopted in the research to describe the best outcomes the organisations could achieve with ESs for ongoing business changes, given its organisational situations and technical conditions, compared with a portfolio of alternative solutions, and measured against the metrics of the effect, implication and costs of adaptation and risks of urgency, financial strength, criticality and expertise availability. The goal for flexible adaptation varies according to different organisational situations that include criticality of the business changes, urgency for achieving business changes, financial strength and expertise availability. Organisations shall weigh on balance not only among the effect of adaptation, the implication on organisations, and the cost required, but also among the flexibility that could be achieved and the flexibility that is desired due to different organisational and technical conditions. It is presented in the model that optimal flexibility can be achieved through two level of assessment: 1) actual flexibility assessment and 2) contextual flexibility assessment. The two level assessments for flexible adaptation involve the systematic identification and valuation of the risk and feasibility for attaining flexibility. Although actual flexibility assessment is important for organisations to understand the extent of capability of change, there is a downside to rely solely upon performance and resource evaluation. The problem is that it does not recognise the contextual environment or the organisational capacity to which the flexibility is subject. Offering too much flexibility in a dimension where it is not desired is a waste of resources and may not satisfy the criteria that are aimed for. As a matter of fact, the second level of assessment for flexibility evaluates the risk of attaining best outcomes by measuring key criteria of flexibility mentioned in the first level of flexibility assessment against the capacity or conditions for adaptation including criticality, urgency, financial strength and expertise availability. This finding is aligning with Volberda (1999)'s argument that flexibility is associated with the controllability of the organisation and the control capacity of management. Similarly, the "optimal flexibility" calls for the balance of capabilities that the adaptation can perform and the control capacity that organisations can offer. The decision for adaptation needs to assess the performing capability of the adaptation (actual flexibility assessment) and organisational capacity of adaptation (contextual flexibility assessment) in order to find a most realistic solution. Moreover, the two stage flexibility assessment can help organisations to identify their weakest dimensions and strongest dimensions so that organisations can concentrate on what is most important for adaptation.

The model (Figure 9) demonstrates that by identifying environmental uncertainties and assessing the performance and resources for a portfolio of adaptation solutions against organisational capacity and conditions, organisations can opt for an adaptation tactic that could generate most benefits. Adaptation tactics characterise management's intervention for providing solutions to the environmental requirements. Six adaptation tactics are identified. They are technical adaptation, technical banking, technical workaround, business workaround, procrastination and inaction. These six adaptation approaches cause different impact on business flexibility. Table 58 illustrates the intention of adaptation tactics and their impact on the original business requirements.

1). Technical adaptation tactic is widely accepted and a preferred path for organisations to respond to changing business environment. With the technical adaptation tactic, the main goal of which is to alter IT systems to fully satisfy business change requirements. Therefore, the expected effectiveness of adaptation is high. Technical adaptation is a suitable tactic when the criticality level of business change is high which requires high level of effectiveness for system change. Moreover, in order to maximise the effectiveness that the businesses desire, it requires technical flexibility and matching resources to back the adaptation. Depending on the actual adaptation solution and activities, the associated cost and requirement for technical adaptation vary. The research shows that technical adaptation usually requires higher level of resources in order to achieve best fit than technical workaround and business workaround tactics. It is because that technical workaround and business workaround approaches reduce the need to achieve best fit for the business problem by offering an alternative solution that compromises the business requirement.

2). Technical banking is an aggressive or offensive tactic where organisations may want to proactively build more system capacity for future needs instead of merely passively satisfying current business needs. Technical banking has a great impact on organisations. First, as technical banking seeks to build more functionality and capacity in the system than what is needed for current business requirements, technical banking is more demanding for resources to support the adaptation.

Therefore, organisations shall prepare sufficient resource in order to support the technical banking approach.

3). Technical workaround is an approach that offers an IT solution that manages to accommodate part of the business need. Technical workaround is a compromised solution towards business problems. Technical workaround has important implication. First, technical workaround does not aim to fully solve business needs, and the expected effectiveness is compromised. Second, technical workaround could mediate the pressure of business requirements by offering a compromised method to meet part of the business needs. Third, technical workaround could avoid complicated technical solution that aims to fully meet business requirements. Organisations must find an economical way of dealing business uncertainties. Simply satisfying what business asks could only drain the limited resources the organisations have. Technical workaround offers an option for organisations that organisations can manipulate their resources to achieve "optimal flexibility" by sacrificing the efficiency and effectiveness of the business needs.

4). Business workaround tactic is a proactive path for organisation to solve business problems. It takes off the pressure for changing adopting IT systems, but focuses on redefining the need for IT flexibility by changing the business itself. Business needs are solved by altering business processes and performing some manual intervention. It is found in the research that business workaround were adopted in four occasions: a). when a system adaptation is uncertain; b). when organisations decided to align with their IS plan and procrastinate the change of their systems; c). when the critical level of business needs is high and there is no available technical solution to meet the business demands; d). when the business workaround solution is proven to be more cost-effective or flexible than other solutions;

5). Procrastination aims to delay the need for IT change when it is not a right time to conduct the change. The research shows that the three studied organisations had used the procrastination tactic for five reasons; aligning with IS plan, waiting for the business requirement to mature, aligning with third party solution development schedule, aligning with ES vendor development schedule and waiting for the realisation of pre-requisite technical condition; and

6). Inaction is an approach that organisations choose to totally ignore the business change requests. This boldly approach is normally accepted for any business requirement that is not significant enough or adopted to work with procrastination approach. As inaction approach does not consume any resource, it may be an ideal solution when the importance of business request is low and it is adopted with the procrastination approach.

The study has analysed the impact of different nature of business needs on ES adaptation. Three features are identified for the impact of different nature of business changes:

1. Technical adaptation and technical banking solutions are usually adopted to high critical business changes;
2. The resource preparedness for supporting business changes varies due to the nature of business requirements. When the business requirement is critically important towards affected organisations, organisations are willing to allocate adequate resource to support the adaptation. With low critical business

requirements, the decision for choosing adaptation solution is more based on how to better use existing resource to achieve reasonably better result; and

3. High critical business changes do not necessarily result in a high cost adaptation solution and the cost of adaptation depends on the actual adaptation solution. The resource requirement is more associated with the actual adaptation solution rather than the criticality level of business changes.

Finally, the impact of operational solution on business flexibility are analysed and characterised. The impact of adaptation can be indicated in the following aspects:

1. the nature of adaptation activities. They are categorised as system exploitation, system tailoring and system extension (see section 6.2). Each type of adaptation method comprises of several types of adaptation activities, which cause different level of impact. In general, it is found in the research that most of system exploitation and system tailoring solutions are less resource demanding than system extension solutions (see Table 56 and Table 65). Table 65 illustrates the impact of adaptation activities on time, cost and HR requirement summarised in the study;
2. extensiveness of ES adaptation – the level of usage of system adaptation;
3. the number of different adaptation type used. Usually a system adaptation is a combination of several adaptation types. Different type of adaptation may require different level of IS staff and business operational staff to support the adaptation. Hence the number of different adaptation type used may increase the complexity of adaptation and coordination among supporting personnel;

4. the degree of conversion and replication in data. The research shows that converting historical data is one of the concerns when a solution is to replace an existing application or to build a separate application system on ES. It is a massive work to migrate data into a new system. Therefore, in order to save the time and cost of adaptation, historical data is not to be converted and replicated into the new application system. This is particularly appropriate for small organisations where budget for IS support and maintenance is low.

## 8.3 Research Contribution

The purpose of this research is to generate a descriptive and explanatory theory of how organisations use their adopting ISs/ESs to support ongoing business changes. It aims

> *To develop a model of post-implementation ES support for ongoing business changes that allows academics and practitioners better understanding the nature of business changes, various options for coping with these changes with their adopting ESs, and resource and cost associated with these changes.*

The model depicted in Figure 9 would enable academics and practitioners to analyse, plan and achieve system flexibility in face of business environment uncertainty. The key contribution of this research is in five aspects:

1. This research provides a comprehensive literature review of flexibility which lays the foundation for future research in flexibility. The generic framework of flexibility adapted from Gerwin (1993) and further developed into multi-

dimensions and measurement can be adopted by academics and practitioners to develop their own model for analysing and better understanding the flexibility issue in other research disciplines;

2. This research develops a tactics model for ESs post-implementation adaptation (see Figure 9). This model depicts a complicated decision making process for ES adaptation for supporting ongoing business needs. It provides a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes. It demonstrates the dynamic relationship and interaction among emerging business needs, adaptation tactics, adaptation activities, performance measurement and resource measurement;
3. Six generic adaptation tactics are identified in the research. There are technical adaptation, technical banking, technical workaround, business workaround, procrastination and inaction. This finding contrasts with a). traditional view of flexibility where organisations normally consider flexibility is a passive adaptive response towards business uncertainties (Gupta and Goyal 1989, Gerwin 1993) and b). the traditional view of information systems maintenance that the goal of system adaptation and enhancement is to accommodate business operation environment by correcting, adapting, preventing and perfecting information systems (Takang and Grubb 1996). Rather than passively adapting the system to merely meet business needs, business can consider to build more functionality for the future (technical banking), providing a compromising IT solution to satisfy party of the business needs (technical workaround), redefining the need for IT flexibility by altering business processes and performing some manual

intervention (business workaround), procrastinating the system adaptation (procrastination), and totally ignoring the request of business needs (inaction). This provides ES practitioners alternative angle to look at business flexibility and an alternative approach to handle business flexibility;

4. A significant lesson learned in the research is that "optimal flexibility" is the goal that organisations are seeking to respond to their constant changing business environment. This means that the traditional view of flexibility i.e. cost-effective or a combination of maximised performance expected and minimised resources required (Slack 1983; Evans 1991; Upton 1994; Volberda 1996) is not always applicable in today's organisations. Instead, organisations need to assess their organisational conditions and evaluate the effect and the cost of attaining flexibility, and trade off between them in order to achieve optimal flexibility. Achieving business flexibility is more an organisational issue rather than merely a technical issue. "Optimal flexibility" is to describe the best outcomes the organisations could achieve with ESs for ongoing business changes, given its organisational situations and technical conditions, compared with a portfolio of alternative solutions, and measured against the metrics of the effect, implication and costs of adaptation. For this, two level of assessment is proposed in the research: 1) actual flexibility assessment and 2) contextual flexibility assessment. The two level assessments for flexible adaptation involve the systematic identification and valuation of the risk and feasibility for attaining flexibility. The two level of assessment can be used as a tool for ES practitioners and researchers to analyse the impact of an adaptation solution and identify key areas and risks that should be focused on for adaptation; and

5. The research evaluates the impact of multidimensional feature of ES adaptation. Besides the adaptation tactics have been discussed in-depth, the adaptation activities are also depicted. The resource requirement (time, cost, HR requirement) of ES adaptation activities are presented in **Table 65**. This provides ES practioners a general view of the impact of adaptation activities on business flexibility.

## 8.4 Limitation of the Study

The research is exploratory since the research topic, namely "IS Flexibility", to date has received little attention and there is no adequate literature. The overall research approach is to build theory from multiple-case studies. This approach is appropriate as this study, being the first to specifically address the issue, is exploratory in nature, and aims to develop a novel and tentative theory about IS/ES post-implementation adaptation (Eisenhardt 1989). The multiple-case design then was adopted to improve the robustness of the study and the analytic generalisability (Yin 1994; Robson 1993). The limitation exists with regard to the inherent subjectivity nature of case study approaches in that the findings of research could be subject to biases, subjective and selective preconceptions, and interest of researchers (Miles and Huberman 1994).

It is noted that the investigation is limited to the study of three selected organisations (two in the UK and one in China). However, only 15 adaptation occurrences were clearly reported by the three organisations. This could cause the concern for the generalisability of the theory. In addition, the people participated in the interview are all managerial staff due to two reasons. First, during the pilot case study, the researcher found out the end users had limited knowledge and insights about the decisions made for the system adaptation, the interviewees required by the researcher are only managerial staff to ensure each interview could receive detailed information regarding system and business adaptation. Second, the level of access of these three studied organisations was very much limited to managerial staff. Therefore, end users, other staff and external consultants were not participated in the interview. This would suggest that the resulting finding and theory is subject to the biases of involving participants in the three organisations. Furthermore, some part of the flexibility assessment is based on the participants' estimation rather than a well recorded data. For example, for some alternative adaptation solutions, usually there were no solid evidence for the resource requirement and effectiveness and the implication of the adaptation results. These were based on participants' estimation. Lucas and Olson (1994) point out that the evaluation of what is positive and negative depends very much on the observer's position.

Finally, the research had the risk of being biased by the research's own preconceptions and interpretations. There is a risk that the researcher could be led by the opinions have vested interest in ES/ERP. The researcher is self-aware about the pros and cons of ES adaptability. ES is regarded as a flexible technology due to the nature of standard configurable and modularised packages and continuous support from ES vendors. However, it is also widely subject to criticism for its lack of feature function fit, tight integration and lack of independence of software development (Markus et al. 2000; Davenport 2000; Greenwood and Kawalek 2000; Ni, Kawalek and Ran 2002). The researcher had developed a number of tactics to mitigate the preconception. For example, data were collected across all accessible participants, the adaptation processes have been described in detail, findings have been synthesised and compared across the three organisations, the flexibility assessment is quantified by 1-5 scaling, there was triangulation by data source and by method, findings were linked to prior theory and to data. The use of well-proven tactics has guaranteed the objectivity, reliability, internal validity and external validity.

## 8.5 Suggestions for Future Research

The research is exploratory in nature. The purpose of exploratory research is to investigate little understood phenomena and identify or discover important variables to generate hypotheses for further research (Marshall and Rossman 1989). Further research of an explanatory and confirmatory nature is required to develop the findings.

First, this research provides a comprehensive literature review of flexibility. This would lay the foundation for future research in flexibility in other research disciplines e.g. strategic management and other information systems. Moreover, despite definition of flexibility includes a broad review of study in flexibility in various research subjects in the past, other senses and dimensions of flexibility could be identified and operationalised to generate a more inclusive definition of flexibility to support future research in flexibility.

Second, it is recommended to replicate the study for further research. This study has studied three organisations and observed fifteen adaptation occurrences. Among 15 adaptation occurrences there were only 2 strategic changes were reported. However, the researcher believes the limitation in the number of cases studied could cause the concern for the generalisability of the theory. Through replication, it would refine the findings of this study and be possible to formulate hypotheses based on the findings of this study.

As discussed above, there were only 2 strategic changes reported in the study and majority of adaptations were operational changes. There is a great difference between the impacts of these two types of changes. For example, the research shows that some adaptation approaches identified are actually not mentioned in the strategic changes. The resourcefulness and expectation are largely different between operational changes and strategic changes. Therefore, it could cause great difficulty to compare and synthesise findings to formulate a sound theory. It is recommended for future researchers to focus on one particular type of change.

The research has adopted a two level of assessment, i.e. actually flexibility assessment and contextual flexibility assessment. This provides a tool to analyse and measure the flexibility level of adaptation solutions. However, it is a challenge to develop such an assessment scheme for the flexibility of ES adaptation in the absence of past research in detailed measurement on flexibility. In the research, the performance variables and resource variables are scaled. The organisational conditions are also given scales. However, the weight factor of each variable are not defined. Therefore, the measurement is simplified and approximated. It is recommended to develop weight factors according to the organisational conditions in order to get a more accurate measurement for actual flexibility and contextual flexibility. In addition, the actual flexibility can be approximately obtained by a mathematical formula. However, the contextual flexibility assessment is based on subjective evaluation. It is suggested to create a formula for measuring the contextual flexibility that factors in the performance expected and resource required for adaptation, and organisational conditions that the adaptation is subject to.

Further research is required to refine the findings of this study. The performance measurement and resource measurement are operationalised. Additional research is required to refine the operationalisation and develop a more detailed measurement scheme. For example, the cost measurement can be further categorised into the software cost, internal HR cost, external HR cost and hardware cost.

## 8.6 Summary

Today, flexibility is widely concerned as the key capability an organisation should posses due to the fast change of business and technology environment (Haeckel 1999; Golden and Powell 2000). It requires flexibility to quickly respond to new conditions, to absorb sudden shocks and to accommodate diversity and heterogeneity. All of these demands, in turn, feed through to the computer-systems that modern organisations rely upon (CBDi Forum 2001). The attainment of information system flexibility is becoming an essential requirement for the business (Golden and Powell 2000; Behrsin et al 1994). Researchers and engineers have strived hard to make IT/ISs more adaptive and effective. ESs are a recent departure as such, offering enterprise wide integration, functionality and customisation by using standard configurable and modularised packages. However, it is also widely subject to criticism for its inflexibility and rigidity (Markus et al. 2000; Davenport 2000; Greenwood and Kawalek 2000; Ni, Kawalek and Ran 2002). The contradictory voices from industries and academics imply that although ESs overcome the problems and rigidity of legacy IT systems, in this increasing dynamic business world, ES or standard packaged software seems not capable enough to provide flexible solutions to the demands from the businesses in spite of that some claims of flexibility are based on unfounded optimism and unverifiable wisdom. Therefore, it has became an emerging need for research to understand the extent to which the ISs particularly ESs can support business flexibility, and how organisations use their adopting ISs/ESs to cope with ongoing business changes.

This research has presented a great detail and variety of ES adaptation methods for ongoing business changes during the post-implementation stage of ES adoption. A model of tactical ES adaptation (Figure 9) is developed to assist in describing and characterising the evidence involved. This model is established upon Gerwin (1993)'s conceptual framework for flexibility (Figure 3). It provides a theoretical basis to find relevant dimensions for flexibility and helps to identify the nature of business changes, coping tactics and operational actions, and evaluate the flexibility and implication for relevant responses to business changes. With this model the research exposes a complicated decision making process for ES adaptation to support ongoing business changes and attain flexibility. It demonstrates the dynamic relationship among emerging business needs, adaptation tactics, adaptation activities, performance measurement and resource measurement, and risks concerns. A significant lesson is learned in the research that "optimal flexibility" is the goal that organisations strive to attain to cope with ongoing business changes. Organisations shall weigh on balance not only among the effect of adaptation, the implication on organisations, and the cost required, but also among the flexibility that could be achieved and the flexibility that is desired due to different organisational and technical conditions. The model of tactical ES adaptation for ongoing business changes developed in this research would enable academics and practitioners to analyse, plan and achieve system flexibility in face of business environment uncertainty.

Further research topics can be developed from this investigation. Further research would benefit from identifying and operationalising other senses and dimensions of flexibility, replicating the study to refine the findings of this research, and/or developing a more detailed measurement scheme and accurate assessment scheme.

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# APPENDIX 1

## Letter of Introduction

Date

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Dear sir or madam

As a Doctoral Researcher at Warwick Business School, I am approaching you to enquire about the possibility of conducting some research interviews within your organisation. My research is to investigate how organisations cope with the constant change of business environment with their adopting ERP (Enterprise Resource Planning) systems. This research is funded by the CVCP (the Committee of Vice-Chancellors and Principals for UK Universities).

We believe this research is essential because it is focused upon the emerging needs for flexibility due to the fast changing business and technology environment in the 21st century. Business is fundamentally concerned with and driven by change. This requires flexibility to quickly respond to new conditions, to absorb sudden shocks and to accommodate diversity and heterogeneity. All of these demands, in turn, feed through to the computer-systems that modern organisations rely upon.

The research is collaborated with Warwick Business School and Manchester Business School, two leading business schools in the UK, to explore the connection between information systems and flexibility. This research selects ERP systems (pre-packaged business application software, such as SAP, Oracle) as the research object because of

1. the wide adoption of ERP systems in the world,
2. the timeliness of the research on ongoing support and maintenance issues of ERP systems,
3. the paradox of ERP systems flexibility.

We are particularly interested in

1. what is the nature of business change?
2. how ERP systems respond to different change requests?

3. what factors might affect system adaptability?
4. how cost and benefits are justified against different adaptation solutions?

This result of this research (by research report) will benefit your organisation as follows:

1. by providing a diagnostic tool to understand the nature of different problems and level of difficulty when responding to uncertainties.
2. by improving strategic decisions and operational decisions in relation to its current capability for business changes.
3. by suggesting improvements in areas such as management, application, technology, users, and support which are shown as critical or important to the ongoing system changes.
4. To be used as a guideline for ERP managers to justify cost and benefit of choosing the decision alternatives;
5. Referenced as the critical success factors in order to improve the organisational capability to cope with ongoing changes and reduce the total ERP software cost;

We understand your time is precious. Therefore, we are only looking to conduct a maximum of 4 interviews in your organisation. Also we will provide a confidentiality statement therefore no company information will be disclosed without your permission. We are also happy to come to you site for a briefing introduction before the research in your organisation if you think it will be appropriate.

I hope that this brief overview of my research means that you will be interested pursuing my request. If you require any further information, please do not hesitate to contact me, or my supervisor Dr. Peter Kawalek.

Thank you. I am looking forward to hearing from you soon.

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# APPENDIX 2

# Confidentiality Statement

THE UNIVERSITY OF WARWICK

## CONFIDENTIALITY STATEMENT

Yong Ni, Doctoral Research at Warwick Business School, the University of Warwick, (the "Researcher") with a mailing address at the end of the statement agrees as follows:

**Background:** The companies and individuals ("Participants") receiving this letter have trade secrets and other proprietary information relating to their arrangements (the "Confidential Information"), which they wish to maintain in confidence. The Researcher desires to receive information which might be considered as Confidential Information solely for research purposes as part of the Researcher's research program and in accordance with the purposes of a state-supported, academic, educational institution (the "Agreed Purpose") and recognizes the importance of keeping such information in confidence.

**Confidentiality:** The Researcher shall maintain in confidence of all Confidential Information, including names and other identifying information, and shall use it only for the Agreed Purpose, unless otherwise agreed in writing or to the extent required by law, provided the Participants has received advance notice of the disclosure. Non documental materials will be taken off site, unless otherwise agreed in writing or to the extent required by law, provided the Participants has received advance notice of the disclosure. The Interview might be recorded by tapes or handwriting. All materials containing Confidential Information will be securely stored in a locked office and locked, password protected files, such that the Researcher is the only individual with access to this information. Further, they will be destroyed once the research is completed.

**Definitions:** For purposes of the Agreement, Confidential Information means all technical, economic, and individual information, business or research strategies, trade secrets and material embodiments furnished by the Participants to the Researcher, except for that which: (a) is publicly available or (b) is required to be disclosed by an operation of the law.

**Publication:** As per the foregoing, the Researcher will not disclose the identities or Confidential Information of Participants in any publications. All reports and publications, interpretations, and examination of information reported in the research will only be based on aggregated results.

**Amendments:** This agreement may not be amended, modified or released except by a written instrument signed by the parties involved.

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# APPENDIX 3

# Pilot Case Study Questions

All information given will be treated in the strictest confidence and with respect. Any tape recordings will be made only with the permission of the interviewee. We will feedback via a report, but information will be anonymous within this.

**I. Personal Background Questions**

1.Your name:

2.Your job title:

3.Your telephone number:

4.What business operations do you use the SAP system for?

5.Do you use the SAP system yourself?

   a. If yes, how often,

      on a daily basis?

      Two/three times a week?

      Rarely.

**II. Background questions**

6.General questions about organisation's business environment

   a. Please describe the business environment of your organisation?
   b. What is the business strategy?
   c. What is the corporative objective?

7.General questions about the operation environment of information systems

   a. What is the IS strategy?
   b. Do you have any plan on ES? If so, what is it?
   c. Please comment on your budget control on IS development and maintenance

8.The initiative of ES changes

a. What is the initiative of ES changes?

b. What is the risk and benefits for the change?

**III. To what extent does the technology used for ES provide flexibility?**

9.Process: Please comment on the process of change.

10. Technological components required to change: What technology components were required to change?

11. Cost: How much was the cost of the change?

12. Evaluation: Closed questions: At what level do you think your ES is flexible?

13. Evaluation: Open questions: what other properties do you think is important to system flexibility? How you evaluate them?

**IV. To what extent the management factors influence the capability of ES to change? How each of these management factors influences the capability of ES to change?**

14. Human resources
15. Alignment of ES plan with IS plan
16. Alignment of IS plan with business plan
17. User satisfaction
18. User involvement
19. Minimal customisation
20. Longevity of ES use
21. Integration of ES with other adopted system
22. Organisational size
23. Industry sector
24. Other factors (open to interviewees): What are the other factors you think might influence the capability of ES to change? Why? And how?

**V. What is the impact of ES change on the business operation? How the process of enhancement and maintenance affect the use of ES and business operation?**

25. Users' unwillingness for further change
26. Business efficiency

27. The ease of carrying out your daily tasks
28. IT skills retraining
29. Organizational roles
30. Team motivation and group-working
31. Ability to satisfy customer needs
32. Ability to work with other teams within your department
33. Ability to work with teams outside of your department and outside of your organisation
34. New problems arose because the change in ES

**VI. Open questions: Do you have any other comments on system flexibility and its impact.**

# APPENDIX 4

# Case Study Protocol

*(Note: The case study protocol is written in several different colours. The colours chosen may be displayed in different kind of grey when print out through a B/W printer. The notes, written in red, shall not be shown to interviewees and used as notification for interviewers. Some bullet points after each question are written in grey, which means that these information may not be shown to interviewees but used for recording purposes only.)*

**Part 1: Introduction**

I. Specify goal of the research to the participant:

We are trying to explore business and system changes in your company. We want to be able to identify and classify certain kinds of change and to see the implications that arise from them. Our particular point of interest is to examine change in the context of ERP, by understanding the origination of change issues and their implications. We hope to extract the lessons your company learned while maintaining your ERP system.

II. Explain the confidentiality policy

All information given will be treated in the strictest confidence and with respect. We would like to tape record the interviews for our own research purposes. The transcripts will be review by us only. We do not publish these transcripts without your and your company's permission. If you like we will give you a copy of confidentiality agreement (APPENDIX 2
Confidentiality Statement).

III. Participant information

Personal

We first to need to ask you some questions about yourself:

- Job title
- Email address (in case we have further questions, we can contact you by email.)
- Years in current position
- Years in company
- Previous position hold

Experience of using ERP and Other Information Systems

Your experience of using information systems will help us to draw a brief picture of your relationship with information system/ERP also help us to ask more specific questions which could save the time of interview.

- Current use of ERP
  - Which ERP module / sub-module you use for your daily work currently?
  - What business operations do you use the ERP system for?
  - When did you start to use it?
  - Do you use the ERP system yourself?

    If yes, how often? (daily, two/three times a week, or rarely)

- Current use of other systems or application software
  - Beside ERP, do you use other information systems or other application software?
  - What business operations do you use the system for?
  - When did you start to use it?
  - Do you use the system yourself?

    If yes, how often? (daily, two/three times a week, or rarely)

- Role: What role, if any, did you play in the system implementation?
  - Key users
  - End-users
  - Project manager
  - Steering committee member
  - Senor manager
  - IS staff
  - Other

I am interested in your version of the story of your company's experience of how to cope with changes of adopting ERP system and how day-to-day business operations are affected by the ES. I am particularly interested in learning how business make best use of their ES, ensuring that it is a valuable asset for a long time to come. The following questions are designed to help me gain some important insights into day-to-day life with the ES.

Please the more descriptive you can e.g. with more specific examples, the better.

**Part 2: Business flexibility and system change**

**2.1 Examples of Change**

(** It might be best to ask this question before the research interview or during the earlier stage of interview. It would be helpful to obtain some documentation recording change requests, software change process and reconfiguration.)

I. I want you to start by thinking about examples of change that have affected your company *after* the implementation of the ERP. Think about some strategic issues, some tactical issues, and some operational issues. For example, you might want to mention a shift in business strategy, some business process changes and some changes to the ERP system itself.

Please list four or five examples of these different types of change (i.e. business strategy, business process, ERP system).

1. ______
2. ______
3. ______
4. ______
5. ______

II. Make a brief note of any links between the changes that you have listed (e.g. did the business strategy change motivate the process and ERP changes?)

III. Add any further points of explanation here. You might want to describe the context of the changes you have listed. You might want to give business specific information. You might want to add information about other important changes that are not mentioned above.

(**Some debate will follow to determine an agreed list of changes.)

## 2.2 Strategic flexibility

Q2.2.1. Business environment and strategy

- Please describe the business environment in which your organisation functions?
- What is your business strategy and corporative objective?
- What is your IS policy?
- What is your IS strategy and plan?

Q2.2.2. Context of strategic development

- Experience: Have you experienced any strategic development (e.g. organisational change, business process change, process automation etc.) after your ERP System went live? If so, please comment on the process of development and implementation.
- Reason: What was the reason to initiate the strategic development?
- Benefits: What benefit could / did this strategic development provide to your organisations?

Q2.2.3. Role and importance of ERP systems?

- What role did your corporative IS and ERP system play when making decisions on strategic development and its implementation?
- How important was your ERP system for supporting the strategic development?

Q2.2.4. Coping mechanisms

- What coping mechanisms (workaround, ignore, partly done etc.) did you adopt to deal with these change requests? Why did you adopt these coping mechanisms?

Q2.2.5. Type of technical solutions

- What were the technical solutions (reconfiguration, ERP programming, etc.)?

Q2.2.6. Concerns and risks

- What are the issues of concerns when undertaking the strategic development?
- What was the risk of the strategic development? Did ERP system help reduce the development and implementation risk?

Q2.2.7. Difficulties and problems encountered

- Have you encountered any difficulties and problems when undertaking the strategic development? Please describe.
- When you encountered difficulties, what coping mechanisms (e.g. ignorance, workaround, partly solve, solve it no matter what would cost etc.) do you adopt?

Q2.2.8. Flexibility measurement

- Cost: What was the cost of the strategic development? How were the cost structured (e.g. cost on internal staff, cost on purchasing hardware, cost of consultancy and external support)?
- Time: How long did it take to complete the strategic development? Please specify it in detail e.g. time spend on managerial approval, time spend on development and implementation etc.
- Effectiveness: How did you measure the success and effectiveness of the strategic development? Were all the benefits mentioned above fulfilled?
- Resilience: What is the impact of the strategic development on other business functions?
- Resilience: What is the implication of these strategic development for support, maintenance and upgrading?

Q2.2.9. Future opportunities

- What opportunities could ERP system provide in the future?
- Do you have any plan of strategic developments in the future? What role did your corporative IS and ERP system play when making decision on strategic development?
- How did you use ERP system to support competitive difference?

## 2.3 Operational Flexibility

Q2.3.1. Context of operational development

- Have you experienced any minor ERP system change and adaptation due to business operation requests (e.g. new report, new display, minor business process change)? Please comment on the process of development and implementation.
- What was the reason for these change requests? What were the benefits?

Q2.3.2. Coping mechanisms

- What coping mechanisms (workaround, ignore, partly done etc.) did you adopt to deal with these change requests? Why did you adopt these coping mechanisms?

Q2.3.3. Type of technical solutions
- What were the technical solutions (reconfiguration, ERP programming etc.)?

Q2.3.4. Concerns and issues
- What were the issues of concerns when dealing with these change requests and undertaking the development and implementation?
- What difficulties and problems were faced when undertaking the development and implementation?

Q2.3.5. Flexibility measurement
- Cost: What was the cost of the development and implementation? How were the cost structured (e.g. cost on internal staff, cost on purchasing hardware, cost of consultancy and external support)?
- Time: How long did it take? Please specify it in detail e.g. time spend on managerial approval, time spend on development and implementation etc.
- Effectiveness: How did you measure the success and effectiveness of the system adaptation? Were all the benefits mentioned above fulfilled?
- Implication: What is the impact of the system adaptation on other business functions?
- Implication: What is the implication of these system adaptation for support, maintenance and upgrading?

*(Note: Participants usually respond well to this question and will likely talk at length. It is usually best to only interrupt to ask for specific examples. Whenever the respondent gives a platitude, ask for a specific example to illustrate the point. Try to cover all the issues below after discussion. Some respondents may not be able to respond well to all these issues. If this happens, focus on the issues they feel more comfortable to tell and discuss them in depth.)*