Patterns of enterprise system implementation - the case of Chinese aerospace corporate transformation

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Patterns of Enterprise System Implementation

-the Case of Chinese Aerospace Corporate Transformation-

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SUMMARY

This dissertation aims to identify patterns in the managerial processes during an enterprise system implementation (ESI) period. An ESI remains a notorious challenge. In most cases, it concurrently involves business strategy change, organizational change, and technical innovation. This dissertation adopts structuration theory as a "sensitizing device" for understanding change forces behind an ESI. Structuration is positioned as a social process that involves the reciprocal interaction of human factors and structural features of organizations; it recognizes that human actions are enabled and constrained by structures on the one side, and on the other side, these structures are the results of previous human actions (Giddens, 1984).

A pattern-recognition method is used to extract and describe patterns of managerial processes out of the structuration insights. Two sub-structuration processes are selected in order to make the structuration process observable and identifiable for the pattern recognition: Communicating significance by top management and facilitating learning for ESI. Ten in-depth empirical cases are studied in a longitudinal way. Eight patterns are identified and described in this dissertation.

The main contribution of the thesis to the academic community is four-fold: (1) the thesis designs a pattern-recognition method for conducting process studies (Structuration). It has capabilities to create generalizable and actionable research results but still keep context rich elements. (2) A set of process patterns are identified. These patterns clearly show the predictive power of the process studies. (3) A method to operational-structuration theory. The 'modalities' embedded in the structuration framework are operationalized as a specific set of techniques within certain managerial processes which are observable and actionable. (4) New insights into the performance criteria of a strategic ESI project. A success of an ESI should not only be decided by operative criteria, but also should be judged by the achieved strategic impact.

For project managers who take the responsibilities of managing an ESI project, they can benefit from this study in three key ways: (1) Eight managerial process patterns out of 10 in-depth cases present a reference database for project managers positioned in their own projects. (2) A new insight to understand ESI project performance, that clearly differentiates the operative performance from capability enhancement oriented performance. (3) The dynamic managerial processes with support to achieve different goals (Operative deliverables Vs. Strategic-impact orientated results).

SAMENVATTING

De dissertatie heeft als doel om patronen te definiëren in management processen tijdens een periode van enterprise system implementation (ESI). Een ESI blijft een beruchte uitdaging. In de meeste gevallen heeft het gelijktijdig betrekking op de verandering van bedrijfsstrategie, organisationele verandering, en technische innovatie. Deze dissertatie neemt structuration theory als een een "*sensitizing device*" voor het begrijpen van de veranderingen achter een ESI. Structuration wordt geponeerd als een sociaal proces dat wederkerige interactie van menselijke actoren en structurele kenmerken van organisaties betreft. Het erkent dat, aan de ene kant, menselijke handelingen zowel worden mogelijk gemaakt als beperkt door structuren, en dat, aan de andere kant, deze structuren het gevolg zijn van eerdere menselijke handelingen (Giddens, 1984).

Een methode voor patroonherkenning wordt toegepast om, op basis van de inzichten van structuration, patronen van management processen te extraheren en te beschrijven. Twee sub-structuration processen zijn geselecteerd om structuration processen observeerbaar en identificeerbaar te maken voor patroonherkenning: communicatie significantie vanuit het topmanagement en het faciliteren van leerprocessen voor ESI. Tien cases zijn longitudinaal bestudeerd. Acht patronen zijn geïdentificeerd en beschreven in deze dissertatie.

De voornaamste bijdrage van de thesis aan de academische gemeenschap is viervoudig: (1) de thesis ontwerpt een methode voor patroonherkenning voor het verrichten van processtudies (structuration). De methode bevat vaardigheden voor het creëren van generaliseerbare en actiegerichte onderzoeksresultaten, zonder daarbij de rijkheid aan contextuele elementen te verliezen. (2) een set van procespatronen is geïdentificeerd. Deze patronen tonen de voorspellende kracht van processtudies duidelijk aan. (3) een methode om structuration theory te operationaliseren. De "modaliteiten" die in het structuration kader zijn ingebed zijn geoperationaliseerd als een specifieke set van technieken binnen bepaalde management processen die observeerbaar en actiegericht is. (4) Nieuwe inzichten in de prestatie indicatoren van een strategisch ESI project. Het succes van een ESI zou niet alleen moeten worden beschreven op basis van operatieve criteria, maar zou ook moeten worden beoordeeld op basis van de strategische impact.

Projectmanagers die de verantwoordelijkheden voor het managen van een ESI project op zich nemen kunnen als volgt van deze studie profiteren: (1) Acht management procespatronen uit de 10 cases vormen een referentie database voor projectmanagers om zich in hun eigen projecten te positioneren. (2) Een nieuw inzicht in de prestaties van ESI projecten, dat een duidelijk onderscheid maakt tussen operatieve prestaties en prestaties die specifiek gericht

zich op het verkrijgen van nieuwe vaardigheden. (3) Dynamische management processen die het behalen van verschillende doelen ondersteunen (operatieve resultaten vs. resultaten die gericht zijn op strategische impact).

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LIST OF ABBREVIATIONS

CEO	Chief Executive Officer
CFO	Chief Financial Officer
CIO	Chief Information Officer
CRM	Customer Relationship Management
CTO	Chief Technology Officer
DTPB	Decomposed Theory of Planned Behaviour
ERM	Enterprirse Resource Management
ERP	Enterprise Resource Planning
ES	Enterprise System
ESI	Enterprise System Implementation
IDT	Innovation Diffusion Theory
IT	Information Technology
PDM	Product Data Managment
TAM	Technology Acceptance Model
TTF	Task Technology Fit
UTAUT	Unified Theory of Acceptance and Use of Technology

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1. INTRODUCTION

"We have spent the last 50 years on the T in IT, we need to spend the next 50 years on the I in IT"

Peter Drucker (1999)

1.1. Motivation and Objectives

Enterprise systems (ES) are commercial software packages for the seamless integration of all the information flowing through a company – financial and accounting information, human resource information, supply chain information, customer information (Davenport; 1998; Davenport, 2000). These systems are also referred to as Enterprise Resource Planning (ERP) or Enterprise Resource Management (ERM) systems (Davenport 2000). Through information flows ERP systems allow for enterprise-wide integration of business functions in operations processes from sales, logistics to manufacturing and distribution (Welti, 1999). Similarly Product Data Management (PDM) is software for integration in the new product development process from research and development to process planning and life-cycle support. Therefore ES are of strategic importance for efficient and effective processes.

Implementation of a new ES is related to an ambitious organizational strategic change effort. (Davenport, 2000; Falk, 2005; Markus, 2004; Markus & Benjamin, 1997; Broadbent et al., 1999). For example, a successful ERP implementation can facilitate the quick and flexible response to transient market conditions, thus, gaining new competencies for an organization (Ross, 1999a; Gupta, 2000). An ES implementation as well can enable organizations to adjust their business scope and develop new business models (Venkatraman, 1994; Weil & Aral, 2004). It is a recognized trend that organizations are increasingly implementing ES to support organizational strategic objectives (Partington et al., 2005; Pellegrinelli, 2002; Ribbers, 2002).

However, enterprise system implementation (ESI) remains a notorious challenge. In most cases, it concurrently involve business strategy change, organizational change, and technical innovation (Hammer, 2004; Hammer & Champy, 2001; Davenport, 1998; Klein & Sorra, 1996; Mukherji, 2002). For example, ES enable "real-time" automatic report generation and information provisioning throughout the organization. This initially creates new and more efficient working and decision making routines, which can ultimately lead to a different approach when dealing with customers and business opportunities. An ESI often take many years and approximately half of them fail to achieve the anticipated benefits (Robey et al., 2002; Applegate et al., 2001; Westerman, 2004). For example, the implementation project

often experiences out-of-control budget (Scheider, 1999); and the project does not deliver the expected value (Ross, 1999b).

Given the dilemma between the perceived strategic importance and the persistent negative implementation record, ESI is an ongoing research focus to improve the track record. The topic of ESI and related organizational change has been studied by researchers of many multi-disciplinary backgrounds, such as computer science, management science, organizational development and sociology etc. The vast majority of existing research on ESI aims at identifying the critical success factors that explain implementation success (Ross, 1999b; Sarker & Lee, 2000; Holland et al., 1999; Brown & Vessey, 1999; Scott & Vessey, 2002). For example, top management commitment and user participation of those factors are frequently emphasized (Sabherwal, 1995; Katzy & Ma; 2005; Scott & Vessy, 2002). Apparently, application of these critical success factors confuse practitioners because it ignores the specific organizational setting (McAfee, 2003), meaning that a set of factors may not be applicable to more than only one setting (Edmondson, 2003).

More promising is research that understands ESI dynamics as a process or sequences of stages. ESI has been described as models having three (Kwon & Zmud, 1987), four (Markus & Tanis, 2000), five (Ross, 1999a), and six stages (Esteves & Pastor, 2001). These stage models provide a useful guide for practitioners due to their simplicity and straightforward characteristics. While the structure is generally helpful, there models are criticized as being incapable of explaining the underlying forces (Robey et al., 2002).

Process theory approaches are dynamic but concentrate on those forces that explain how change emerges, develops, and diminishes over time (Mohr, 1982; Van de Ven & Huber, 1990; Huber, 1991). It is dynamic interactions that explain how and why changes occurs (Leonard-Barton & Deschamps, 1988; Markus & Robey, 1988; Sabherwal & Robey, 1995; Majchrzak et al., 2000; Boudreau et al., 2001; Robey et al., 2002). For example, Robey et al. (2002) explain how organizations solve knowledge barrier issues in the implementation process using a dialectical process theory. Process theory approaches are said to lack generalization and prediction capabilities. In fact, most process research is limited to single case studies, which is understandable because of the large amount of effort needed for process research (Barley, 1990; Barley, 1986; Orlikowski, 1993; Orlikowski, 1992; Majchrzak et al., 2000; Edwards, 2000). Consequently, research results of these process studies are often illustrative cases (Fichman, 2000; Van de Ven et al., 2000; Langley, 1999; Sabherwal & Robey, 1993; Sabherwal & Robey, 1995).

In my eyes this can be attributed to the fact that the development of process research and its methods is still at an early stage. There is no mature process research approach yet in literature. Existing process research approaches either focus only on an interpretive perspective, or require immense amount of time to record the events. It is difficult to code the data, and it is not feasible for an ESI as it can take months or years to complete observation of the process.

The thesis will contribute to make effort to improve the existing process research methods through combination with pattern recognition methods applied at other research field (e.g. information signal processing etc.). Then second contribution is to describe underlying forces in a pattern that is a combined package of stages and dynamic forces over time. The thesis looks at the aerospace corporate in China, and then verifies the method and patterns in other general industries in China.

The thesis adopts structuration theory as a "sensitizing device" for understanding structures and change forces. Structuration is posited as a social process that involves the reciprocal interaction of human actors and structural features of organizations (Giddens, 1984). It recognizes that human actions are enabled and constrained by structures on the one side, and on the other side, these structures are the results of previous human actions. Structure is understood as a generic concept that is only manifested in the structural properties of social systems (Giddens, 1979, p: 64).

The rationales behind selecting structuration theory are: (1) structuration theory has been verified to have a strong interpretive power to explain co-evolution path of an organization and the implemented ES; (2) structuration theory can help to identify how social actors (stakeholders of ESI) possess and apply their knowledge and power in the day-to-day social encounters during an ESI period; hence (3) it should be very powerful to understand the dynamics of change forces. While structuration theory is conceptually powerful, it is abstract and cannot generate actionable insights (Jones, 1999; Whittington, 1992).

A pattern recognition method is used to extract and describe patterns out of abstract structuration insights. Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data etc (Friedman, 1999; Theodoridis & Koutroumbas, 1999). Pattern recognition aims to classify data (patterns) based on either a prior knowledge or on statistical information extracted from the patterns. The patterns to be classified are usually groups of measurements or observations, defining points in an appropriate multidimensional space.

Two sub-structuration processes are selected as the focus of this research in order to make structuration process observable and identifiable for the pattern recognition: communicating significance by top management and facilitating learning for ESI. The interpretation of these two processes is often referring to the critical success factors: top management commitment and user participation.

The relevant process constructs and observable artefacts for these two structuration processes are defined. Ten in-depth empirical cases are studied in a longitudinal way. A pattern template is designed for extracting and clustering patterns (Van de Ven et al., 2000; Van de Ven & Huber, 1990). The managerial process patterns in the implementation period are observed and identified. The impact of these managerial process patterns on ESI outcomes is analyzed. Based on the analytical results, the recommendations for researchers and practitioners are described.

1.2. Goal and Research Questions

The overall goal of the PhD thesis is to understand the complex dynamics of an ESI that typically enables an organizational change. In addition, the thesis aims to design a process research method to identify patterns based on multiple in-depth case studies. This thesis addresses the following two research questions:

> ***Q1: "Are there recognizable patterns in the managerial process during an ESI period?"***

And if the answer of the above research question is yes, then:

> ***Q2: "How can these patterns be described and interpreted?"***

1.3. Expected Results and contribution

The first contribution of this thesis is to improve existing process research method and develop one with a feasible and affordable operation effort. Existing process research is criticized to be either too abstract or without predicative capabilities (Markus & Tanis, 2000; Fichman, 2000). Lack of mature analysis methods hinders the wide acceptance of process research because of the intensive effort required.

The second contribution is to explore managerial process patterns during an ESI period, which go beyond the traditional process research scope. The identified managerial process patterns can be used to discover the underlying forces for an ESI in a generalizable format.

The thesis contributes to the application of structuration theory. It not only verifies that structuration theory (Giddens, 1984; Giddens, 1979) is a powerful "sense making" theory to understand the social phenomena like an ESI, but also propose a new way of using structuration theory to support empirical studies (Jones et al., 2000; Jones, 1999). The patterns of managerial process can be deduced via operationalization of structuration theory in this way (Sabherwal & Robey, 1993; Robey & Boudreau, 2000).

The patterns of managerial process provide a contribution for managing ESI. The patterns can support practitioners improving their relevant managerial & organizational capability for ESI and relevant strategic goals. They can as well help managers be aware of the potential risks of an ESI and increase managers' understanding of the dynamics involved in an ESI.

1.4. Research Methodology

The research of this thesis takes a constructivist epistemological standing in order to understand and analyse the process of managing an ESI.

In order to design an appropriate research plan, the question of how reality can be known has to be addressed. Due to the increasing complexity and social intertwined nature of an ESI and lack of unified satisfying research theory, the exploration, thus, is based on a research design that allows the researcher to learn from the multiple in-depth case studies and to extract a new theory.

The research design incorporates several steps (Figure 1). Firstly, some initial concepts and constructs are developed from a literature review and discussed with senior researchers and experienced consultants; second, research questions are defined; third, an appropriate theory is selected and a process research method is designed to support the research objective; Fourth, a package of data collection method is developed, the empirical cases are selected and the method is validated using a pilot case; Fifth, is the data collection with the revised constructs and protocol; Sixth, a cross-case analysis is performed, and the process patterns are derived and refined.

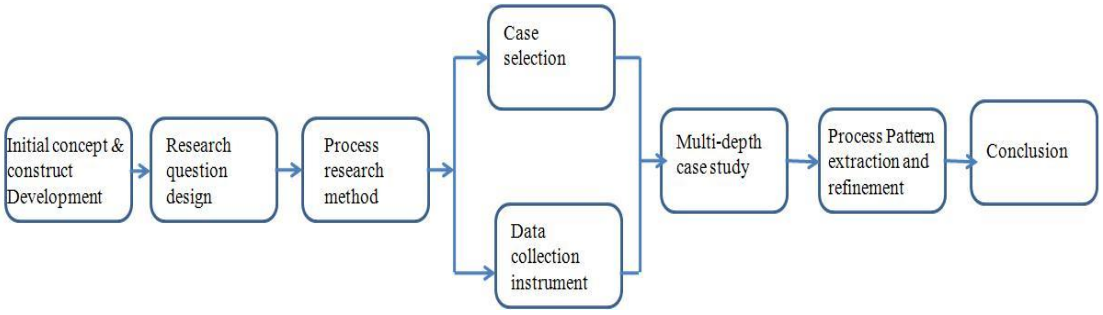


Figure 1, Research Method

Ten cases are carefully selected to explore whether it is possible to generate patterns out of the empirical case analysis. The author uses a complementary data collection method to ensure good data quality. First, the project managers are asked to fill out the demographic questionnaire before the interviews. Next, four to six different roles in each ESI project are interviewed, such as the project sponsors, project managers, line managers, external consultant and end users. Each interview takes between one hour and one and half hours. Lastly, relevant project information is required, such as the project progress reports, meeting minutes, managers' notes etc. Interviewing different roles ensures that the researcher obtains a complete picture of the implementation process.

1.5. General Outline

In Chapter two, the literature review about ESI is presented. Based on the analysis, the author explains how and why a process research method is needed to support this study. In Chapter three, the core elements of the research method and the theoretical rationale behind it will be introduced. Chapter four will consist of single case analyses. In Chapter five, the cross-case analysis results and the patterns extracted from these analyses are presented. In Chapter six, the theoretical discussion will be deployed and its implication for academia and practitioners; Chapter seven is the conclusion.

2. ENTERPRISE SYSTEM IMPLEMENTATION: WHY DO FAILURE RATES REMAIN HIGH?

"Most of the barriers that prevent knowledge from flowing freely in organizations – power differentials, lack of trust, missing incentives, unsupportive cultures, and the general busyness of employees today – won't be addressed or substantially changed by technology alone."

(Davenport, 2007)

2.1. ESI Literature

Existing research about ESI can be classified into two streams: one with a variance approach and the other with a process approach. Variance research seeks to explain outcome variable variation by associating those outcomes with antecedent conditions and predictor variables. In variance theory, "the precursor (X) is a necessary and sufficient condition for the outcome (Y)… time ordering among the independent variables is immaterial to the outcome." (Mohr, 1982, p: 38). Process research is concerned with understanding how things evolve over time and why they evolve in this way (Van de Ven & Huber, 1990). Most process research aims at understanding interactive social processes in an ESI (Kwon & Zmud, 1987; Markus & Tanis, 2000).

The distinction of variance approach and process approach is illustrated in Figure 2.

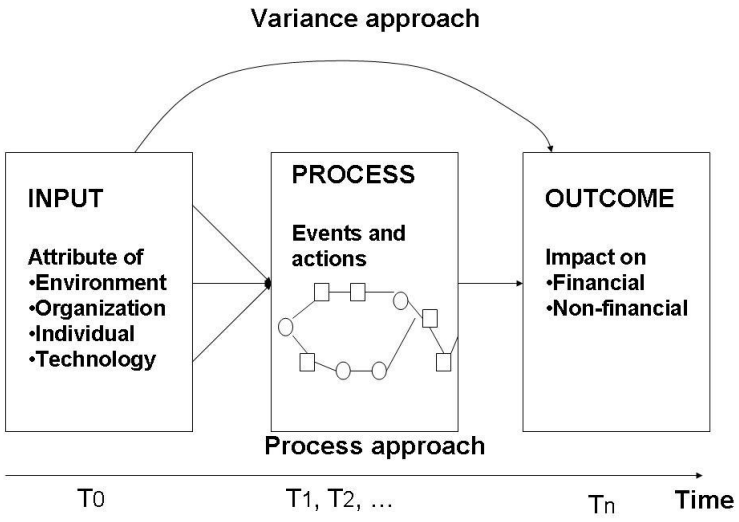


Figure 2, Variance and Process Research

The bulk of academic research on ESI has adopted a variance approach (Markus & Tanis, 2000). Advocators of the variance approach developed a different lens to investigate the

impact of “INPUT” on the “OUTCOME” of an ESI. For example, technology acceptance perspectives emphasize the acceptance model of an individual user on certain technologies. They believe the acceptance “OUTCOME” is decided by a certain combination of technology features and individual characteristics. Research on critical success factors tends to discover the success factors from different perspectives (Bingi et al., 1999; Brown & Vessey, 1999; Holland et al., 1999; Sumner, 2000).

Recently, the variance research group as well inspire researchers to keep an eye on the impact of “dynamic processes” and “informal organizational structures and processes” on the implementation “OUTCOME” (Hirschheim & Sabherwal, 2001). Because some studies verify that “INPUT” impacts the “OUTCOME” to some extent, but also found that to achieve a successful “OUTCOME” is not a one-time stop, but a long dynamic processes (Sabherwal et al., 2001).

Researchers of organizational development and organizational change understand the importance of a change process in relation to the “OUTCOME” (Weick & Quinn, 1999; Pettigrew, 2001; Robey & Boudreau, 1999). Based on the classical three stage model-Unfreeze, Transformation and Freeze (Lewin, 1951) and Thusman’s equilibrium’s state research (Tushman & Anderson, 1986), researchers and practitioners re-defined the change processes into three, four, five, six and seven planned change stages. They developed the change management guideline to support practitioners to smoothly pass all these phases. For example, Kotter’s eight step guideline (Kotter, 1996) and Hammer’s business process re-engineering guidelines (Hammer & Champy, 2001). However, they don’t produce clear measures to help organizations develop needed competence.

Process research approach contribute to understand the PROCESS during an ESI (Yates & Orlikowski, 1992; Orlikowski, 2000; Orlikowski, 1993; Orlikowski, 1992; Barley & Tolbert, 1997; Barley, 1990; Barley, 1986; Majchrzak et al., 2000). ESI is not deterministic and the ESI process is shaped by the interaction of human actions and organizational structures which is impacted by the social context (Orlikowski, 1993). However, these studies are incapable of producing generalized results and mainly act as “sensitising devices” or “provide an explanation of the logic of research into the human social activities and cultural products” (Jones, 1999, p: 104).

Considering the objective of this thesis is to explore whether there are patterns in the managerial processes during an ESI, if so, how to describe and interpret these patterns. The existing relevant research streams are analysed and their contributions to the thesis are discussed in next sections.

2.1.1 Technology acceptance: an analysis of the individual and technology

Technology acceptance model (TAM) applies a variance approach and has mainly focused on the antecedents of adoption and usage of new technologies. The TAM presents an important theoretical contribution towards understanding information system usage and acceptance behaviours (Davis, 1989). It explain over 40 percent of the variance in individual intention to use technology (Davis et al., 1989; Taylor & Todd, 1995; Venkatesh et al., 2003; Venkatesh & Davis, 2000; Venkatesh, 2000).

The TAM posits that perceived usefulness and ease of use determine an individual's intention to use a system. It theorizes that an individual's behavioural intention to use a system is determined by two beliefs: perceived usefulness, defined as the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease of use, defined as the extent to which a person believes that using the system will be free of effort.

The TAM theorizes that the effects of external variables (e.g. system characteristics, development process, and training) on the intention to use are mediated by perceived usefulness and perceived ease of use. According to the TAM, perceived usefulness is also influenced by perceived ease of use because, if other things being equal, the easier the system is to use, the more useful it can be. Figure 3 shows the basic concept underlying TAM models.

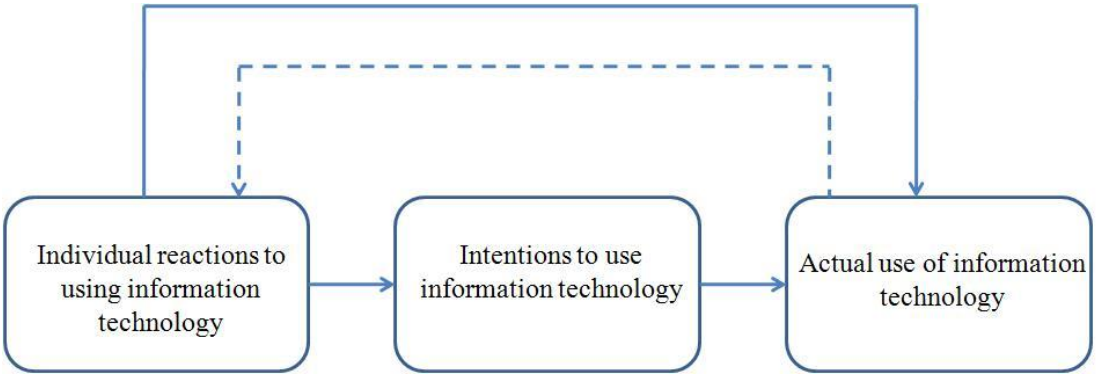


Figure 3, Basic Concept underlying TAM (Venkatesh et al., 2003)

Four TAM models contribute to identifying the factors that can influence user adoption (e.g., performance expectancy, social influence, task-technology fit, and compatibility): the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003; Venkatesh & Davis, 2000; Davis et al., 1989; Davis, 1989), innovation diffusion theory (IDT) (Rogers,

1995), decomposed theory of planned behaviour (DTPB) (Taylor & Todd, 1995), and task-technology fit (TTF) (Dishaw et al., 2002; Dishaw & Strong, 1999; Goodhue & Thompson, 1995; Goodhue, 1995; Zigurs et al., 1999; Zigurs & Buckland, 1998).

The unified theory of acceptance and use of technology (UTAUT) aims to explain a user´s intention to use an information system and his/her usage behaviour. The theory proposes four key constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions) are direct determinants of usage intention and behaviour (Venkatesh et. al., 2003). Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs on usage intention and behaviour (Venkatesh et. al., 2003). Subsequent validation of UTAUT in a longitudinal study found it to account for 70% of the variance in usage intention (Venkatesh et. al., 2003).

The innovation diffusion theory (IDT) conceptually interprets the diffusion process of an innovation (Rogers 1996). Everett Rogers defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 1996). Rogers' definition contains four elements that are present in the diffusion of the innovation process. The four main elements are: (1) Innovation - an idea, practices, or object that is perceived as new by an individual or other unit of adoption. (2) Communication channels - the means by which messages get from one individual to another. (3) Time - the three time factors are: (a) innovation-decision process, (b) relative time with which an innovation is adopted by an individual or group. (c) Innovation - rate of adoption. (4) Social system - a set of interrelated units that are engaged in joint problem solving to accomplish a common goal.

The decomposed theory of planned behaviour (DTPB) is the work of Taylor and Todd (1995). The theory postulates that attitude, subjective norm and perceived behavioural control influence the intention to use a technology. Attitude is a product of beliefs about behaviour and an individual's evaluation of the outcome resulting from that behaviour (Ajzen, 1991). It is postulated that the intention to perform behaviour will be higher when the individual has positive evaluation of performing the behaviour (Ajzen, 1991; Taylor & Todd, 1995). Subjective norm refers to an individual's perceived social pressure to perform or not to perform target behaviour. The subjective norm is a composite of normative beliefs about a certain behaviour and the individual's motivation to comply with relevant others (Fishbein & Ajzen, 1975).

Perceived behavioural control reflects an individual's perception of ease or difficulty of performing target behaviour. It is a product of control beliefs about certain behaviour and the

individual's perceived facilitation of each control belief. Control beliefs reflect the individual's beliefs of his or her ability to perform the behavior, which are affected by external resources (e.g., time and money) and internal component (e.g., ability and self efficacy). Perceived facilitation indicates the individual's assessment of the importance of each control belief or the extent in which a control belief facilitates or inhibits performance of the behaviour (Ajzen, 1991).

Task-technology fit (TTF) theory holds that IT is more likely to have a positive impact on individual performance and use, if the capabilities of the IT match the tasks that the user must perform (Goodhue & Thompson, 1995). Goodhue and Thompson (1995) found the TTF measure, in conjunction with utilization, to be a significant predictor of user reports of improved job performance and effectiveness that was attributable to their use of the system under investigation. The TTF has been applied in the context of a diverse range of information systems including electronic commerce systems and combined with or used as an extension of other models related to information system outcomes. The TTF measure presented by Goodhue and Thompson (1995) has undergone numerous modifications to suit the purposes of the particular study (Staples and Seddon, 2004; Zigurs and Buckland, 1999).

Venkatesh and Davis (2000) extend the TAM by incorporating additional constructs covering social influence processes (subjective norm, voluntariness and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) (See Figure 4).

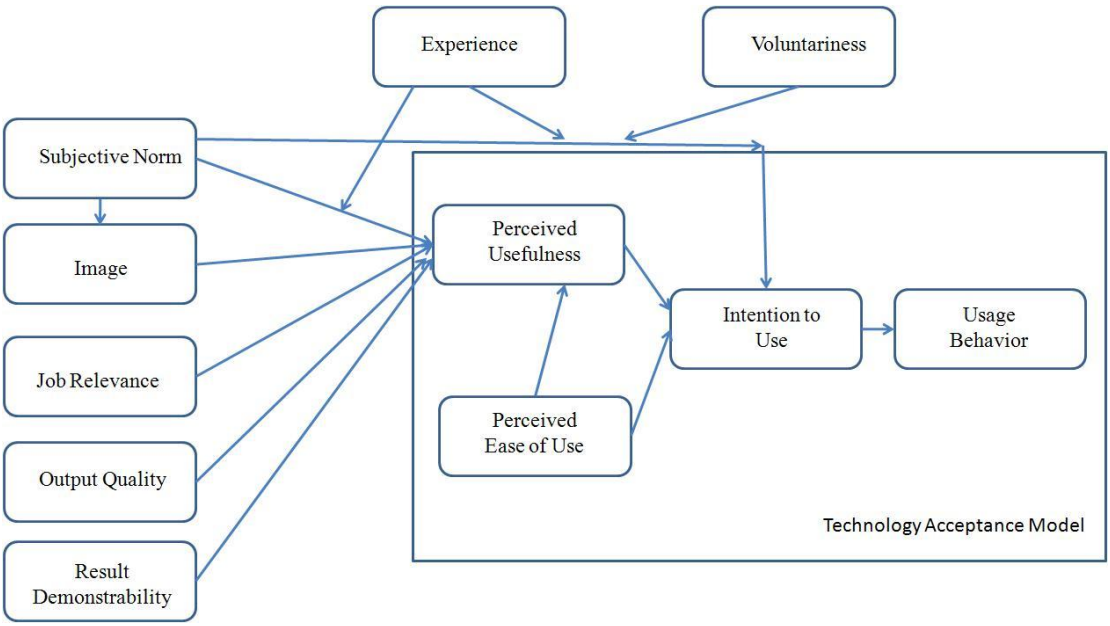


Figure 4, Extension of the TAM (Venkatesh and David 2000)

In a nutshell, these TAM models are focused on simple technology and individual acceptance and performance (Venkatesh et al., 2003). Now the adoption of an ES in organizations shifts towards organizational wide ES (e.g. SCM, ERP, CRM etc.) to support strategic objectives. Hence, focus on individual level is not sufficient to understand the implementation challenges. Even TAM researchers think that traditional TAM research should not be limited at individual and technology analysis level (Venkatesh et al., 2003).

2.1.2 Critical factors for ESI: implementation checklists for practitioners

Critical factor research seeks to explain implementation "OUTCOME" variable variation by associating those "OUTCOME"s with antecedent conditions and predictor variables from a multi-level perspective (individual, group, organization and institution) (Barki et al., 2005; Kumar et al., 2003). It moves one step beyond the TAM models, as it is not limited in the individual and technology level. Organizational, institutional and individual factors received the widest recognition next to the technological factors (Kumar et al., 2003).

Critical factors are useful for practitioners and consultants due to its straightforwardness, simplicity and easiness to be understood. The most frequently mentioned factors are: top management support (Keil & Robey, 1999; Armstrong & Sambamurthy, 1999), project organizational structure (Boehm, 1991), technology reliability and capability (Barki et al., 2001), alignment with organizational business strategy (Soh et al., 2003), team leadership (Keil et al., 1998), communication methods (Hartman & Ashrafl, 2002), stakeholder management (Keil et al., 1998), organizational culture (Doherty & G., 2003; Harper & Utley, 2001), and organizational environment (Barki et al., 1993).

The following Table 1 summarizes the main findings about critical factors in these years.

Order	Critical Influence Factors	Main References
1	Lack of adequate technology infrastructure	(Ewusi-Mensah, 1997)
2	Technological newness, strained technical capabilities, failure of technology to meet specification	(Barki et al., 1993; Boehm, 1991; Cash et al., 1992)
3	Lack of agreement on project goal	(Ewusi-Mensah, 1997; Block, 1983)

4	Lack of technical expertise	(Ewusi-Mensah, 1997)
5	Lack of application knowledge	(Ewusi-Mensah, 1997; Barki et al, 2001; Barki et al., 1993)
6	Lack of user commitment, ineffective communication with users	(Keil et al, 1998; Keil & Robey, 1999)
7	Lack of senior management involvement	(Keil et al., 1998; Keil et al., 2003; Keil & Robey, 1999; Newman & Sabherwal, 1996)
8	Technical complexity	(Barki et al, 1993)
9	Misunderstanding requirements, changes in requirements	(Keil et al, 1998; Boehm, 1991; Block, 1983; Cash et al, 1992)
10	Organisational environment (resource insufficiency, extent of changes)	(Barki et al., 1993)
11	Unrealistic schedules and budgets	(Boehm, 1991)
12	Lack of effective methodology, poor estimation, failure to perform the activities needed	(Keil et al, 1998; Keil & Robey, 1999)
13	Changing scope and objectives	(Keil et al, 1998; Keil & Robey, 1999)
14	Conflicts between user departments	Keil, Cule, Lyytinen, and Schmidit, 1998
15	Inappropriate staffing, personnel shortfalls	(Keil et al., 1998; Keil & Robey, 1999) (Boehm, 1991)
16	People and personality failures	(Block, 1983)

17	Lack of measurement system for controlling risks, inadequate project management and tracking	(Ewusi-Mensah, 1997)
18	Inappropriate training, and user involvement	(Hartman & Ashrafl, 2002)
19	No-fit of application with organisation culture	(Scott & Vessey, 2002)
20	Project goal not fit firm strategy vision and business needs	(Scott & Vessey, 2002)
21	Scope ill defined	(Scott & Vessey, 2002)

Table 1, Main Findings: Critical factors

Some researchers focus on assembling these different critical factors into more holistic frameworks to help practitioners assess potential risks of ESI (Holland et al., 1999; Gibson, 2004; Akkermans & Helden, 2002; Ginzberg, 1981; Lyytinen et al., 1998). While these results are useful to some extent, they offer few insights beyond conventional wisdom. Most studies lack a theoretical framework that adequately explains why the investigated project outcome occurs (Robey & Boudreau, 2000), despite the efforts made to arrange them into certain frameworks (AI-Mashari et al., 2003; Akkermans & Helden, 2002).

Recently, several researchers and consultants have said that too many fragmented critical factors are unhelpful to the practitioners (McAfee, 2003). Factor checklist assumes the one-best-practice-for-all approach, without considering the influence of existing organizational structures and the external environment, thus, are not applied in the different organizational settings (Edmondson, 2003).

In my eyes, critical factor approaches bottle shapeless factors into a certain framework and lack specific context and temporal information consideration, therefore making it weak in accuracy. They stay on the superficial level of the dynamic implementation process, and by nature, they are not capable of determining the general driving motors below the surface.

2.1.3 ESI and strategic alignment: the 'strategy fit' in times of dynamic change

ESI have business relevance and should therefore support rather than contradict a company's business activities. Strategic alignment is a synonym for an ES's fit with the firm's business strategy. This definition is in line with the organizational research tradition where "fit" (Galbraith, 1973) and mutual coherence (Nadler & Tushman, 1997) of the different parts of an organization and its fit with its environment is a condition for its survival.

Strategic ES alignment is consistent with this tradition in arguing that alignment enhances not only success of the ES but of the organization as well (Chan, Huff, Barclay, & Copeland, 1997; Sabherwal & Chan, 2001; Henderson & Venkatraman, 1993). Some empirical studies confirm that strategic alignment is positively related with business performance (Sabherwal & Chan, 2001; Venkatraman, 1989).

Strategic alignment is a multidimensional fit between business strategy and an ES. For example, Broadbent and Weil (1993, p.162) defined alignment as a strategic fit and stated that it was "the extent to which business strategies were enabled, supported and stimulated by information strategies". Henderson and Venkatraman (1993) include organizational structure and define strategic alignment as a simultaneous match of business strategy and structure with ES strategy and structure. Hirschheim and Sabherwal (2001, p.88) further include management instruments and in their definition of strategic alignment which results in "the extent to which information system mission, objectives, and plans support and are supported by the business mission, objectives and IS (information system) strategies".

Each dimension of fit can be modelled as a critical success factor (Sabherwal & Kirs, 1994; Reich & Benbasat, 2000; Luftman, Papp, & Brier, 1999) that directs managers' attention towards creating the right collection of internal arrangements to achieve such a fit (Peak, Guynes, & Kroon, 2005; Sledgianowski & Luftman, 2005).

For example, Reich and Benbasat (2000, p.81) identify four such success factors, namely "1) shared domain knowledge between business and information system executives, 2) information system implementation success, 3) communication between business and information system executives and 4) connections between business and information system planning processes".

Figure 5 shows the Strategic Alignment model of Henderson and Venkatraman (1993).

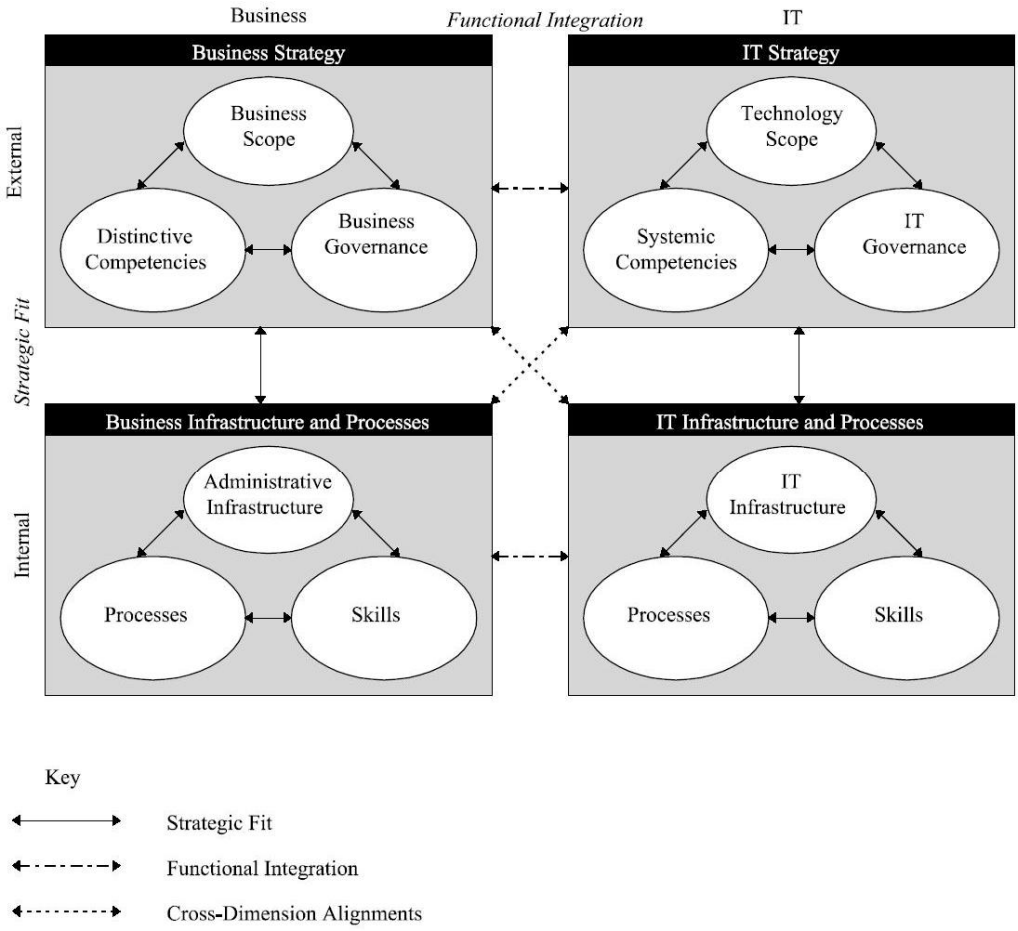


Figure 5, A Strategic Alignment Model (Henderson and Venkatraman 1993)

Existing research on the approaches used to achieve strategic alignment hold the same principle: strategic alignment is a static outcome. These research assume that the outcome are either decided by critical success factors which focus on the right collection of internal arrangements (Sabherwal & Kirs, 1994; Reich & Benbasat, 2000; Luftman et al., 1999), or step by step generic "plan and control" managerial methods aiming at achieving "fit" outcome (Sledgianowski & Luftman, 2005; Peak et al., 2005).

The fact is that much has been written about firms that perceive an increasing pace of change and instability due to globalization, or information technology innovation.

Even if a status of perfect strategic alignment would be achievable and lead to competitive advantage, the risk would be that it dissolves with environmental changes. In order to be the source of sustainable competitive advantage strategic alignment therefore cannot not be seen as an event or status, but as "a process of continuous adaptation and change" (Henderson & Venkatraman, 1993, p.473).

The initial research efforts on the dynamics of strategic alignment mainly profile the static strategic alignment status at different times. They eventually realize that strategic alignment is not an event, but "a process of continuous adaptation and change" (Henderson & Venkatraman, 1993, p: 473).

The progress of strategic alignment research shows that an organization has to support ongoing efforts to establish and maintain a series of interdependent relationships between businesses and ES strategies. An organization should have the capabilities to keep the dynamic alignment among diversified relevant components (Hirschheim & Sabherwal, 2001). Hirschheim & Sabherwal (2001)'s study shows that organizations seek alignment through some amount of incrementally changing one or more of the components of strategic ES alignment in one direction, then changing some other components, and occasionally undoing recent changes.

In summary, existing strategic alignment models are still incapable of telling us what the driving forces are behind a dynamic ESI process, how these driving forces shape the alignment.

2.1.4 Dynamic capability: ESI as the capabilities to re-establish alignment

A dynamic capabilities framework provides a promising way to understand how organizations can achieve sustainable strategic benefits from an ESI in a changing environment. Teece et al. (1997, p: 516) define a dynamic capability as a "subset of competences, which allow the firm to create new products and processes, and respond to changing market circumstances". Eisenhardt and Martin (2000, p: 107) posit a dynamic capability as "the firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources - to match and even create market change" and in addition to that, they point out "Dynamic capabilities are a set of specific and identifiable processes such as strategic decision making…" (Eisenhardt & Martin, 2000, p: 107). Zollo and Winter (2002, p: 340) regard dynamic capabilities as "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness".

Dynamic capabilities, thus, are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve and die. The dynamic capabilities framework is ideally suited to explain and understand management of ESI projects. An ESI project typically involves reconfiguring the organizational resource

base. Management of an ESI has to be performed by a series of managerial actions and processes, which can be identified. It has already been identified that organizational routines are a source of organizational continuous change (Feldman & Pentland, 2003; Feldman, 2000).

From the dynamic capabilities perspective, the outcome of an ESI lies in the capability of maintaining and developing the relevant organizational and managerial processes. In other words, well developed organizational and managerial processes can help an organization to successfully implement an ES, and furthermore, to develop and sustain the competitive advantage.

Managerial processes are significantly shaped by the assets the firm possesses (internal and market) and by the evolutionary path it has experienced (Teece et al., 1997). Eisenhardt and Martin (2000) identify the forces shaping the evolutionary track of organizational dynamic capabilities. They find that a path of organizational dynamic capabilities development is guided by learning, e.g. repeated practice, small losses & mistakes, pacing of experience and experiment. In addition, they stress that this evolution also depend on market dynamism. For example, experience and analysis are closely related to the evolution in moderately dynamic markets, and experiment and selection are more crucial in high-velocity markets (Eisenhardt & Martin, 2000).

Following this argument, the organizational capabilities of implementing an ES could be done by analysis of (1) the resources committed and assigned to the project, (2) the historic path, (3) the learning mechanism (4) and the relevant organizational & managerial processes. Figure 6 shows the dynamic capabilities of managing an ESI.

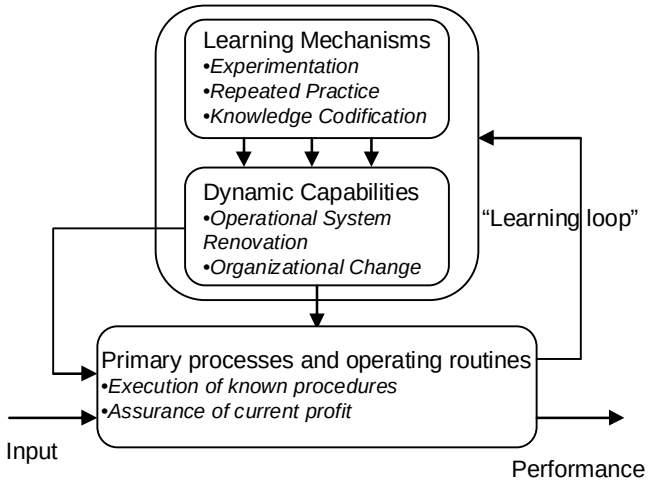


Figure 6, Dynamic Capabilities of ESI (adapt: Strehle, 2006)

The term resources in this context relate to the specific organizational resources allocated or committed to activities relevant to an ESI including: human resources, financial budget, structural asset (formal and informal structure of the organization and program) and external forces that impact the program. (E.g. market, regulation). The historic path acknowledges that 'history matters' (Teece et al., 1997). The organization's previous experiences constrain its future behaviour in an ESI process. The managerial & organizational processes represent the knowledge and its competence, and it is the way things should be done in the organization (Teece et al., 1997; Garvin, 1998).

Katzy and Ma (2006) identified seven managerial processes relevant to an ESI. The integration process is the capability to continuously integrate all executed technical, business and organizational change activities in the course of implementation. The resource (re)allocation process is the capability to assign and re-assign organizational resources, structures and processes. The stakeholder coordination process is the capability to identify and involve all relevant organizational stakeholders (e.g. top management level, middle line management, user level). The end user involvement process is the capability to achieve end users acceptance and leverage their knowledge and experience towards performance.

The knowledge and experience acquisition process is the capability to identify and adopt existing experience and knowledge for design and implementation of the ES. The knowledge and experience articulation process is the capability to collectively reflect and articulate implicit knowledge and experience on ESI. The knowledge and experience codification process is the capability to turn tacit knowledge & experience into artefacts that can transfer and diffusion across ES application knowledge across organizational boundaries.

Despite the insignificant research effort to adopt a dynamic capabilities approach to understand ESI, the dynamic capabilities approach, at the least, conceptually inspires us which aspects we should pay attention to, in order to develop the relevant organizational capabilities and managerial processes (Katzy & Ma, 2006). The Dynamic capabilities approach shows the essential elements of the organizational capabilities for an ESI, but cannot tell how these capabilities can be developed.

2.2. Process theory of change: ESI as drivers for the capability evolution

Process theories of change possess the potential capabilities to identify the underlying forces which shape the organizational capabilities evolution during an ESI. It helps to understand how things evolve over time and why they evolve in such way (Van de Ven & Huber, 1990),

and explore the dynamics embedded in a ESI process (Amburgey et al., 1993; Armenakis & Bedeian, 1999).

Process studies observe and investigate the logic behind sequences of incidents (Pentland, 1999). Process researchers acknowledge that context and action are inseparable, that theories of change should explain continuity, and that time must be an essential part of investigation of change if processes are to be uncovered. The variety and richness of the incidents described and of the linkages between them should convey a high degree of authenticity, but cannot be achieved economically with a large sample (Golden-Biddle & Locke, 1993).

Process studies are typically labelled as narrative and/or interpretive oriented studies (Langley, 1999; Walsham, 1993; Pentland, 1999). This approach involves construction of a detailed story from the raw data. These studies plunge itself deeply into the processes themselves, collecting fine-grained qualitative data, and attempt to extract theory from the ground up (Bower, 1997; Pettigrew, 1992; Orlikowski, 1992; Barley, 1986; Crowston & Short, 1998; Crowston, 2002).

They believe that researchers must examine themselves to truly understand how and why events play out over time (Mintzberg et al., 1998; Langley, 1999; Langley & Truax, 1994). These narrative or interpretive stories try to maintain high accuracy but are low on simplicity and generality (Langley, 1999; Rumelt, 1997; Van de Ven, 1992).

Some process researchers make efforts to structure incidents in a simple way to create the results with higher generality (Barley, 1986; Langley, 1999; Denis et al., 1996). For these studies, the entire process is decomposed into several successive “periods”. The rationale behind this approach is that there is certain continuity in the activities within each period with certain discontinuities at its frontiers. Beyond its descriptive utility, this type of temporal decomposition offers opportunities for structuring process analysis and sense-making (Langley, 1999). With this approach, a shapeless mass of process data is transformed into a series of more discrete but connected blocks. Figure 7 illustrates Barley’s research approach.

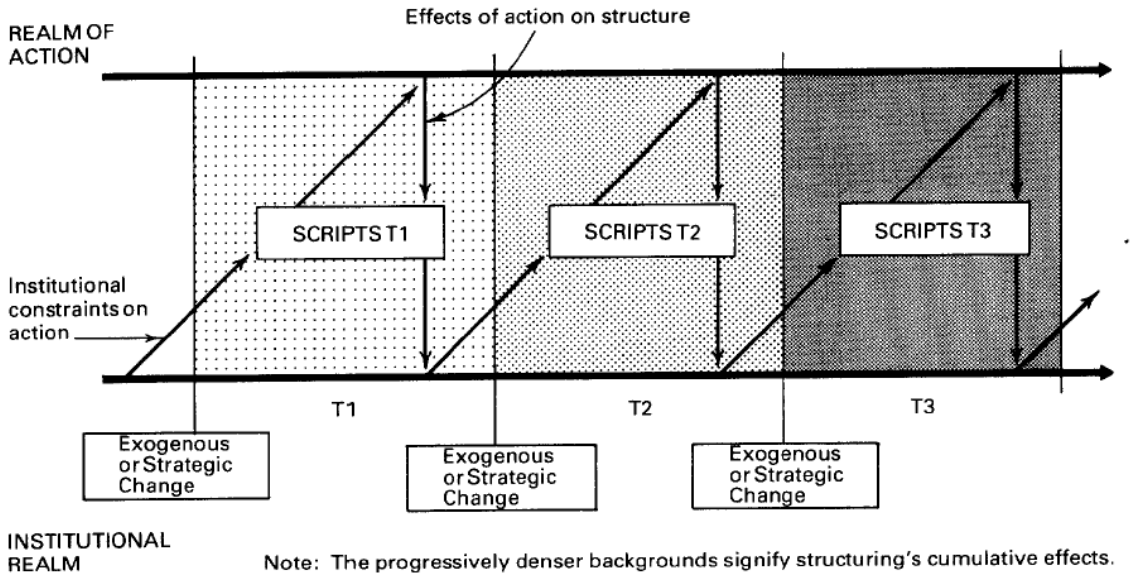


Figure 7, Barley's research framework (Barley, 1986)

Van de Ven et al. (2000) promote quantitative process analysis to increase the predictive power of process researches. In this approach, researchers start with in-depth process data collection and then systematically list and code qualitative incidents according to predetermined characteristics, gradually reducing the complex mass of information to a set of quantitative time series that can be analysed using statistical methods.

Assuming that the original data is complete and that the coding of incidents is reliable, descriptive patterns identified in the quantitative approach can be verified systematically. The types of statistical analysis appropriate to process theorizing are somewhat different from those used in most variance research. In principle most process theories are founded based on the idea that there are fundamental similarities in the patterns of event sequences across cases. However, traditional techniques (regress, ANOVAI) are designed to explain variance (difference) - not to show similarities (Langley, 1999).

It is claimed that pattern recognition is the final goal of process research to enhance predicative power (Marcus, 2000; Van de Ven et al., 2002). Here the definition of pattern is referred to that proposed by Alexander et al. (1977): 'Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem'. As implied here, the word pattern has two subtly different meanings – the repeated similarity of the problem (pattern = repeated decorative design) and the archetype of the solution to that problem (pattern = form to shape a mould for a casting).

However, the fact is that only few studies try to identify patterns in an ESI process. For example, Sabherwal and Robey (1993) adopt Abbott (1995)´s optimal matching algorithms to develop the taxonomy of ESI based on the coding of 53 event chronologies. Other quantitative researchers (e.g. Forrester, MIT system dynamic groups) use system dynamics approaches, and these methods are appropriate for examining the dynamic relationships between events within a single case (Pentland, 1999). The commonalities among these approaches are that "incidents" must be defined to be very generic in form, with little contextual richness attached to them.

In my opinion, the quantification approach will be much more convincing if it is used in combination with other approaches that allow conceptualization of the abstract data, adding nuance of interpretation and confirming the mechanics of the mathematical model with direct evidence, e.g. Garud and Van de Ven (1992) and Van de Ven and Polley (1992) on learning during innovation.

In summary, existing quantitative process researches have not found a balanced approach to conceptualize the richness of process data. These approaches drastically simplify the original data, setting aside certain dimensions and replacing the ambiguous, rich, and specific context by precise, thin, and general indicators. A dilemma for these researches is, on the one hand, making the effort to collect rich qualitative data, but on the other hand, feeling uncomfortable with the richness. In order to solve this issue, they always rush to transform it into a much thinner data set that can be managed in traditional ways.

2.3. Structuration theory: a sensitizing device

Structuration theory (Giddens, 1984; Giddens, 1979) is frequently referred to as a powerful sensitizing device for studying the interplay of agency and structure in an ESI (Barley, 1990; Barley, 1986; Yates & Orlikowski, 1992; Orlikowski & Yates, 2001; Orlikowski, 2000; Orlikowski, 1993; Orlikowski, 1992; Orlikowski & Robey, 1991; Pettigrew, 1985; Willmott, 1987; Jones, 1999; Jones et al., 2000; Edwards, 2000; Brass & Burkhardt, 1993).

Structuration (Giddens, 1984; Giddens, 1979) is posited as a social process that involves the reciprocal interaction of human actors and structural properties of organizations. It recognizes that human actions are enabled and constrained by structures on the one side, and on the other side, these structures are the results of previous human actions.

Structural properties consist of the rules and resources mediating human actions, while at the same time they are reaffirmed through usage by human actors. Human actors are recognized as knowledgeable and reflexive. Giddens (1984, p: 22) notes "All social actors, all human

beings are highly 'learned' in respect of knowledge which they possess and apply, in the production and reproduction of day-to-day social encounters." Reflexivity refers to the capacity of humans to routinely observe and understand what they are doing while they are doing it. It is not merely self-consciousness, but includes the continuous monitoring of physical and social contexts, and activities (their own and others). Human actors' knowledge and reflexivity, however, is always "bounded to some extent by the situated nature of action, the difficulty of articulating tacit knowledge, unconscious sources of motivation, and unintended consequences of action" (Giddens, 1979, p: 144).

Patterns of social interactions become established as routines or practices in organizations through the regular action of actors, e.g. coordinating a project meeting. Over time, habitual use of such practices eventually is institutionalized, forming the structural properties of organizations. Humans in their ongoing interactions draw on these structural properties, and by doing this, in turn, reinforce these institutionalized properties. In this meaning, an ESI can be understood as an instance to adjust relevant organizational properties.

The social interaction involve four structural properties: (1) rules attributed to the constitution of meaning; (2) rules pertaining to normative rights, obligations and sanctions; (3) allocative (material) resources; (4) authoritative resources. Rules are considered to be the core of the 'knowledgeability' of human agents: they are the techniques and procedures applied in the enactment and reproduction of social practices. Resources are the facilities drawn upon by agents, organized as properties of social systems. Given these characteristics of structure, the analysis of properties in any given social system will yield three analytical configurations (Figure 8):

1. Structure of signification (semantic rules)

2. Structure of domination (authoritative and allocated resources)

3. Structure of Legitimating (normative rules and resources)

The **signification** structure provides actors with a number of interpretive schemes or standardized stocks of knowledge to communicate the reality of their actions when interacting. According to Giddens (1979, p: 83): they "form the core of the mutual knowledge whereby an accountable universe of meaning is sustained through and in processes of interaction". The signification structure is supported by the Legitimating structure (vice Vera) that binds human actors' actions according to the accepted norms regulating and sanctioning interaction. These systems of moral rules stress the interplay of norms and power is implicated in social interaction.

Giddens conceptualizes power as 'transformative capacity' chronically implicated in human agency. However, this "notion of power has no inherent connection with intention or will" (Roberts & Scapens, 1985, p: 449). Consequently, the "use of power in interaction thus can be understood in terms of the facilities that participants bring to and mobilise as elements of the production of that interaction, thereby influencing its course" (Giddens, 1990, p: 92).

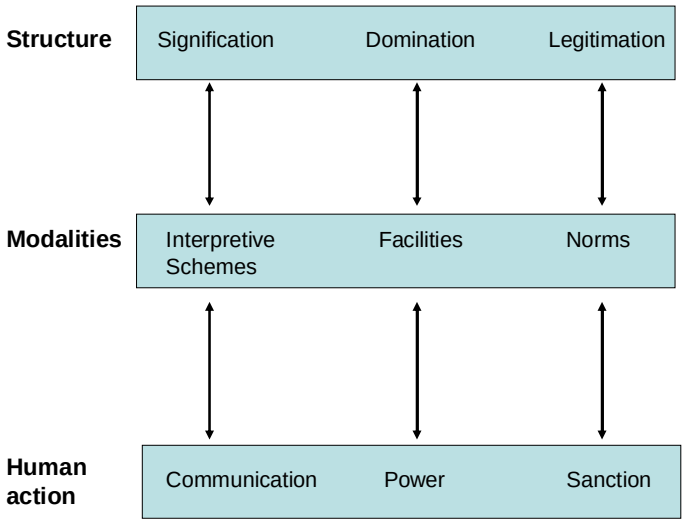


Figure 8, Structuration Modality Patterns (Gidden, 1984)

These structures have no reality except, that they are instantiated in activity or retained mentally as remembered codes of conducts or rights to resources, and are also central to structuration accounts of social order (Orlikowski, 1991). The main difference between this form of analysis and those of a volunaristic or deterministic type is that action and structure are considered to be simultaneously interacting. Therefore, the focus of analysis of the structuration centres on the ***reproduction of social systems (patterns)***.

> ***"The basic domain of study of the social sciences****, according to the theory of Structuration****, is neither the experience of the individual actor nor the existence of any form of societal totality, but social practices ordered across space and time****" (Giddens, 1995, p: 2)*

From the structuration perspective, the outcome of an ESI is not seen as the result of freely participating individuals, nor is it believed to be dependent on some objective characteristics of an organization, but rather, it reflects the modification of those rules and resources that mediate the interaction of stakeholders. Knowledge about the conditions of structure properties can be reflexively used by actors to maintain, influence, shape or modify those organizational orders, hence, to achieve the expected outcome of an ESI. In particular, agents

have the *"potential to choose actions deliberately and to carry them through effectively, even in defiance of established rules and prevailing powers" (Whittington, 1992, p: 696).*

Ultimately, an ESI process represents the intersection of the structures of signification, domination and legitimation instantiated in a network of social relations(Jones, 1997).

An ESI process is seen as inherently uncertain reflecting social interactions between competing groups involved in the introduction of new practices and routines (both technological and organizational dimensions), thereby reinforcing or modifying institutional arrangements.

The modalities of structuration (interpretive schemes, norms and facilities) are mobilized to constitute the interaction. Modalities are described as conceptual useful for understanding managerial behaviours (Willmott, 1987; Bloodgood & Morrow Jr, 2003). The modalities link the process of interaction with the structural components of social systems. Modalities can be instantiated as the methods in which actors drawn upon and mobilize the structural elements (rules and resources) in their social relations. The methods of mobilizing the modalities are linked to the establishment of arrangements that regulate the social system (Giddens, 1984).

In the following sub-sections, we summarize the main research achievement of using structuration in information system adoption and implementation in order to understand how it can inspire this study.

2.3.1 Technology as embodying structural properties

From the structuration perspective, an ES plays a role similar to that of organizational properties. It is posited not as a purely physical entity or social construction, but as a set of constraints and enablement realized in recurrent practice by the appropriation (Orlikowski & Robey, 1991; DeSanctis & Poole, 1994).

Most existing structuration models of technology (Barley, 1986; DeSanctis & Poole, 1994; DeSanctis & Gallupe, 1992; Orlikowski & Robey, 1991; Walsham, 1993) primarily posit two propositions: that technologies become 'stabilized' after development, and that they 'embody' structures which (re)present various social rules. In these models, technologies are built in during technology development, which are then appropriated by users during use of the technology (Orlikowski, 1992; DeSanctis & Poole, 1994).

An ES can be seen as embodying structural properties only when they are instantiated in recurring practices. People interact with it on a regular basis, and engage with properties of an

ES. External entities and internal schemas are only constituted as structural properties when they are implicated in recurrent social action (Sewell, 1992). Giddens (1984, p: 33) observes:

> *"Some form of allocative resources (e.g. land, raw materials etc.) might seem to have a real existence. In the sense of have a 'time-space' presence this is obviously the case. But their 'materiality' does not affect the fact that such phenomena become resources …* ***only when incorporated within process of Structuration****."*

Hence, an ESI provokes human interactions that may subsequently revise social structures. Existing studies discovered that an organization response to the implementation of a similar technology is different (Barley, 1986; Sino & Hinds, 2004; Burkhardt & Brass, 1990; Burkhardt, 1994). For example, Barley concludes that:

> *"Technologies do influence organizational structures in orderly ways, but their influence depends on the specific historical process in which they are embedded. " (Barley, 1986, p: 107)*

Barley (1986, p: 81) also argues that

> *"…since technologies exist as objects in the realm of action, one cannot hope to understand a technology's implications for structuring without investigating how the technology is incorporated into the everyday life of an organization's members".*

These structuration models are not appropriate in the context of the dynamically reconfigurable, user programmable and highly internet related technologies (Orlikowski, 2000). Orlikowski states that structuration models of technology should be extended to *"focus on what structures emerge as people interact recurrently with whatever properties of the technology at hand, whether these are built in, added on, modified, or invented on the fly"* (Orlikowski, 2000, p: 407).

2.3.2 Technology as enacting structural properties

Orlikowski focuses on "emergent rather than embodied structures, an alternative view of technology use becomes possible – a view which allows us to frame what users do with technologies not as appropriation but as enactment" (Orlikowski, 2000, p: 407). Rather than examining how actors appropriate its embodied structures, this view starts with human

actions and examines how it enacts emergent structures through recurrent interaction with the technology at hand (Orlikowski, 2000).

That technologies "embody" a social structure is a departure from Giddens' (1984) view of structures as having only a virtual existence, that is,

> *"no reality except as they are instantiated in activity" (Whittington, 1992, p: 696).*

The use of technology is not a choice among a set of fixed possibilities, but a situated and recursive process of constitution. Technological structures are not simply embodied in technologies waiting for being appropriated. Rather, they are emerging from people's repeated and situated interaction with particular technologies. These enacted structures of technology use are the sets of rules and resources that are (re)constituted in people's recurrent engagement with the technologies at hand.

Similar to other social structures, technological structure is also the set of enacted rules and resources that mediate social action through three modalities: interpretive schemes, facilities, and norms. When people use a technology, they draw on the properties of the technological artefact (embedded, added, enacted features), and also their skills, power, knowledge, assumptions and expectation, which typically impacted by training, communication and previous experience (Orlikowski & Gash, 1994). Users also draw on their knowledge of and experience with the institutional contexts.

In this way, peoples' use of technology become structured by the experiences, knowledge, meaning habits, power relations, norms, and technological artefacts at hand (Orlikowski, 2000). Such structuring enacts a specific set of rules and resources in practice that then serves to structure the interaction with the technology in their recurrent practice. Subsequently, over time, people (re)constitute a structure of using technology. Figure 9 shows the structuration process during the use of a technology.

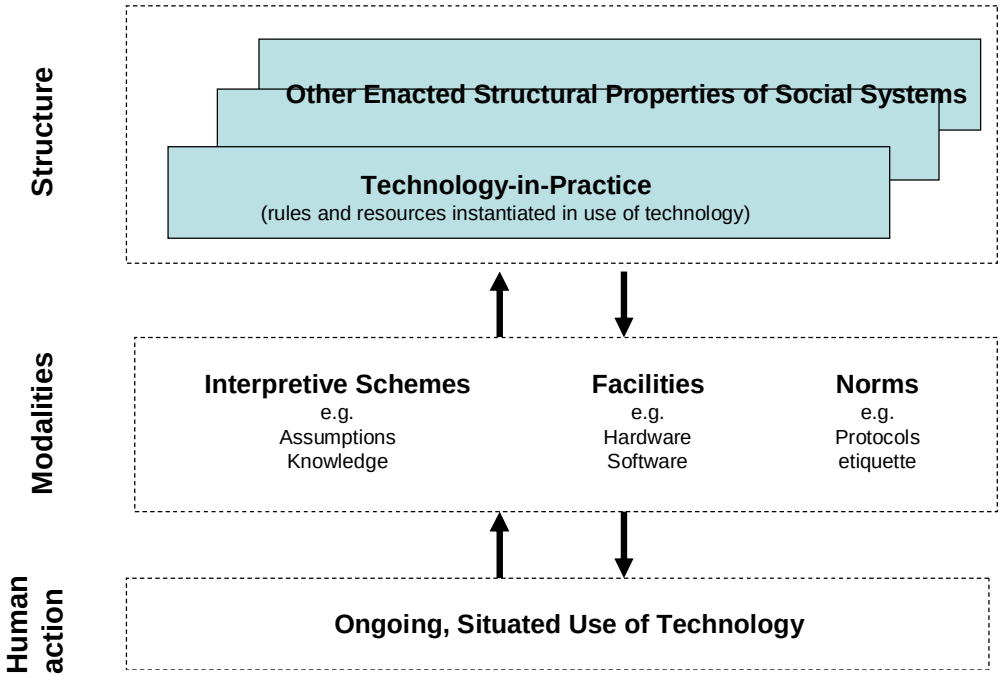


Figure 9, Technology as a Mediator of Structural Change (Orlikowski 2000)

This structuration model can explain the emergent, unexpected and opportunistic events that occur in the ESI process. It is also consistent with the recent research results about continuous organizational change (Orlikowski, 1996; Weick & Quinn, 1999; Pettigrew, 2001; Brown & Eisenhardt, 1997). It provides the insight of the co-evolution between technologies and organizations, and the understanding of the effectiveness of managerial processes.

2.3.3 Structuration: implication for managerial work

Structuration theory provides a conceptual framework that links the strategic conduct and organizational structural (properties). Managerial work, as a social practice, can be analysed as the achievement of agents and as an expression of structural properties of a social system (Willmot, 1997). On the one hand, managerial work is seen to be accomplished by managers who strategically develop and enforce rules and deploy resources. On the other hand, managerial conduct is also understood as a possibility only when they have much resources and rules on hand during social interaction. Giddens (1995, p: 373) called the analysis of strategic conduct: "*social analysis which places in suspension institutions as socially reproduced, concentrating upon how actors reflexively monitor what they do; how actors draw upon rules and resources in the constitution of interaction*".

Dominant studies on managerial work have been guided by frameworks that disregard institutional realities (Dalton, 1959; Turner & Müller, 2005; Bass & Avolio, 1993; Dulewicz & Higgs, 2003). These studies on 'behaviour' have largely disregarded the 'political aspect' of managerial work, or have been exclusively identified with the skills and strategies devised and applied by individual managers to perform the defined roles and tasks (Willmott, 1987).

Mintzberg (1973) notes that it is a mistake to explain managerial work in terms of the personality characteristics of an individual manager. He appears to take into account the social nature of managerial work, but he does so without "appreciating the relational and contested production of this reality" (Willmott, 1987, p: 251). Kotter (1996) acknowledges the central importance of social relationships and the power in the managerial work, but stay at the level of identifying their significance and potential for achieving a more effective usage of an individual manager's talent (Willmot, 1987).

Structuration approaches provide a valuable theoretical lens to understand the nature of managerial work. Willmot (1987)'s study shows that the major contribution of using structuration theory to study managerial work "lies in their capacity to illuminate the dynamics of social life" (Willmott, 1987, p: 263). Macintosh and Scapens (1991) uses structuration theory to explain the adoption actions of two management accounting systems.

Beckert (1999) proposes that the strategic choice of managers should be carefully linked with institutionalized practices in organizations. Coopey et al. (1998) advocate that organizational managers' innovation should be considered in the frame of structuration thinking.

Despite its promising power, existing studies still concentrate on the conceptual level and explain the usefulness of structuration models. There is little research done to investigate how these interpretations can be implemented step by step in management practice.

2.3.4 Structuration process: implication for path creation.

An ESI always involves the adjustment of organizational routines and creation of a new organizational path (Robey et al., 2002). Structuration theory is increasingly applied to analyse an organization path on a higher (macro) level (e.g., Staber & Sydow, 2002; Feldman, 2004). These applications contribute especially to the understanding that organizational structures are somewhat like a fluid social system; however they are strongly influenced by their own history even during the course of change.

Path creation is defined by Garud and Karnoe (2001, p: 6):

> *"Specifically, entrepreneurs may intentionally deviate from existing artefacts and relevance structures, fully aware they may be creating inefficiencies in the present, but also aware that such steps are required to create new futures. Such a process of* ***mindful deviation lies at the heart of path creation****"*

In the case of an ESI, individual actors join forces in order to create a new organizational path. Human agents must develop effective relational or coordinative practices that are based on common understandings and norms, simultaneously, and are able to draw on sufficient resources in order to generate "momentum" (Garud & Karnoe, 2001). This generation of momentum makes it clear that an organizational path is likely to take time and requires resources and sustainable actions from the path creators.

An intended path creation and/or organization change process is described by Sydow (2005 et al.) as four phases of path creation: Generating momentum, Path shaping, Path dependency and Path breaking (Figure 10).

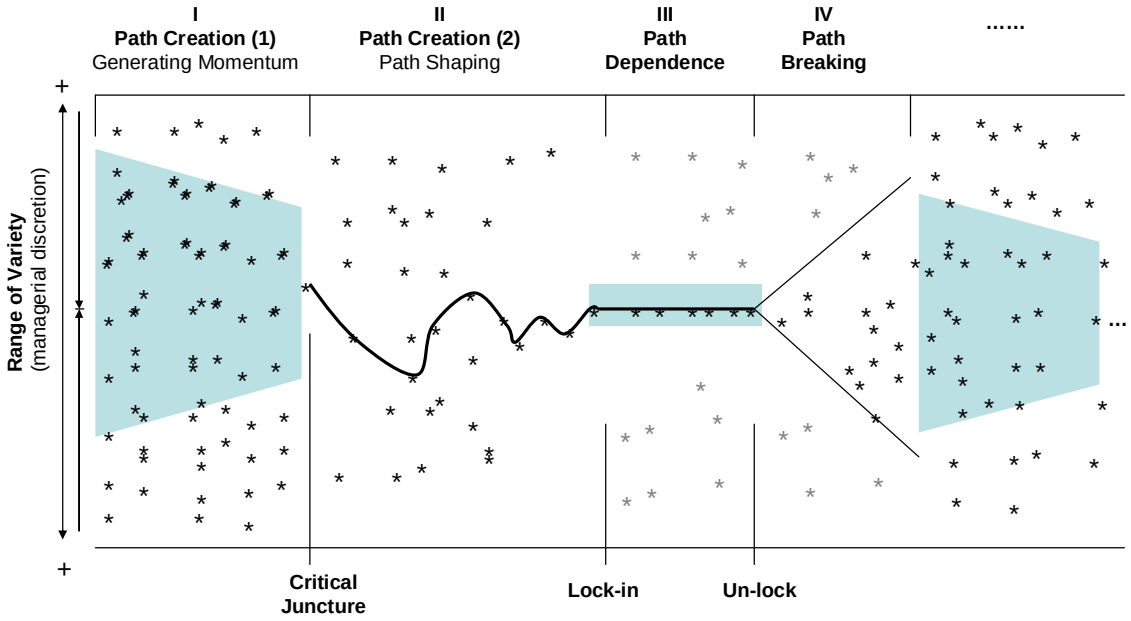


Figure 10, Breaking and Creating Organizational Path (Sydow et al., 2005)

Phase I: generating momentum; at this early phase, human agents already refer to the structures of a social system (e.g. organization) and more or less consciously selects one of the many alternatives. Depending on the social conditions, they naturally narrow down the scope of choice available, while powerful agents ally together to create the momentum necessary for a new organizational path. The needed momentum must be so great that a

critical mass develops, attracting additional actors with their contributions and resources, and eventually deviates them from an existing path. These junctures are critical because once a particular option has been selected; it becomes progressively difficult to return to the initial conditions with multiple alternatives (Mahoney, 2000). Up to now, it is still unclear how exactly such a momentum can develop (Sydow et al., 2005).

Phase II: path shaping highlights the necessity of a sustained effort by organizational members to collectively shape the path. This phase of path creation requires that agents possess the necessary resources, understand the rules, organize collective actions, and gain legitimacy for these actions (Human & Provan, 2000; Rao & Singh, 2001). These collective actions are still constrained and enabled by existing organizational structure properties, thus, some unexpected and/or emergent events nonetheless have a significant impact on the creation path. The end of this phase means that the process becomes locked-in and enters into path dependence.

Phase III – path dependency, a new organizational path is widely adopted or a new enterprise system is institutionalized at this phase. Viable alternatives are no longer at hand. However, within a social system (e.g. organization), human actors often have the flexibility to interpret a path differently, and even deviate from this path by acting different.

Structuration theory facilitates understanding the evolution of the path creation processes. It inspires us that strategic actions towards an ESI should consider not only competent reference to rules and norms, but also significant amounts of allocative and authorative resources. Taking path-creation processes into account will give managers a more realistic understanding about the possibilities and limitations of an ESI project.

2.3.5 Short summary of the existing structuration applications

Structuration theory conceptually tells us the way to answer the research question: ***Are there recognizable patterns in the managerial process during an ESI period***. In structuration models, any effective intervention (managerial process) designed to break down an old organizational structure has to address the (social) system level and include social, spatial, temporal and symbolic dimensions of change (Giddens, 1984).

Existing applications of structuration theory show that the theory has the strong analytical power at the conceptual level to: (1) explain the role of an ES as occasion for organizational change; (2) explain the embodying and enacting process of an ESI; (3) explain how an ES can be institutionalized as part of the organizational structure; (4) conceptually interpret the organization path creation process during an ESI; (5) link the managerial strategic act with

relevant institutional contexts; (6) analytically reveal the facilities, interpretive schemes and norms that managers use to conduct an ESI.

Given the objective of this study is to find out generalizable managerial process patterns along an ESI process, there is no approach ready that can be equipped to identify dynamic patterns of managerial processes. There are limited existing efforts for process pattern identification (Sabherwal & Robey, 1995; Van de Ven et al, 2000), but these studies do not consider social, temporal and symbolic dimensions of an ESI.

The modalities of structuration theory imply what managerial processes are crucial to an ESI. The critical managerial processes for an ESI can potentially be extracted by operationalizing the modalities of structuration theory. Giddens specifies three "modalities" that link the realm of action and the realm of social structure**: *interpretive schemes*** are a standardized, shared stock of knowledge that human actors draw on to interpret behaviour and events, hence achieving meaningful interaction. ***Facilities*** are the means through which intentions are realized, goals are accomplished, and power is exercised. ***Norms*** are the rules governing sanctioned or appropriate conducts and the legitimacy of interaction (Giddens, 1984). An appropriate pattern identification approach must be used for operationalizing the modalities in structuration theory.

2.4. Pattern Recognition: a contribution to a process research mehtod

Pattern recognition is the research area that studies the operation and design of systems that recognize patterns in data. Pattern recognition as a field of study developed significantly in the 1960s. It was very much an interdisciplinary subject, covering developments in the areas of statistics, engineering, artificial intelligence, computer science, psychology and physiology etc (Friedman, 1999; Theodoridis & Koutroumbas, 1999).

Generally pattern recognition classifies data based on either a prior knowledge or on statistical information extracted from the patterns (Friedman, 1999). A pattern recognition system consists of a sensor that collects the information to be classified or described; a feature extraction tool that computes numeric or symbolic information from the observed information; and a classification or description scheme that does the classification or description, relying on the extracted features (Figure 11).

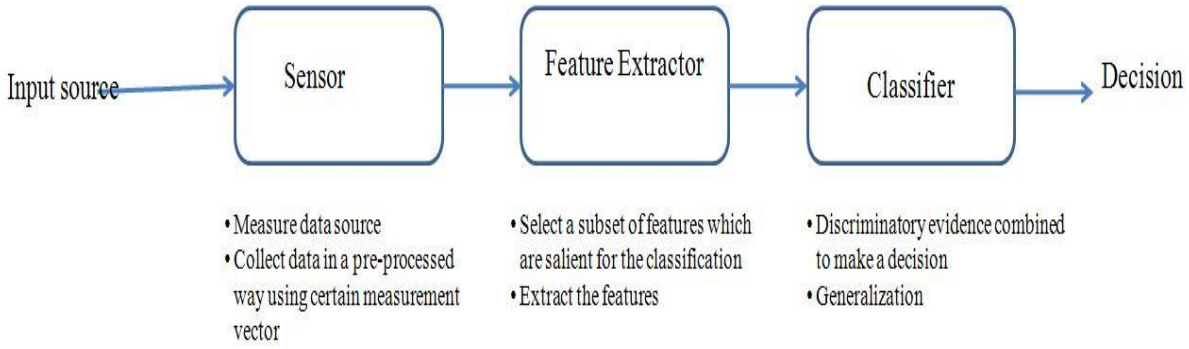


Figure 11, Pattern Recognition Stages

A typical pattern recognition investigation may consist of several stages as listed blow. Not all stages may be present; some may be merged together so that the distinction between two operations may not be clear, even if both are carried out; also, there may be some application-specific data processing that may not be regarded as one of the stages listed (Theodoridis & Koutroumbas, 1999).

1. **Formulation of the problem:** gaining a clear understanding of the goals of the investigation and planning the remaining stages.

2. **Data collection**: making measurements on appropriate variables and recording details of the data collection procedure.

3. **Initial examination of the data**: checking the data, calculating statistics and producing plots in order to get a feel for the structure.

4. **Feature selection or feature extraction**: selecting variables from the measured set that are appropriate for the task. To some extent, the division of feature extraction and classification is artificial.

5. **Unsupervised pattern classification or clustering**. This may be viewed as exploratory data analysis and it may provide a successful conclusion to a study. On the other hand, it may be a means of pre-processing the data for a supervised classification procedure.

6. **Apply discrimination or regression procedures as appropriate**. The classifier is designed using a training set of exemplar patterns.

7. **Assessment of results**. This may involve applying the trained classifier to an independent test set of labelled patterns.

8. Interpretation.

The above is necessarily an iterative process: the analysis of the results may pose further hypotheses that require further data collection. Also, the cycle may be terminated at different stages: the questions posed may be answered by an initial examination of the data or it may be discovered that the data cannot answer the initial question and the problem must be reformulated.

Pattern recognition aims at removing redundant or irrelevant information, and transforms it to a form more appropriate for subsequent classification. The term intrinsic dimensionality refers to the minimum number of variables required to capture the structure within the data. In the speech recognition example mentioned above, a pre-processing stage may be to transform the waveform to a frequency representation. This may be processed further to find formants (peaks in the spectrum). This is a feature extraction process (taking a possible nonlinear combination of the original variables to form new variables). Feature selection is the process of selecting a subset of a given set of variables.

It is a challenge to design these filters parameters. If the classifier is too complex (there are too many free parameters) it may model noise in the design set. If the classifier is not complex enough, then it may fail to capture structure in the data. It may be possible, in a classification problem, to achieve 100% classification accuracy on the design set but the generalisation performance – the expected performance on data representative of the true operating conditions (equivalently, the performance on an infinite test set of which the design set is a sample) – is poorer than could be achieved by careful design. Choosing the 'right' model is an exercise in model selection.

It is widely admitted that data collection process for process research on ESI is a treacherous task. The crucial dilemma is that until now, no process research approach can effectively exploit and deal with piles of process data that require huge research efforts (Van de Ven & Huber, 1990; Sabherwal & Robey, 1993).

Applications of a pattern recognition approach for an ESI indicate the following critical issues:

1. Design a "sensor" to effectively collect the needed process data, which should eliminate 'noise' in the data, and keep the context richness. The "sensor" should be capable of collecting data which incorporates social, temporal and spatial dimensions of the studied ESI phenomena, but should reduce the redundant data, hence make the needed data collection effort feasible.

2. Design a “feature extractor” that includes a set of parameters and this parameter configuration refers to the number of variables required to capture the principal structure of an ESI. This is not a simple stage because an ESI typically involves organizational change, business strategy alignment etc, and is a long term journey. Hence, the selected features should be process oriented, with multi-disciplinary roots that can represent the basic structure of the data.

3. Develop a “classifier” to generate patterns. There are no prior patterns that can be used for a ‘classifier” design, an iterative learning cycle has to be considered to initiate training and learning process of the design of an effective ‘classifier’ machine. Hence one of the results of this study is to analytically build up a ‘classifier’ prototype that can be used for the future statistic pattern recognition study.

Meanwhile, the ESI research is different with other engineering studies: it is not possible to infinitely design or collect data to explore and test in the pattern recognition process. Hence, for the specific objective of this study, ten in-depth empirical cases are intentionally selected. In Chapter 3, the designed process pattern recognition method for ESI research is described in detail.

3. A PROCESS RESEARCH METHOD

The central challenge of process research lies:
"Moving from a shapeless data spaghetti towards some kind of theoretical understanding that does not betray the richness, dynamism, and complexity of the data that is understandable and potentially useful to others"

(Langley, 1999, p: 694)

3.1. Introduction

The discussion so far reveals that existing research streams are not able to be used to answer the research question of this study. The goal of this thesis is to identify patterns of managerial processes in an ESI.

The analysis as well clearly shows that process research offer a potential theoretical lens through which to achieve the goal of this thesis. While it shows the promising vision indicated by existing process researches, the gaps obviously stand there. Recalling the main gaps identified in chapter 2, they can be summarized as:

1. How to identify the crucial managerial processes for an ESI

2. How to recognizing the patterns of the identified managerial process

Pattern Recognition shows a promising solution to solve these challenges. A pattern is a way to create results with high generality, simplicity and good predictability and pattern is a way to capturing and communicating best practice. The analyses done in the previous chapter can help to extract the challenges of a process research method that will be used for ESI research in this thesis.

3.1.1 A sensitizing theory is needed

From the pattern recognition perspective, an appropriate theory should function as an algorithm inside a "sensor". It is shown in the existing literature analysis (in Chapter 2) that in order to identify the dynamic patterns of managerial processes for an ESI, the chosen research theory must be dynamic oriented, multi-level analysis, create the results with at least medium to high generality. It will be used to support: (1) identifying relevant managerial processes, (2) collecting the research data with rich context information; and (3) releasing the burden of collecting daunting volume of aimless data.

Hence, the new process approach should be supported by a social science theory which addresses the system level to include social, temporary and symbolic dimensions of change. Balogun et al.(1999) stress that the management of (ESI enabled) organization change is context-specific and therefore, an understanding of the organizational context is essential. Mintzberg (1973) and Willmott (1987) clearly state that managers should be reflexive about the impact of their actions to the social system (organization) and learn from it for next actions. Giddens (1984) and Sydow et al. (2005) conceptually state that human actors must understand organizational structure and mobilize a critical mass to break down the existing organization path and create a new organization path.

3.1.2 Extract concrete "parameters" out of the theory

The second challenge is to condense the theory into certain concrete "feature parameters" for "feature extractor". The goal of the operationalization is to make the abstract social theory actionable to some extent and creates some applicable results (Orlikowski, 2000; Orlikowski, 1993; Barley, 1986; Pentland, 1999). Here it can be assumed that the results have better generality compared with narrative and interpretive studies (e.g.,Orlikowski, 2000; Orlikowski, 1993).

3.1.3 An explicit template for patterns

Defining an accurate and useful process oriented pattern template is a necessary pre-requisite for generating high-quality patterns. With an explicit pattern template, a pattern is a way of capturing and communicating best practice.

Considering the research objective of this study, a process pattern template used should consider the following elements: (1) the template should incarnate the skeleton of the used theory, (2) the template should embody the dynamics as it is process oriented, (3) the template should make the comparison analysis explicit and understandable.

Existing process approaches already made some initial effort on it, which could inspire us towards certain direction. For example, Van de Ven et al (2000) design the common template to codify the process "events".

Barley (1986) splits the implementation process into several 'periods" to better understand the interaction process between adopted CT scanner and organizational routines. Sydow uses the four steps template (Generating Momentum, Path shaping, Path Dependence, and Path Breaking) to understand how a new organizational path is created (Sydow et al., 2005).

3.1.4 Multiple longitudinal in-depth case studies

A starting point for pattern recognition research is certain number of cases to allow identifying the potential recurring problems. After exploring pattern categories with these cases, a base is built up for a self-training "pattern classifier". Consequently data collection effort will be reduced for the next step statistic pattern recognition.

Most existing process research is limited in one or few intensive cases (Langley, 1999). Several main reasons are identified by researchers (Langley, 1999; Pettigrew, 2001; Robey et al., 2002; Markus & Tanis, 2000): (1) effort to collect longitudinal data is huge, it is very difficult to collect comparable multiple cases (2) results are mainly either "descriptive" or "interpretive" stories, which is difficult to compare, (3) process data collected mainly deal with sequences of "events": a conceptual entities that researchers are less familiar with, (4) the data often involve multiple levels and units of analysis whose boundaries are ambiguous.

In the next section, the concrete steps of a designed process approach based on these four challenges are described in detail.

3.2. The process research method for ESI

Doing a process recognition research in this thesis is neither a pure inductive (data-driven generalization) nor a deductive research (theory driven hypothesis testing). However, it is more a constructive approach which involves both strong theoretical analysis and empirical research elements. It draws indiscriminately on experience, formal data, common sense and prior theories etc.

The method of doing a process recognition research carefully refers to the previous work on multiple case studies (e.g., Yin, 1994; Eisenhardt, 1989), grounded theory building (Glaser & Strauss, 1967) and other process research approaches (Van de Ven & Huber, 1990; Sabherwal & Robey, 1993; Langley, 1999).

The specific steps of doing process recognition research are as Table 2:

Step	**Activity**	**Reason**
Define research focus and research question	Definition of research focus and research question	Focus effort; reduce data collection effort.

Select a (meta) theory as "sensor"	Theoretical selection Help to filter the data Decide which process data should be selected	Removing redundant or irrelevant information, and transforms it to a form more appropriate for subsequent classification.
Define "Feature parameters" to further extract discriminate parameters	Define key structural properties of the process data Select candidate salient discriminators	Select those variables that are important for classification for pattern deduction Select key signals, but ignore noise
Develop a "Process Pattern Template" to define pattern format	Define pattern template, and the inner logic linkages between template and feature parameters	Necessary for pattern recognition, and make pattern comparison possible
Select empirical case sample	Theoretical sampling	Constrain extraneous variation and sharpen external validity Focus on theoretical useful cases
Crafting data collection instrument and protocols	Multiple data collection methods Qualitative and Quantitative data combined	Triangulation of evidence Synergetic views
Conduct a pilot case study	Single case study	Validate the templates and protocols Get familiar with such study
Replicate the empirical in-depth case study	Multiple case study	Force researchers go deep into data and look for patterns from

		evidence shown in multiple cases
Generate the analytical process patterns	Iterative cross case analysis Generate patterns	Generate analytical patterns
Enlarge the research sample to statistically validate the patterns **(It is not covered by this study)**	Enlarge research sample to more small scale studies with less data collection effort Statistic analysis	Validate and generate statistic patterns

Table 2, Process of doing process pattern recognition research

Step 1: Define Research Focus and Research Question

Without a well defined research focus, it is easy to become overwhelmed by the volume of data, especially for process research. Mintzberg (1979, p: 585) notes: "no matter how small our sample or what our interest, we have always tried to go into organizations with a well-defined focus – to collect specific kinds of data systematically".

Step 2: Select a (Meta) Theory as a "Sensor"

A sensor is used for removing redundant or irrelevant information, and transforms it to a form more appropriate for subsequent classification. A well designed sensor can help a process researcher further focus her/his effort to collect the real signal data and ignore noises.

Step 3: Define "feature parameters" to further extract discriminate parameters

After designing the scope of data using the "sensor", it is necessary to further select those variables that are important for classifying patterns. These new variables may be obtained by a transformation of the original set (feature extraction).

In practice, we usually do not know what structure and what noise is in the data. Hence, for the new process approach, it is necessary to carefully analyze the meta-theory and extract an initial set of feature parameters which can be validated in the later pattern classification step and act as a starting point for training a classifier (the procedure of determining its parameters).

Step 4: Develop a pattern Template

Defining a process oriented pattern template is a pre-requisite for generating high-quality patterns. The principle of designing a process oriented pattern template is described in Chapter 3.1.3

Step 5: Select empirical case sample

Selection of cases is an important step of the pattern recognition research. Similar with other multiple case study methodologies (Yin, 1994; Eisenhardt, 1989), such research relies on theoretical sampling, not for statistic reasons. The aims of a theoretical sampling are to constrain extraneous variation and sharpen external validity. It has different psychology roots with traditional hypothesis testing studies relying on statistical sampling, where the data sample are randomly selected, and the goal of sampling is to obtain accurate statistical evidence on distribution of studied variables in the sample population.

Step 6: Crafting data collection instrument and protocols

A social science oriented process pattern recognition research typically requires the combination of multiple data collection methods, such as interviews, observations, questionnaires and archival documents etc. The rationale is that the triangulation made possible by multiple data collection methods provides stronger substantiation of constructs and patterns.

Qualitative and quantitative evidence should be combined. The combination of data types can be highly synergistic. Quantitative data can indicate relationships which are not easily identified by interviews and other qualitatively oriented data collection methods. Moreover, it can also bolster findings when it corroborates those findings from qualitative evidence. The qualitative data are useful for understanding underlying relationships revealed in the study and leverage the interpretive power of the results.

Step 7: Conduct a pilot case study

There are daunting amounts of analytical work involved in process pattern recognition research. Conducting one pilot case can also help researchers to reflect the effectiveness of the data collection instrument and the usefulness of the process pattern template.

Moreover, it can also allow researchers to check whether there are unique patterns emerging before researchers push to generalize patterns across cases. Based on the lessons learnt, process researchers can gradually perfect them in a way so that the following data collection and analysis can be operated more effectively.

Step 8: Replicate the empirical in-depth case studies (8-12 cases)

The final goal of the process pattern recognition research is to identify process patterns. Hence, cross case analysis is the heart of this type of research. Equipped with data collection protocol, process pattern template and defined feature parameters developed the data analysis procedure is repeated one by one after the pilot case study.

The number of cases needed is dependent on when theoretical saturation is reached (theoretical saturation is simply the point at which incremental leaning is minimal because the researchers are observing phenomena seen before (Glaser & Strauss, 1967). In practice, theoretical saturation is often intertwined with pragmatic consideration (e.g. time and money). From the relevant literature, a number between 4 and 10 cases usually works well (Eisenhardt, 1989). Considering the specifics of the goal of process pattern recognition for an ESI and the experience the author have, 8 to 12 cases should be ok if there is no ideal number of cases.

Step 9: Generate the analytical process patterns

This step is a highly iterative process and aims at systematically comparing the emergent patterns with evidence from the other cases in order to assess how well or poorly it fits the case data. The central principle is that researchers constantly compare theory and data – iterating towards resultant process patterns that closely fit the data.

Process researchers should iterate their intermediary findings with these data step by step up to the point when the research results are testable, logically coherent and better to be parsimonious.

Step 10: Enlarge the research sample to statistically validate the patterns

While generating statistic process pattern is not the scope of this thesis, it should be a necessary step of a holistic process pattern recognition method.

The key elements of developing statistical pattern are initially and logically established after following up the previous nine steps, e.g. data sensor mechanism, feature extractor and some known pattern class which is testable. Process researchers can then extend further to a statistical pattern recognition research by conducting more small-scale case studies with a large sample.

Now it is realistic, as there is already a testable and solid base from which there is less data collection and analysis effort needed. Researchers do not need to do in-depth case studies, and they can depend on a questionnaire plus one or two interviews to collect the data input. They

can also adapt the existing pattern recognition methods and techniques in other field to do the statistic analysis based on the structured data they collected.

3.3. The concrete steps

An extensive literature analysis is conducted in a systematic way for this study. The research questions are clearly defined afterwards. The author also exchanges ideas about the research question and motivation of this research with peer academic colleagues (e.g. European Doctor Summer School), and experienced consultants and project managers (which is through a 2.5 years' participation in an international R&D project). These experiences and this knowledge help the author clearly define the research focus and questions for this study.

3.3.1 Design a "sensor" for collecting process data

In this thesis, structuration theory (Giddens, 1984; Giddens, 1979) is chosen to be the sensitizing theory. Structuration theory fits the required elements for a research into the interaction of an ES and organizations (Orlikowski & Robey, 1991; Markus & Robey, 1988).Structuration theory is "an emergent, process theory, which accommodates multiple levels of analyses, is contextually and temporally situated, and avoids the blinders of ahistorical account of social phenomena" (Orlikowski & Robey, 1991, p: 164).

Selecting structuration theory as a "sensor" intrinsically delimits the scope of data that should be collected. It is consistent with other process research that first of all, the sequence of events that occurred during an ESI should be collected. Structuration theory guides us intentionally defining the criteria for which type of events should be identified during the data collection period. It also indicates that dynamic interactions among relevant organizational actors around an ESI should be carefully learnt as it facilitates us to understand the event sequence and will be an input for pattern recognition.

The selection of structuration theory as a "sensor" helps to avoid the aimless data collection process, and act as a core thread which guides the whole data collection process.

3.3.2 Extracting the "feature parameters"

The modalities of structuration theory are an idea abstract prototype to extract "feature parameters". The modalities can be considered as driving forces which together, with existing structural properties, shape the process of an ESI.

The modalities provide the linkage between the process of interaction and the structural components of social systems. Three modalities offer a conceptual package from which to

extract the "feature parameters". Managing an ESI can be understood as human actors mobilizing interpretive schemes, norms and facilities which collectively are described as the modalities of structuration. In their recurrent social practices, they draw upon their knowledge of their prior action and the situation in hand, the facilities available to them, and the norms that inform their ongoing practices. By these means, they apply such knowledge, facilities and habits of minds and body to "structure" their current action. In doing so, they recursively instantiate and reconstitute the rules and resources that structure their social action.

While the elements of modalities (interpretive scheme, facilities, and norms) are treated as analytically distinct, they are in social reality, highly interdependent and not separable (Orlikowski, 1992). Three modalities (interpretive schemes, facilities and norms) are always involved simultaneously in social interactions; it is impossible to be clearly discerned (Barley 1986).

Some existing studies offer useful insights for disentangling these modalities. For example, (Orlikowski, 2000, p: 410) concluded that "*People also draw on their skills, power, knowledge, assumptions, and expectations about the technology and its use, **influenced typically by training, communication, and previous experience***". Garud and Karnoe (2001) emphasize that ***'collective entrepreneurship'*** in order to create a new organization path strategically. That is, "*individual actors join forces in order to their activities and develop a true chance to…*" (Sydow et al., 2005, p: 27). Eisenhardt and Martin (2000, p: 14) claims: "these ***learning mechanisms*** guide the evolution of dynamic capabilities", e.g. the needed capabilities to manage an ESI.

We select these three modalities as an engine from which we will develop concrete "pattern feature parameters" that will serve as the foundation on which we will explore patterns of managerial processes. For the purpose of developing "feature extractor" out of these conceptual modalities, we discuss each of the three modalities below in detail.

- ***Interpretive Schemes***, "forms the core of the mutual knowledge whereby an accountable universe of meaning is sustained through and in processes of interaction" (Giddens, 1979, p.83). The interpretive schemes enable shared meanings and eventually mediate communication. From the institutional perspective, interpretive schemes comprise the signification component which embodies the social rules that enable, inform and inhibit the communication process. Hence, interpretive schemes also serve as conduits for the imposition of structure constraints.
    - ***Indication to Instantiation of candidate patterns:*** managerial process pattern which aims at creating a shared understanding among the relevant

organizational stakeholders (e.g. top management, affected line managers and end users) about an ESI.

- ***Facilities*** are provided for humans to achieve intentions. The use of facilities in organizations, which in default means, power is mediated via organizational resources (allocative and authorative). From institutional perspective, resources are the structural property that constitutes organizational structures of domination. All social systems are characterised as an asymmetry of resources. It is only when existing asymmetry of resources is explicitly challenged that the existing structure of domination may be modified.
    - ***Indication to Instantiation of candidate patterns:*** managerial process pattern which aims at providing and acquiring the needed resources to change existing orgnaizational structure, routines and stakeholders' attitude towards an ESI etc.
- ***Norms*** are organizational normative rules or conventions governing legitimate or appropriate conduct. Human actors create these rules out of the continuous use of sanctions as they interact. Norms play an active role in shaping of legitimate behaviours. At the same time, human action is guided by legitimacy and reflected in these norms. From institutional view, norms articulate and sustain established structures of legitimation.
    - ***Indication to Instantiation of candidate patterns:*** managereial process pattern which aims at enacting explicit, normative rules and policies to support an ESI.

Combining the insights offered by existing studies and the analysis done here, two concrete managerial processes are defined in this study, which act as salient feature parameters for the process pattern recognition:

- Managerial process to facilitate learning of ESI
- Managerial process to communicate the ESI significance

These two managerial processes are selected to be the concrete instances of the three abstract modalities. Managerial process to facilitate learning can explain how much effort organization managers make to facilitate shared organizational understanding of the ESI, and to which extent they are willing to allocate resources to facilitate the learning process etc. It also includes enacting new rules for organizational members to learn the new ES etc.

Managerial process to communicating significance can account for the authoritative power and resources embodied for an ESI, the priority of the ESI project, rules and policies enacted

for the project. Considering the strategic meaning of an ESI, communication of significance should be conducted from top management level.

3.3.3 The managerial process to facilitate learning of ESI

A managerial process to facilitate learning of an ESI is one of the key forces that help shape organizational ESI capabilities. Organizational resource reconfiguration capability evolves through a learning process over time (Eisenhardt & Martin, 2000; Zollo & Winter, 2002). Such managerial effort should be designed to support organizations to overcome two barriers in an ESI project: 1) to gather necessary implementation knowledge from various information channels; and 2) to facilitate shared organizational understanding of the project mission and impact.

It is quite common that organizational learning efforts failed in an ESI (Lyytinen & Robey, 1999). An ESI is not a linear and easy journey as organizations have to face various knowledge barriers (Robey & Boudreau, 2000), and it is hard for them to unlearn what they already know (Bowker, 1997). It requires changes in the causal map retained by the organization and in the organization behavior routines (Maitlis, 2005). The ESI performance is dependent on revision results in existing organizational memory which is closely related with organizations' capabilities to learn how to use the same technologies (Robey et al., 2002).

The specific elements of an managerial process that facilitate learning of ESI can be categorized as the activities used to reduce uncertainty, and others used to smooth out ambiguous understandings (Daft & Huber, 1987; Ford & Ogilvie, 1996). Thiry (2001) and Weick (1995) have made a clear distinction between uncertainty and ambiguity/equivocality. Uncertainty is defined by the difference between the data required and the data already possessed; it is the "lack of information". Generally, organization planning, cost management and risk management are key elements of uncertainty reduction. Ambiguity, on the other hand, means the existence of multiple and conflicting interpretations; it is linked to confusion and lack of understanding. Benefits, stakeholders, and communications are softer issues, linked with ambiguity, which project managers still do not apply explicitly. Figure 12 shows the two types of learning effort.

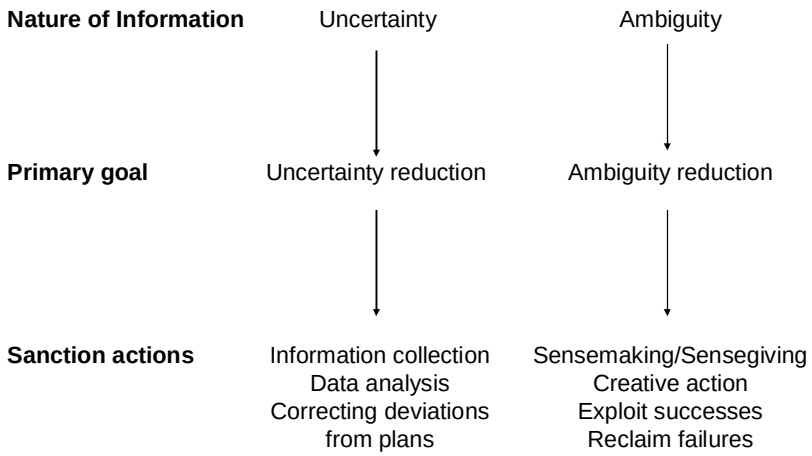


Figure 12, two types of learning effort (Thiry, 2001; Weick, 1995)

The two types of learning efforts work for different objectives. Zollo and Winter (2002)'s conceptual analysis of deliberate learning shows that diversified learning mechanisms are necessary for an ESI performance. An ESI is a highly heterogeneous, ambiguous project, and organizations do not use it frequently. Zollo and Winter (2002) suggest that: the higher the degree of causal ambiguity , the lower the frequency of experiences and the higher the heterogeneity of task experiences, will lead to the higher need for ambiguity reduction oriented learning effort.

Four constructs of uncertainty reduction oriented learning effort are defined in the study in Table 3: (1) Formal training by externals, an approach which is directly related to learning to overcome barriers to acquiring new knowledge, (2) Formal internal learning effort, the formal learning effort which is not done by external trainers, (3) Informal internal learning efforts, not connected to formal learning efforts, rather, knowledge barriers are overcome through learning that emerges informally from the social context of work (Robey & Boudreau, 2000), (4) Learning from others, the effort to learn from external practices and lessons, e.g. benchmarking.

Learning Effort Construct	**Observable Artifacts**
Formal training by externals	Technical Training Business / Organizational impact Training
Formal internal learning effort	Experiment Pilot Usage case

	Experience / Knowledge Codification
	Process Analysis
	Cross-functional Team
	Steering Committee
Informal internal learning effort	Self-motivated technical learning
	Self-motivated business/organizational impact learning
	Informal personal coach
	Informal personal idea exchange
Learning from others	Intermediary agent (e.g. consulting company)
	Learning from other company
	Hire experienced professionals

Table 3, the Uncertainty Reduction Oriented Learning Techniques

Three basic constructs of ambiguity reduction oriented learning effort are defined in the study as shown in Table 4: (1) Mission dissemination, effort to explain the project mission to organizational stakeholders (2) Interactive learning effort, two-way effort to facilitate organizational understanding (3) Other managerial effort to facilitate ambiguity reduction.

Learning Effort Construct	**Observable Artifacts**
Mission Dissemination	Newsletter
	Poster / Bulletin
	Personal Explanation
	Seminars /Workshops
Interactive Learning Techniques	Scheduled Group Meeting
	Unscheduled Group Meeting
	Scheduled Personal Dialogue / Meeting
	unscheduled Personal Dialogue / Meeting
	Discussion Forum
Other Techniques	Process Diagram
	Stakeholder analysis
	Rules and Regulations

Table 4, the Ambiguity Reduction Oriented Learning Techniques

3.3.4 The managerial process to communicate ESI significance

Communication of significance can be understood to provide all types of interpretive schemes of the importance of an ESI to organizational stakeholders.

Existing research verify that effective and appropriate communication is a vital element in the success of an ESI and other organizational change campaigns (Lewin, 1951; Goodstein & Boeker, 1991; Kotter, 1996; Yazici, 2002). Conversely, ineffective communication is a major contributor to the failure of change initiatives (Coulson-Thomas, 1999).

At the individual level, effective communication of significance can help stakeholders to understand the objective of an ESI and its impact. Effective (significance) communication can be used to reduce resistance, minimize uncertainty, and gain involvement and commitment (Balogun et al., 1999; Klein, 1996). At the organization level, communication plays an important role in supporting managers to challenge embedded cultural and structural norms (Deal & Kennedy, 2000; Pinnington & Edwards, 2000; Heracleous & Barrett, 2001).

There has been relatively little prior research into the precise techniques that managers can use to communicate with stakeholders for a ESI (Goodman & Truss, 2004). Researchers typically list the principles to achieve the success of communication: spreading a vision (Joffe & Glynn, 2002), involving employees by seeking their input into process of change (Kitchen & Daly, 2002), minimizing uncertainty (Klein, 1996), overcoming barriers to change (Carnall, 1997), gaining employee commitment (Kotter, 1996), keeping stakeholders informed (Hutschison, 2001), providing frequent and digestible information (Hutschison, 2002) and challenging the status quo (Balogun et al., 1999).

In this study, we refer to the classification research done by Eisenberg et al. (1999) as shown in Figure 13.

1. one-way communication as conduit of information,
2. transactional communication as two-way rationale communication, and
3. dialogue communication as constitutive of meaning

Existing research reveals that static one-way significance communication is not sufficient anymore for organization change projects (Goodman & Truss, 2004). The three sorts of communication techniques should be used, especially constitutive techniques for an ESI implementation because an ESI project is complex and highly interactive among stakeholders (Babrow, 1993).

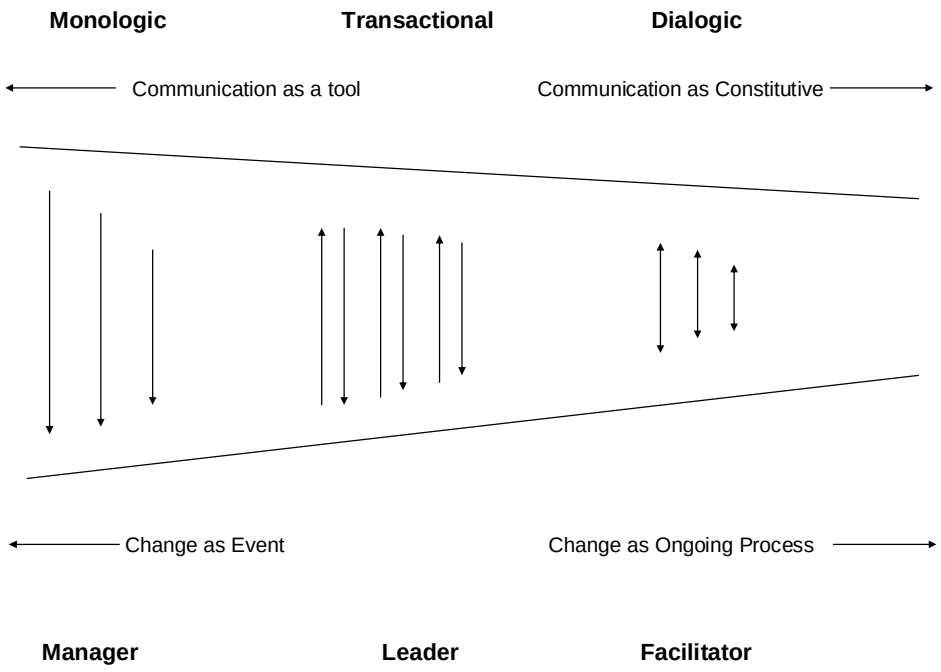


Figure 13, Classification of Communication Methods (Eisenberg et al, 1999)

The other criteria to group communication of significance effort used in an ESI is (Katzy & Ma, 2005; Daft & Huber, 1987):

1. Technical oriented communication of significance, aiming at reducing technical uncertainty.
2. Business / organizational impact communication, aiming at communicating business, organizational and personal impact and achieve stakeholders' buy-in and support etc.

Table 5 summarizes the constructs used in this study:

Construct	**Observable Artefacts**
One-way Communication	Project Mission & Vision statement Project Newsletter Rules and policies Launch Directive or Mandate
Two way rationale communication	Receiving and evaluating project reports about organizational change and business impact Formally checking project progress (business and organizational impact aspects)
Dialogue communication	Project Steering committee (board) meetings Participation in project meetings (e.g. process decisions,

	process analysis) Participation in workshops (e.g. training, negotiation, discussion) (Dialogue) Informal supportive behaviours (e.g. personal talk with stakeholders, informal check of the project progress)

Table 5, the techniques for communicating significance

3.3.5 A process pattern template

To make the patterns accessible, they must be stored using a consistent template. To meet the prescribed criteria as analysed in the previous section, a process pattern template should: (1) incarnate the skeleton of the used theory, (2) embody a process dynamics, (3) make the comparison analysis explicit and understandable.

Existing process pattern templates are rather static. The typical format to record a process pattern in software development area is (Ambler & Hanscome, 1998):

- **Pattern name**: Provide a concise name for the pattern
- **Intent**: describe the process pattern in one or two paragraphs, providing if applicable a graphical description of the process pattern
- **Context**: indicate the situation to which the pattern solution applies
- **Solution**: Describe in detail how to perform the steps/activities of the process pattern
- **Consequence**: Indicate the situation/context which will result from performing the process pattern solution
- **Known uses/Examples**: Indicate where/how the process pattern has been applied in use.

The other simplified template for process pattern is (Robertson et al., 1996):

- **Pattern Name**: A descriptive name to make the pattern part of your vocabulary
- **Context:** The boundaries within which the pattern is relevant
- **Solution:** A description of the pattern using a mixture of words, graphics and references to other documents

- **Related Patterns**: Other patterns that might apply in conjunction with this one. Other patterns that might help to understand this one

The essential issue for this study is to design an explicit and comparable format to describe the "solution" part of a process pattern of managerial techniques. The Skelton of "Solutions" should be replicable case by case.

Disentangling the structuration process should be ideal for this study to meet these requirements. Sydow classifies a new organization path creation as four phases: Generating Momentum, Path Shaping, Path Depending and Path Breaking (Sydow et al, 2005). Clearly defined phases support the clustering of activities that occurred during an ESI process.

Similarly a project life cycle phase scheme is widely adopted as a general template in organization studies. Project lifecycle models are practical, useful, visible and identifiable pattern templates. Project life cycle could be traced back to Van den Ven and Poole's "life cycle motor" of organization change (Van de Ven & Poole, 1995). Existing research distinguishes three (Kwon & Zmud, 1987), four (Markus & Tanis, 2000), five (Katzy & Ma, 2005)) or six phases (Kwon & Zmud, 1987).

Considering these existing research effort, a four phase template for structuration process is adopted here:

1. **Initiation** Phase, initiate and communicate the mission of an ESI
2. **Definition** Phase: human & financial resource acquisition and allocation to the project. Project governance (structure, process, rules and roles) set up, and detailed project plan set up
3. **Implementation** Phase, system configuration, testing and business process change
4. **Benefit Realization** Phase, stabilization of the system and benefit achievement.

Hence, a template of presenting a process pattern of managerial process is shown below (Table 6):

Pattern Name	**a concise name for the pattern**
Context	indicate the situation to which the pattern solution applies

Pattern of Solution:	A description of the pattern using a mixture of words, graphics and references to other documents The patterns of managerial techniques will be described along four phases: Initiation, Definition, Implementation and Benefit realization
Consequence	The situation/context which will result from performing the process pattern solution
Examples	Where/how the process pattern has been applied in use.
Related Patterns	Other patterns that might apply in conjunction with this one. Other patterns that might help to understand this one

Table 6, the pattern template

In the Chapter four and five, ten empirical cases will be analysed and the process patterns of managerial techniques will be identified.

3.3.6 Case sample selection

Selection of cases is an important aspect for such research, as appropriate population controls extraneous variation help to define the limits for generalizing the findings, and sharpen external validity. On top of this, the cases maybe chosen to replicate previous cases or extend emergent theory, or they maybe chosen to fill theoretical categories and provide examples of polar types. Pettigrew (1988) notes, it makes sense to choose cases such as extreme situation and polar types in which the process of interest is "transparently observable."

Thus, the goal of theoretical sampling is to choose cases that are likely to replicate or extend the emergent theory, but is not the statistical sampling by traditional research.

The research sample consists of ten state-owned manufacturing enterprises in China that have implemented or initiated ESI projects to support their strategic change goal. The sample enterprises are described in Table 7.

Firm	System	Result	Modules
C1	ERP	Failure	Financial management, material management, production

			planning, human resource management, project management
C2	ERP	Failure	Financial management, business information warehouse, production planning, sales, plant maintenance, human resource management, quality management, workflow
C3	CRM	Failure	No module implemented
C4	ERP	Failure	Financial management, business information warehouse, production planning, sales, quality management, workflow
C5	PDM	Delay	Document management, workflow and process management, parts management
C6	ERP	Delay	Material management, production planning, human resource management, quality management
C7	PDM	Delay	Document management, workflow and process management, parts management
C8	ERP	Success	Business information warehouse, sales, production planning, material management
C9	ERP	Success	Sales, material management, workflow
C10	ERP	Success	Financial management, material management, production planning, sales, distribution, quality management, workflow

Table 7, Case Sample

The Chinese Fourteenth Congress' decision to "transform the State Owned Enterprises (SOE) into modern enterprises" was taken in November 1993 and the privatisation decision for small SOEs "Grasping the large (SOEs), and letting go the small (SOEs)" at the Fifteenth Congress in 1997. In 1999, the Chinese government divided AVIC (Aviation Industry of China) into AVIC I and AVIC II in an effort to become more competitive in global markets. This event was the trigger for all case firms to engage in corporate change programs. AVIC I's focus is on large- and medium-sized aircraft, while AVIC II gives priority to feeder aircraft and helicopters.

AVIC I and II both cooperate and compete with each other. Six of our ten cases are from AVIC II, and all cases have introduced ES between 2000 and 2003. The other four companies are also large and medium sized state owned manufacturers. They introduced the ESI projects between 2001 and 2003.

These ten cases are selected as the ESI outcome ranges from completely failed projects (4 cases: abandoned in the half way), partly successful projects (3 cases: out of plan, but achieve the expectation), and completely successful projects (3 cases: finished within budget and fulfil the expectation). We hope the selection of these multiple cases can facilitate us to find out some observable similarities and difference, furthermore, generate new insights for ESI research area.

3.3.7 Data collection instrument and protocol

Multiple data collection methods (interviews, archival sources, questionnaires, focus groups discussion etc.) provide stronger substantiation of constructs. The qualitative data are useful for understanding the rationale or theory underlying relationships; quantitative data can indicate some context and historical background, and discover the relationships, which may not be salient to the researcher from the qualitative study (Table 8).

Interviews are one of the most important sources of case study information, and also essential source of case study evidence because most case studies are human affairs. These human affairs should be reported and interpreted through the eyes of specific interviewees, and well-informed respondents can provide important insight into a situation. They also can provide shortcuts to the prior history of the situation, helping you to identify other relevant sources of evidence (Yin, 1994).

Demographic Questionnaires are used to obtain some structured information not available through interviews and archived documents. This information is context information required for analyzing the empirical information obtained by other channels. The aim of the demographic questionnaire is to obtain the relevant context information on ESI project (e.g. organisation characterization, implementation information, user information etc.). Quantitative data is a necessary complement to qualitative data, which help to discover some not salient underlying theory that is not discovered by qualitative data. Moreover, it is useful to validate some knowledge obtained from qualitative data.

The most important use of documents is to corroborate and augment evidence from other sources (Yin, 1994). An ESI is a long-term dynamic implementation process within or among social organisations, which makes it demanding and necessary to study the ESI within

specific historical and contextual environment. Conducting interviews all at one time will cause the one to overlook certain insights into the real implementation circumstance. Thus, archival document review is a complementary method for collecting data from the case studies, which includes letters, memoranda, agendas, and meeting minutes, written reports, progress reports and other internal documents. Hence, careful and systematic analysis archival documents will make the author better prepared for the field study by learning the historical context of implementation and having a good overview of the implementation story.

Sources of Data	**Examples**
Interviews	Semi-structured interviews, informal interviews, follow-up interviews
Questionnaire	Demographic Questionnaire before doing interviews
Archival Documents	Internal memoranda, internal presentations, agenda and minutes of meetings, internal and external reports, proposals, progress reports, and administrative forms
External Documents	Internet publications, external presentations, press releases

Table 8, Data Collection Methods

In the research on ESI, no single perspective, no matter how numerous the observations from that one vantage point, would reveal the entire pattern involved in an implementation process (Leonard_Barton, 1990). As the innovation and objective of this study is to understand the dynamic complex interactive implementation processes and issues (e.g. actions of project manager etc.), it is necessary that the research methodology covers at least the most relevant roles vertically through the organization, obtaining data from multiple levels and perspectives, which is the pre-requisite for the success of the research. Table 9 shows the rationale of selecting interviewees.

Roles	**Project member** (yes/no)	**Rate of importance** (rating 1-5, 1 = most important)	**Reason behind the rating**
Project manager (Person responsible for the operative project management and success)	Y	1	To obtain overall project information To obtain project context information and to understand timing of events and actions taken/reported to the project.
User line manager (Manager, in whose department the system will be used)	N	1	Adoption of a system in a department depends largely on the backing from the responsible line manager. In-depth case study should cover a line manager if possible
Project sponsor (Senior manager representing the project e.g. on the board and to the organisation	Y	1	Project sponsor know the initiation process of ES, its relationship with company business strategy and its organisation value fit.
Standard user (Person using the system for some tasks with specific functionality)	Y/N	1	These people have to be convinced and trained to adopt system and are rather sceptical. Good measure for success of implementation.
Project team member (Person responsible/involved in the change management and training)	Y	1	They know exactly the educating process during implementation. They have the richer picture on involved people's mind change process, specific training programme content and its effect.
Consultant (Not really a role, Project Manager, IT specialist, etc. can be consultants)	Y	2	If consultants were involved, we should speak with at least one of them Consultants are external compared to internal project team. They are comparably independent to the internal politics. They can offer on different story on implementation, and enrich study insights.
Power user (Person using the system as core instrument of his work with a lot of its functionality)	Y/N	2	These people usually know strengths and weaknesses of the system by heart and are very curious about such project In-depth case study should cover at least one power user

Roles	**Project member** (yes/no)	**Rate of importance** (rating 1-5, 1 = most important)	**Reason behind the rating**
System vendor (Person representing the software supplier for the project. Can be full team member, or only contact point)	Y/N	2-3	Priority depends on, whether the link to the system vendor influenced project outcomes considerably

Table 9, Rationales of Selecting Interviewees

Based on the case study protocol, the author, together with the support from these ten companies, arrange total 50 interviewees in August, September and October of 2003. I also did some follow-up interviews to clarify their statements and verify some of the research findings in 2004. Table 10 shows the interview overview.

Firm	Numbers of interview	Interview Profile
C1	5	Project manager, project sponsor, line manager, core team member, end user
C2	5	Project manager, project sponsor, core team member, end user, software vendor
C3	3	Project manager, the assistant of the project sponsor, the team member
C4	4	Project manager, project team member, line manager, external consultant
C5	5	Project manager, project sponsor, core team member (Business), core team number (IT), end user
C6	5	Project manager, project sponsor, core team member (Business), core team number (IT), end user
C7	5	Project manager, project sponsor, core team member, external consultant, end user

C8	6	Project manager, line manager, core team member (2), end user, software vendor
C9	6	Project sponsor, project manager, line manager, core team member, end user, software vendor
C10	6	Project sponsor, project coordinator, project manager, three line managers (end users)

Table 10, Interviewee Overviews

3.3.8 Data analysis: Validity, reliability and generalizability

Yin (1994) defines the quality criteria for case study research on four levels: construct validity, internal validity, external validity and reliability.

The construct validity means establishment of "correct operational measures for the concept being studied" (Yin, 1994, p: 40). Two distinct steps that have to be met in order to satisfy the construct validity: (1) "select the specific types of changes that are to be studied", and (2) "demonstrate that the selected measures of these changes do indeed reflect the specific types of changes that have been selected." The literatures review in Chapter 2 and the conceptual development in Chapter 3 specify the critical changes in ESI. The study also used multiple sources of evidence: survey instruments, interviews, and documents. The specification of the unit of analysis also provides the internal validity as the theoretical findings are developed and data collection and analysis test those findings.

Internal validity relates to the establishment of causal relationships. Multiple in-depth longitudinal case studies do address the issue of internal validity. It offers the ability to move back and forth among these multiple settings and thus "formulating theory in one setting and then immediately placing the embryonic ideas in the context of the other kind of study for potential disconfirmation" (Leonard_Barton, 1990, p: 259). Multiple cases strengthen the results by replicating the pattern matching, thus increasing confidence in the robustness of the theory. This study applies a technique of pattern matching by engaging in the exploration of a potential probability relationship rather than confirming or rejecting a proposed causal relationship.

External validity relates to whether the findings can be generalised (Yin, 1994). The final goal of this study is to generalize process patterns. Multiple in-depth cases augment the external validity (e.g. Generalizability) and help to guard against observer biases. Yin argues that the

logic underlying a multiple case study approach is similar to that guiding multiple experiments and that each case should be selected so that it "either predicts similar results (a literal replication), or produces contrary results but for predictable reasons (a theory replication)" (Yin 1994). Since the objective of the research is to sharpen and deepen extant theories relevant to numerous different managerial situations and capable of explaining success or failure of implementation, a methodology including both literal and theoretical replication is necessary and required for the study.

The reliability of the study means the extent to which they study design demonstrates that the operations of the study can be repeated with the same results (Yin, 1994). Two tactics can be used to increase the reliability: use a case study protocol, and using a case study database. This study uses a standard case study protocol, which also was validated in one European research project for its replicability and usability. All these studied cases, together with other cases in this European project, are transcribed and stored in one standard database. Furthermore, numerous reports have been written during this study, leaving a paper trail that allows for effective auditing (Yin, 1994). All the interviews have been transcribed and maintained in a database.

3.4. Summary

In this chapter, the process of doing a process pattern recognition research is introduced. Then the author illustrates how this approach is used in this study, specifically describes: (1) how a "sensor" is designed; (2) how to extract "feature parameters" for pattern recognition; (3) a process pattern template; (4) a defined case sample; and (5) a data collection instrument. In the following chapter 4, the case analysis will be described in detail.

4. CASE STUDIES: INDIVIDUAL PATTERN EMERGING

In this section, each case will be described and analysed in detail. As mentioned in chapter 3, a process template is used to support the case analysis. Antecedent context conditions (historic path) and project outcome are also introduced in order to understand the causal relationships.

4.1. C1: an abandoned ESI

C1 is a large state owned manufacturer belonging to China Aviation Industry Corporation II. After about 50 years' development, it has become a large enterprise group combining scientific research, production and marketing of the aviation products, motorcycles, motors and textile machineries. Since 1989, C1 has always been listed as one of the top 500 largest industrial enterprises in China.

To response to the environment change, C1 cooperated with several partners and developed motorcycles, projectile weaving machines, sport exercisers, paper-making machines, mopeds and electric bicycles, golf carts, electric power equipment, coating and decoration equipment and building equipment, in addition to the training plane and agricultural aircraft. Since 1999, the state government released its control of large aviation corporations and issued series of policies to support transformation of these aviation corporations. e.g. new policy – 'taking aviation products as a basis, developing civil products in a large scale, engaging in diversified economy and speeding up product development'.

The ERP project was proposed by the manager of the production department. Three main project objectives were defined: (1) achieve smooth information integration with the legacy systems; (2) dynamic capacity balance; (3) cost check off. The project was started in 2002, with 5.2 Million RMB budget (software: 0.9M, hardware: 3.8M, internal cost: 0.5M) and a fifteen-month timeline. Several system modules were planned including: business information warehouse, executive information system, material management, production planning, human resource management, and project management.

A cross-functional team and steering committee were set up. The CEO was chair of the steering committee, with all the important organizational stakeholders in the committee. The CIO and a vice president co-lead the project operation. A detailed working plan was developed with delimited responsibilities for each involved functional department.

The software vendor held the technical training sessions for the project team members. The project plan was distributed to key stakeholders who were invited to attend the project kick-off meeting. They committed to the defined responsibilities and to send best employees to the project team. Some implicit mandates were written down in the project plan. For example,

> *"Every department must actively cooperate with the project team, and it will link to the performance evaluation at the end of each year."*

Afterwards, a newsletter was distributed to others who did not attend the kick off meeting.

The project structure is as following (Figure 14):

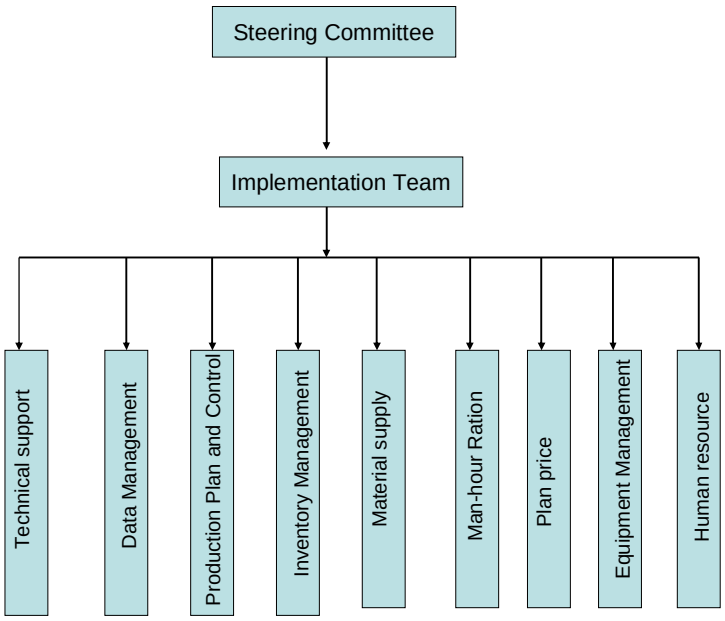


Figure 14, the Project Structure of C1

It was a big challenge for C1 to implement an ERP system, because lack of organizational change experience in the past 40 years, and also because end users have little knowledge about computer. C1 has a slow decision making processes etc. the project managers had to answer several questions: To what extent will the organization will be changed? How to design the training course for the end users? How to coordinate with several departments at the same time? How to achieve the long-term commitment from top management? For example, an interviewee commented:

> *"We have to submit two different reports for the software and needed hardware. Especially for the internal needed hardware, the report must be approved by several functional departments. Hence we have to wait…; I*

> *do not know where the report is now, whether and when it will be approved".*

The CIO and the production department manager took a careful attitude and did some feasibility studies by looking at best practice and receiving training from potential vendors. They decided not to plan a radical organizational change in this project. The manager of the production department told us:

> *"In my opinion, any intended radical organization structure change is not realistic here, it is obvious out of our control… we have very difficult technical knowledge gap to fill, especially for the end users. For example, they do not know how to manipulate the computer."*

However the project was faltering in a muddy during the implementation process. While at the beginning, technical experts at C1 believed they could deliver the ERP system implementation and satisfy the user requirement. One project team member told us*:*

> *"We are confident to deliver the new system based on my participation of the other two projects. "*

The existing organizational governance and slow decision-making process negatively impacted the ESI progress. The budget only covered the new software development cost, and the internal supportive cost was not included, e.g. the hardware cost, end user training cost etc. Even though the management board approved the project, it still took time for other relevant departments to approve the project plan. For example, the manager of the production department told us:

> *"We are a large state owned company. The decision making process is slow here. The project contract is signed for the development cost of the new ERP software, but there is still needed budget for the internal hardware, network and end user training etc, which is not included in the budget allocated. Hence, we must submit the other report to ask for it. However, the report must be approved by several departments, e.g. organizational management office, purchase department, technological renovation centre, management board etc. Hence, frankly to say, I do not know where the report is now."*

The top management members were not actively involved in the operational process. Except for the budget for the software development, other promised commitments were not realized.

The CIO tried to arrange meetings with the CEO and other stakeholders, but later verified as vain less. The CIO told us:

> *"There are some financial constraints. Our project is not about the organizational primary process, and there is no urgent market pressure. The CEO told me that he still needs to find other budget source for it. We have to wait…"*

The ESI project was halted for more than half a year when the interview was conducted. There is no clue when it would be re-launched.

4.1.1 The managerial process facilitating the ESI learning

Table 11 summarizes the managerial process to facilitate learning of ESI at C1.

ESI outcome	The ESI project was stopped. The learning activities for ESI were stopped.
Context	The initiative of the ESI project was within several technical merits minds, and the CEO was convinced by the technical competence brought in. However, there was no systematic and extensive business and organizational impact dialogue among top management members before hand. The position of the ESI project as a traditional technical project left little resource for business and organizational impact oriented learning. Till the implementation phase, no person really understood the impact triggered by the ESI project. It was only later on that the CIO realized the organization impact and tried to pursue continuous top management support and active cooperation attitudes from several line departments. However, he was not on the management board, making it impossible for him to change the project plan and acquire needed resources for organizational learning.
Potential pattern	Organizational resources for facilitating ESI learning are mainly allocated to gain technical knowledge at early project phase (till the definition phase), and there is no effective learning effort for facilitating organizational and business impact understanding.

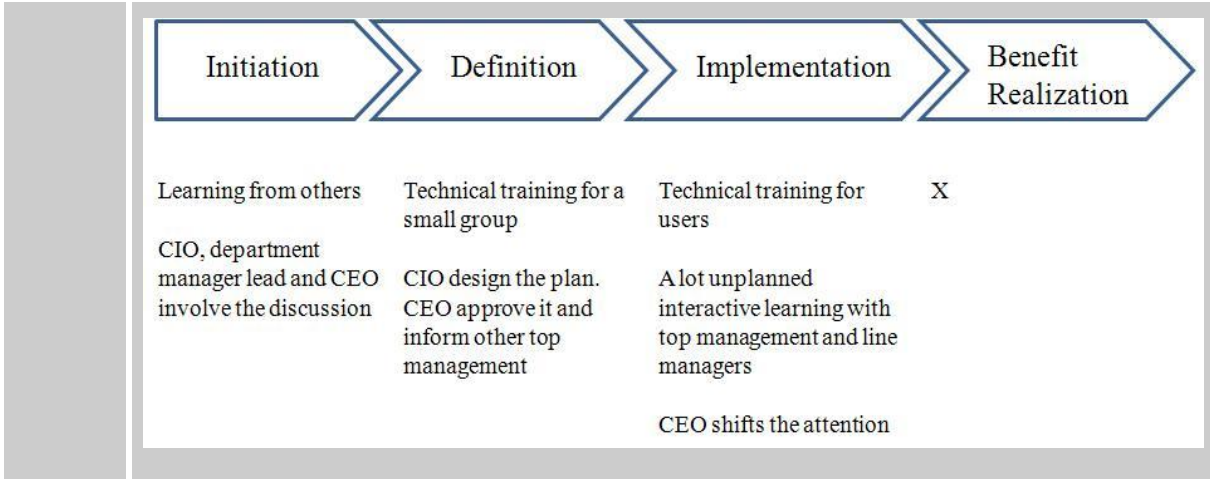


Table 11, the managerial process facilitating the ESI learning at C1

Table 12 shows the detailed observable artefacts of the managerial process facilitating the ESI learning at C1.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from others	Learn from others (Best practice, vendors) Informal internal learning: CIO and his core team Formal training Formal internal learning: process analysis, requirement analysis and knowledge codification	Formal training	X
(Organizational) Ambiguity Reduction		Interactive learning: discussion with CEO and kick off meeting with stakeholders Mission statement: newsletter and posters	Interactive learning meetings (unplanned) with top management and line managers Personal dialogue with line	X

			managers	

Table 12, the observable artefacts of managerial process facilitating the ESI learning at C1

The executed managerial efforts show that interactive learning among stakeholders was not at place at the early project phases. Later it is very difficult to re-engage the stakeholders

4.1.2 The managerial process communicating the ESI significance

Table 13 summarizes the managerial process communicating the ESI significance at C1.

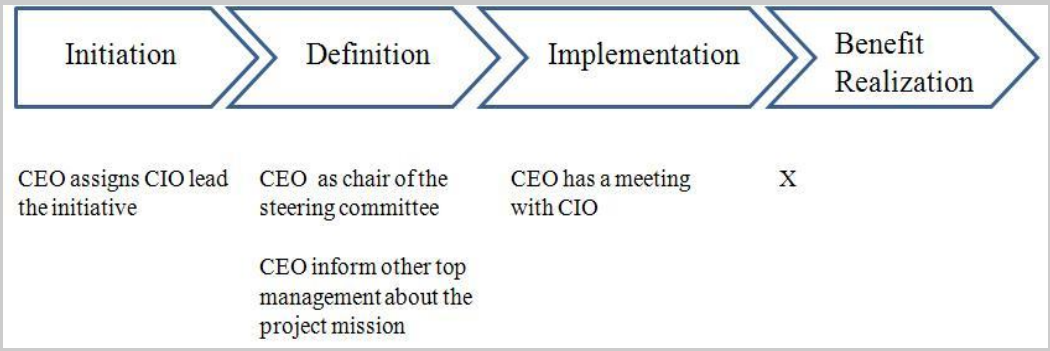
ESI outcome	The ESI project was stopped. The communication of significance from top management was stopped
Context	The top management do not really involve into the project definition and operational phase. They approved the ESI project as a traditional technical project, e.g. CAD project etc. Later during the implementation, the top management realize the difference of the ESI project with other technical projects. However, the original project plan and definition were already widely communicated. They cannot take the immediate action to support this project.
Potential Pattern:	Only one way and two way rationale significance communication from top management were executed till the definition phase 

Table 13, the managerial process communicating the ESI significance at C1

Table 14 shows the observable artefacts of the managerial process communicating significance by top management at C1.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**

Communicating significance by top management	CEO discuss it with CIO and production department manager CEO review the proposal and comment on it	CEO issue the project mission CEO chair the kick off meeting All relevant top management are in the steering committee Implicit mandate by CEO	Meetings with CIO	X

Table 14, the observable artefacts of the managerial process communicating the ESI significance at C1

With the CEO's strong support at the early project phase, the project successful acquired the initial organizational buy-in. However, the project lost the CEO's support as he shifted his attention to other projects, e.g. joint venture and market issues of some products.

Once the commitment from the CEO decreased, organizational inertia starts to impede the project progress. Other top management member and line managers noticed the CEO's attitude, and became more passive towards the ESI project. As a consequence, end users lost the trust of the project team, and it is very difficult to pull the project back to the original plan.

4.2. C2: an abandoned ESI

C2 is one of the four largest firepower electricity generator manufacturers in China. The main products include electrical steamer, steamer electricity generator. Since 2000, C2 has been experiencing organizational changes since 2000 due to the government regulation change.

In 2001, a new C2 was spun off from the old BZ Corporation with the support from an asset management company. The new C2 concentrates on two products: electric generator and steamer. The number of employees reduces from 8000 to 3100. Our study is about the ERP implementation at the new C2.

C2 considered to improve the operational efficiency in 2001 because C2 re-gained its good business performance in 2001 as the Chinese state government released their control in launching the new electric power factory. Then C2 has been experimenting (re) structuring the organization since 2001. Within two years between 2001 and 2003, three re-organization

campaigns were conducted. C2 was also in the process of negotiating with several international corporations, e.g. ALSTOM.

The ERP project was initiated by the CFO, who was convinced by one of the advertisement campaigns of an ERP software vendor in 2002. The project manager told us:

> *"Director XX attended a conference, and attracted by one presentation made by YY Software Company, especially by the promise YY made – YY can help you become better"*.

The CFO convinced the CEO to start the negotiation with the softer vendor. The optimistic attitude of the vendor and its strong position at Chinese ERP market made C2 believes ERP project is not so difficult. The ERP vendor promised a quick implementation plan with little organizational effort and technical development effort.

As a result, several modules were contracted to be implemented at C2, including: financial management, business information warehouse, production planning, logistics, plant maintenance, human resources, quality management and workflow. A steering committee and project team was set up. It was the first time that top management acted as the chair of the steering committee for an ESI project (Figure 15).

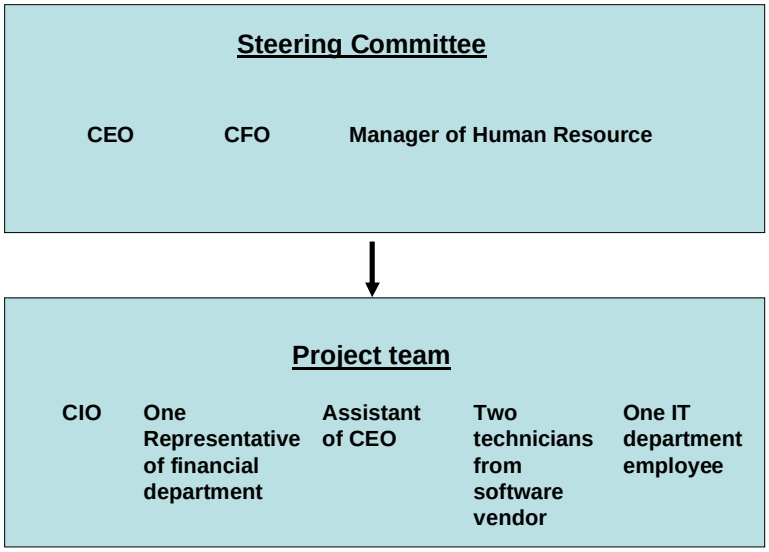


Figure 15, the Project Governance structure at C2

The CFO was wondering the feasibility of the proposed plan by the ERP vendor and narrowed the project scope down to the financial module. The CIO told us:

> *"CFO and I carefully read the project implementation plan proposed by XX (the software vendor); we found it is not realistic to implement several modules within three month. Thus, we raised our questions and lower down the ambition to implement a financial module within three months"*

The top management was influenced by the vendor's attitude, and believed that operational tasks of the ERP implementation project can be done by the IT department alone. The CIO remarked:

> *"Top management think they only need to care about planning and final results. I told them several times that we need to organizational change to support the implementation. They gradually learn it, but still no concrete supportive actions."*

The actual operation did not work as planned. The implementation of the financial module was not signed off after 14 months. The software vendor attributed it to old organizational habits impeding the implementation process. The project manager from the software vendor told us:

> *"C2 is a large state owned company. It has complex clan and social networks. Hence, it is very difficult to implement the new management system (ERP) within a short time."*

Three rounds of training sessions were held for 50 accounts of C2, but resistance continuously emerged during the ERP implementation. End users regarded the new system as mechanical and inflexibility. Several specific comments raised by end users, for example:

> *"The system is too static and not dynamic. It is far from the reality"*

> *"The software is strictly formatted and it is not designed based on the guild regulation"*

> *"The system does not consider specifics of the electric generator industry, hence, some processes they designed is just unrealistic"*

> *"The system assume the external environment is stable, do not support any flexible change tactics we now quite often used"*

The project was out of the control of the CIO because that it affected the working routines of other departments and some members of the management board. He found out that IT

department itself cannot achieve the project plan without strong top management involvement:

> *"CEO and CFO support us, but there are other VPs and line managers who do not support us. The system makes the financial report transparent; hence impact the benefits and working routines of some of them"*

Meanwhile, the CFO and the CEO were also astonished by the needed radical organization change and they shifted their attention to other organizational affairs. The CIO told us:

> *"We found that there are so many inconsistencies between our existing working habits and processes embedded in the ERP system. Some of them touched the working behaviours of certain top management members. It is unrealistic for them to change it"*

Moreover, too many change initiatives were running in parallel at C2. These organizational changes annoyed end users. End users opted to adopt a passive attitude towards the ERP initiative, as one end user remarked:

> *"Since 2001, we have been re-structuring the organization three times. Just now, we are again re-naming and re-define the department level. Most of these initiatives will disappear without any improvement as least from my side soon. Hence, I do not know which one I should response to and which one will create real concrete results"*

A large extent of the customization of the new system was also not realistic from the software vendor's perspective. Combined these difficulties, the ERP project was not signed off after 14 months. The financial department still used the old processes.

4.2.1 The managerial process facilitating the ESI learning

Table 15 summarizes the managerial process facilitating the ESI learning at C2.

ESI outcome	The ERP project was not finished as originally planned. It took 14 months for C2 to implement a single ERP module without any success.
Context	The initiative of the ERP project was done by the CFO, one member of the management board. However, influenced by the software vendor, the project was positioned as a technical project to be leaded by the IT department.

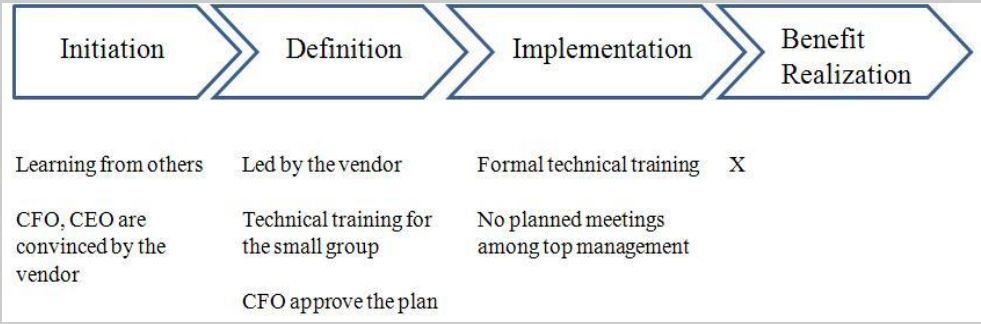
	Meanwhile, too many organizational change activities distract the organization attention for it. Though the CEO and the CFO promise to support the project, the difficulties they did not expected at the beginning of the project gradually turn their attention to other more urgent organizational issues. The project participants including the software vendor, project team and top management were shocked by the emergent unexpected conflicts. No one was well prepared for it.
Potential Pattern:	During the early project phases, there was no effective organizational learning facilitating organizational wide shared understanding and reducing technical complexity. No well-designed organizational learning effort. 

Table 15, the managerial process facilitating the ESI learning at C2

Table 16 shows the observable artefacts of the managerial process facilitating the ESI learning at C2.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from others: the potential vendors	Learn from others (vendors, other companies) Formal technical training	Formal training Formal internal learning: Process analysis	X

(Organizational) Ambiguity Reduction	Interactive learning: CEO and CFO	Interactive learning: discussion with CFO and CEO and kick off meeting with stakeholders Mission statement: newsletter and posters	Interactive learning meetings (unplanned) with the vendor, project team and key users Personal dialogue	X

Table 16, the observable artefacts of the managerial process facilitating the ESI learning at C2

4.2.2 The managerial process communicating the ESI significance

Table 17 shows the overview of the managerial process communicating the ESI significance at C2.

ESI outcome	The ERP implementation was 11 month beyond the plan, still not signed off.
Context	The top management did not really involve into the project definition and operational phase. They were persuaded by the vendor and easily regard the ERP project as a pure technical project. Top management commitment disappear at the implementation phase Lack of top management support at implementation phase ushered the project to nowhere: end users did not trust the project and project team incessantly talk with software vendor. The promise of the software vendor was verified as unrealistic, and both end users and the project team were disappointed with the software.
Potential pattern	The CEO and the CFO showed their commitment to the project at the early project phase, but their commitment disappeared at the implementation phase

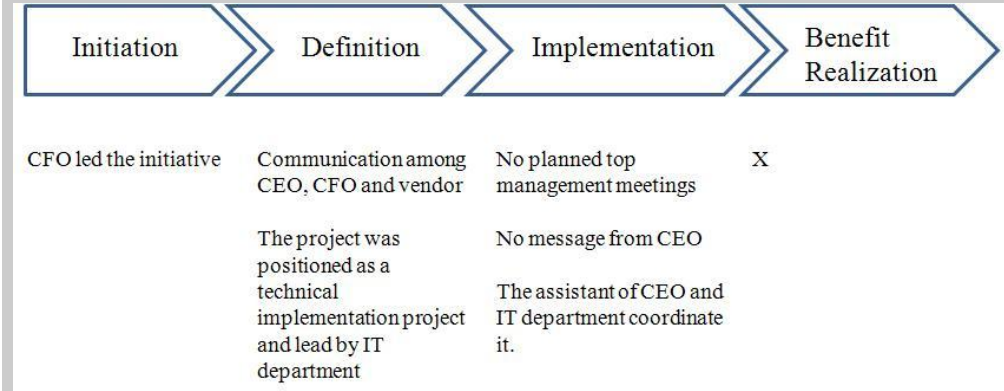


Table 17, the managerial process communicating the ESI significance at C2

The CIO told us:

> *"I must continue to influence the top management that ERP project is not a business of IT department, but should be considered from the whole organizational level. Currently, they still think they only need to concern project planning and final results checking."*

Table 18 shows the observable artefacts of the managerial effort of communicating significance by top management at C2.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	CFO lead the initiative, and CEO support it CEO review the proposal and comment on it	CEO and CFO have meetings with CIO CEO and CFO in the steering committee The mission statement by CEO	The assistant of CEO made efforts to coordinate with stakeholders	X

Table 18, observable artefacts of the managerial process communicating the ESI significance at C2

4.3. C3: Cancel the original project plan

C3 is the one of the largest post-offices in China. Post service has been completely owned by the Chinese state and monopolized until 1998. In 1998, China's postal services' budget deficit reached 18 billion Yuan with 9, 5 billon debts to banks. The Chinese government decided to de-regulate it and divided the Chinese Postal-telecom corporate into Chinese postal offices and Chinese telecom in 1998.

Since 1998, C3 has been experiencing unprecedented difficulties and challenges: on the one hand, the customer demand for traditional postal service was continuously declining due to the emergence of electronic communication. On the other hand, new service demand was expanding quickly, e.g. express mail, logistics.

These external changes posed a critical choice for C3: how to transform the corporation to keep its competitiveness? New entrants have been entering into the market, and international competitiors were allowed to enter into Chinese market, e.g. DHL, FedEX, UPS, and TNT.

Top management at C3 felt the urgency of implementing an efficient e-platform to compete with both international and local competitors. The market share of an international express postal service of C3 is already down to 45% in recent years.

The management board made a decision to implement a CRM (Customer Relationship Management) system in 2002. The CEO was inspired by some other post offices in western countries. , e.g. the decision making system of Canadian postal office, electronic equipment of German counterparts, and other advanced e-based system and service of Sweden, France and USA etc. He believed that it is necessary to implement a CRM system.

The assistant of the CEO told us:

> *"We hope an effective CRM system can bring us: automation of some customer service, automatic management of customer information, support better communication with customers, provide customer data mining, support decision making"*

The CEO had several rounds of meetings with other top management members to communicate the idea. Due to its strategic attractiveness for external consultant, (C3 is the first pilot case of Chinese postal office for CRM), an international consulting company offered a free feasibility study for this CRM initiative. Later in 2003, the consulting company

submitted a report with a detailed implementation plan. The management board did not approve the proposal. The project team leader from C3 remarked:

> *"After reviewing the proposal, top management thought BGY are not capable of doing such large project in the moment, we even do not have good basic dataset. Hence maybe it is better to initiate a project to systematize the customer data first."*

The reality was that less than 3.05% employees have received university level education, which means, it takes more time to do organizational training than their counterparts in the world. Customer information and the operational data are not well managed and integrated.

The assistant of CEO told us:

> *"The working routines, forms and processes are not interoperable across sub-divisions, thus, it is hard to optimise these resources using an advanced information system without effective organization change".*

Later, the management board approved a small-scale ES project for a sub-division of C3.

4.3.1 The managerial process facilitating the ESI learning

Table 19 summarizes the managerial process facilitating the learning of ESI at C3.

ESI outcome	A small pilot project replaces the planned ESI project.
Context	The initiative of the ERP project was done by the CEO with an ambitious goal. After discussing with the management board, a feasibility study was conducted. Considering the organizational capabilities and existing data source. The management board realized there are too many risks for implementing an organizational wide ES.

Potential Pattern	Both technical uncertainty reduction and organizational ambiguity reduction learning techniques were used at the early project phase, and Extensive discussion among top management for the potential risks

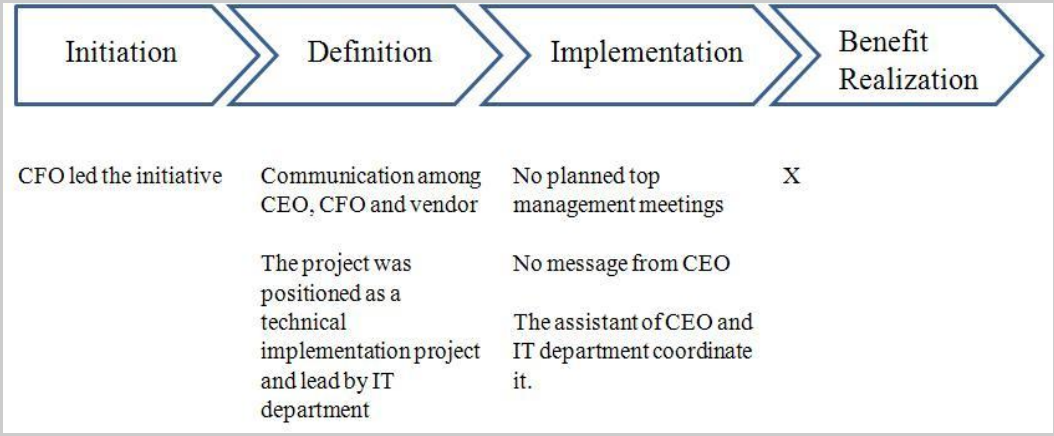


Table 19, the managerial process facilitating the ESI learning at C3

Table 20 shows the observable artefacts of the managerial process facilitating the ESI learning at C3.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from others: (Other companies, consultant) Formal internal learning (do a feasibility study)	Learn from others: (Other companies, consultant) Formal internal learning (do a feasibility study)	X	X
(Organizational) Ambiguity Reduction	Interactive learning: (Top management meetings)	Interactive learning: (Top management meetings)	X	X

Table 20, the observable artefacts of the managerial process facilitating the ESI learning at C3

4.3.2 The managerial process communicating the ESI significance

Table 21 shows the overview of the managerial process communicating the ESI significance at C3.

ESI outcome	Change the project goal and narrow down the scope to make it implementable.
Context	The top management involve into the project initiation and definition phase. A well known consultant company was invited to do a feasibility study which is an instrument for them make decision. Later the top management decide not to start the project because it is too difficult, rather approved a smaller project within a sub-division.
Solution:	The CEO initiated constructive dialogue among top management board members to assess the project and its feasibility at the early project phase.

Initiation	Definition	Implementation	Benefit Realization
CEO led the initiative	Extensive dialogue among top management members Management board collectively make the decision	X	X

Table 21, the managerial process communicating the ESI significance at C3

4.4. C4: a failed ESI

C4 is a large state owned manufacturer with five business divisions and about 6000 employees. The main products include mechanical equipment and certain military products. Since the mid 1990s, C4 lost its market competence in the market. The top management at C4 found that inefficiencies in the old internal operational system impeded furthering development and increased the production cost. Consequently, they thought that they must effectively renovate their operational system soon or later.

C4 succeeded in acquiring a large project funded by Chinese 863 high-tech program including CAD, PDM and ERP projects with about 9 Million Yuan budget in 2001. The

initiative is proposed by the CEO. He invited several different software vendors to write a project proposal for that.

The top management hoped to take this chance to renovate the operational system. The existing operational system has been stable for more than 30 years and is based on the old national planning oriented economy system.

CAD, PDM and ERP projects were kicked-off in parallel. The study is focused on the ERP project. The ERP was contracted with a local software vendor for 1.5 years including production plan, sales, purchase, inventory management, human resource management and financial management modules.

The ERP project was regarded as a technical project, and the training sessions was mainly targeted at operational tasks of end users. The project manager from the software vendor told us:

> "*Due to the limited budget, we* focus *more on customisation of the software, and few training sessions are designed for management boards"*

The CEO strongly promoted the ERP project, but without inquiring with other members of the management board, e.g. the CTO. A project team member from the software vendor observed the passive cooperation attitude from the CTO and other line mangers. He told us:

> *"At C4, the CEO make the decision for everything, hence, I noticed that CTO is not so happy that he is not involved in the initial phase of selecting the software vendor. He is not so active and supportive in the project"*

No detailed and coordinated project plan was developed for these three projects as:

> *"(1) Three software vendors are involved; (2) we do not have enough resources to do that" (Project manager).*

The CEO acted as chair of the steering committee, and all the relevant top management and line managers were asked to be at the committee, despite the fact that they knew little about the ERP implementation project. A newsletter was distributed widely showing the high project priority and top management's commitment.

The CEO still kept the old mind-set of top management from a state-owned company: start off with very strong involvement during the planning phase, and withdraw from participation

later during the project operational phase. Without his continuous commitment, other stakeholders held the wait-and-see attitude toward the project.

The CEO only participated in one relevant project meeting during the implementation phase. The outcome of the improper communication with other stakeholders is that line managers and other top management members did not actively cooperate with the project team. Management level members (both top management level and line manager level) never joined these training sessions. The training sessions were targeted at operational tasks of end users. Without shared organization understanding, there are a lot of additional efforts needed for communication. The project manager told us:

> *"We spend a lot of time to convince them. Finally some of them understand us, but they told me that it is no possible to implement it here as it is unrealistic to radically change the organization"*

Business process change was not included in the project plan and was not touched upon during the early phase of the project. Line managers and other top management were afraid to lose their own benefits due to the ERP implementation, and adopted a passive attitude towards the project or found excuses to reject the project. One project team member told us:

> *"It is quite ridiculous that one manager told us that ERP implementation will produce more useless papers"*

As a consequence of lacking shared organizational understanding of the ERP project mission, little organizational business process analysis and user requirement were done. Moreover, no training sessions were developed for affected line managers. The three con-current running projects: CAD, PDM and ERP completely confuse end users and made them lose the trust and confidence in each project. One end user told us:

> *"I do not know which project has actual realistic intention behind that. I am quite confused with that. I am wondering whether there is some people in the company know it"*

Facing the strong collective resistance, the CEO did not dare to exert press upon it as well; however several compromises were made to continue the project. The other big challenge was lack of data resources, since insufficient amounts of data were recorded in the old operational system. C4 operated on the old operational mode for more than 30 years. Hence, additional efforts were conducted to clean up the data and prepare the required data for the new system.

Later during the implementation phase, the software vendor and C4 put in extra effort to ensure the project would pass the 863 expert review meeting. When we did the interviews, the CAD and PDM projects were completely discarded. For the ERP implementation project, only the financial management module was partly used.

4.4.1 The managerial process facilitating the ESI learning

Table 22 summarizes the managerial process facilitating the learning of ESI at C4.

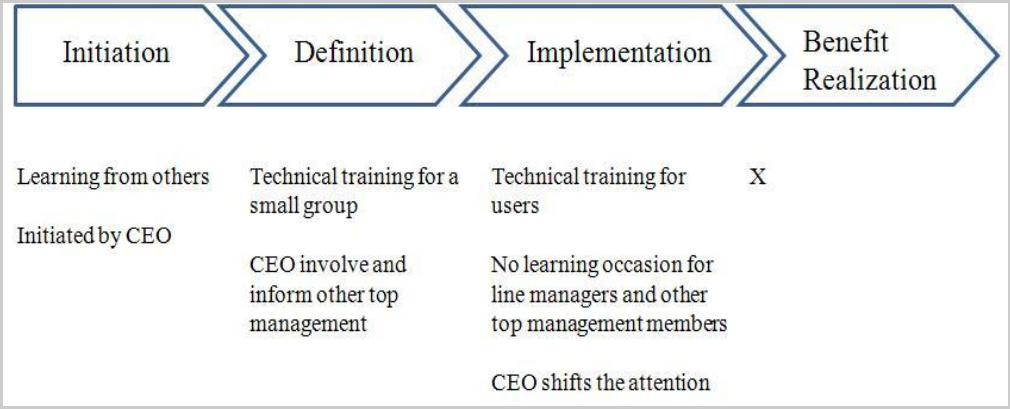
ESI outcome	The ESI project failed, and did not deliver the planned goal.
Context	Though the ERP project is initiated by CEO, it started in a hurry because it is more like a gift from the public body. Meanwhile, three large projects are started in parallel. Except the commitment from the CEO, there is no real organizational buy-in for the ERP project.
Potential Pattern:	Neither systematic technical uncertainty reduction nor organizational ambiguity reduction learning techniques were used at the early project phase 

Table 22, managerial process facilitating the ESI learning at C4

Table 23 shows the observable artefacts of the managerial process facilitating the ESI learning at C4.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**

(Technical) Uncertainty Reduction	Learn from others (Proposal preparation)	Learn from others (vendors, other companies) Formal technical training	Formal training Formal internal learning: software customization, basic data preparation	X
(Organizational) Ambiguity Reduction		Interactive learning: (meetings at the management board, mainly inform others) Mission statement: newsletter	Interactive learning meetings (unplanned) with the line managers, Personal dialogue with line managers One meeting participated by CEO	X

Table 23, the observable artefacts of the managerial process facilitating the ESI learning at C4

4.4.2 The managerial process communicating the ESI significance

Table 24 shows the overview of the managerial process communicating the ESI significance.

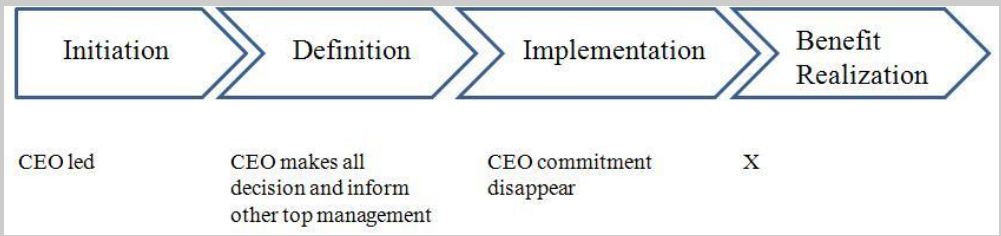
ESI outcome	High resistance and passive cooperation from other stakeholders
Context	The CEO was the only one to actively push the initiative through the early project phases. Other top management members were not well informed about it.
Potential pattern	The CEO initiated some rounds of one way significance communication activities at the early project phase, and No constructive dialogue among stakeholders 

Table 24, the managerial process communicating the ESI significance at C4

Table 25 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C4.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	CEO review the proposal and discuss with potential software vendors	CEO made the decision about the budget allocation CEO inform other members of the managerial board Project mission statement by CEO Implicit mandate by CEO	CEO attend one project meeting	X

Table 25, the observable artefacts of the managerial process communicating the ESI significance at C4

4.5. C5: a delayed and satisfying ESI

C5 is a large state-owned aviation manufacturer with about 10,000 employees. It is one of the 520 core enterprises in China, and is one of the national nominated helicopter research and production bases. The main businesses of C5 are helicopter and automobile products, which are distributed to nine sub-business divisions. C5 has been achieving good business performance since 1992, and is one of the 500 most profitable enterprises in China. C5 was even named as the "China's most famous brand" in 2000. The sales number of their automobile products sector has ensured their consistent ranked among the top ten companies in China since 1996.

C5 has been making an effort to improve their business performance from both internal operational efficiency and external cooperation with international partners. "C5 automotive co-current engineering" and "Helicopter CIMS" projects are highly regarded in China high-tech 863 program. Meanwhile, C5 was in the way of cooperating several external players, e.g. from France and Brazil.

In 1998, C5 succeeded in applying for the two projects from China National 863 high-tech program. It won the 863 rewards for these two excellent cross-functional technical projects. With the experience gained from these two projects, they launched PDM and ERP projects almost simultaneously in 1999. But later, they stopped the ERP implementation, and focused on the PDM system.

The project team included representatives from all affected departments, and the CTO lead the project. The role of IT department was to support the project operation. Most of the core team members were energetic seniors who viewed the invitation to join the team as a credit to their career. Hence, they were self-motivated to spare their time for this project. One team member told us:

> *"It is my credit to be invited as a team member; the best employees from each department were recruited into the project team. It is obvious to show the defeminisation of the top management. I never saw such case in other companies for the similar projects."*

In the beginning, they bought the XXX PM software, and tried to translate it into Chinese, and than used it in their case. The translation and the detailed business process analysis took one year. Meanwhile, the CTO acquired the support from the CEO and did a lot of communication and dialogue with several product managers about this initiative.

The software vendor offered a one week training course to the core project team members. C5 did not highly appreciate the training quality offered. One core team member told us:

> *"Mainly we explore the possibilities of the system. Frankly to say, the representatives of XXX China did not* understand *the system completely as all of them have the software background, not from engineering background. Hence, they only offer this one week's course, later we did entire training sessions by ourselves."*

The project team realized that they must lead the ESI project because the team members knew the existing business processes very well. They had frequent meetings to discuss the project plan. They did some initial business process analysis at this phase. The CTO continued to communicate with product managers and convince the CEO to strongly support this project. A newsletter in the name of both the CEO and the CTO were distributed organizational widely.

The CTO acted as the operational team leader, and the CEO as the steering committee chair. The CTO took the overall responsibilities for coordination with stakeholders with the support from the CIO. One core team member told us:

> *"I told CTO that if he wants me to do the new process design and planning. I can do it, but it should release in the name of him, and he should support me if there are some resistance."*

Later during the implementation process, they found out that the software does not completely meet their business requirement. The CIO told us:

> *"We found that it is impossible to the use the translated system in a short time. The reason is quite simple: the* system *is generic designed, and not specifically for aircraft industry. Hence, the functionality is complex and require the highly qualified end users, which is not realistic for us"*

They spent one more year to customize the software and to optimise the business processes with extensive end user input. One core team member believed it was vital for the success of this project. He said:

> *"In state owned companies, it is difficult to do a lot of training. As a user, he only care about his convenience, he does not care about what will happen afterwards."*

The CTO remarked this change:

> *"The software package is very good, but not designed for aircraft industry; it is too complex and requires highly qualified end users and extensive user training, which is not feasible for state owned companies in China. Too much extensive training is not acceptable for top management, and too long time training makes all the relevant parties' fatigue."*

The project team did not conduct extensive formal user training session. Rather, they went for an interactive personal coach and consultant to acquire the user's comments and input for the customization of the software. The core team member told us:

> *"It is hard process to perfect the customized software. At the beginning, it is quite hard as there are many unexpected bugs. End users plan to use it, but it is not usable. Then the core team sit besides end users; operate the*

> *system together with them. There are two benefits, first we re-realize their requirements, second is that we develop it to fulfil these requirements".*

Such extensive informal user-participation training methods increasingly acquired end users' support. One end user told us:

> *"At the early phase, I was afraid the new system, but later Mr. XX always stay with me and coach me, that makes me quickly get used to the new system as it is simple and straightforward"*

There was some emerging resistance from both end users and product managers. Here, the project team adopted two methods in parallel. One way was extensive communication and dialogue with end users and product managers. The CTO was frequently involved in these activities. One core team member told us one example:

> *"There is one senior engineer who has not touched computer based system. He asked me to give him the privilege of not using the new system. I did not agree with him, and he turned back to CTO to ask for support. CTO directly refused him and told him to learn it otherwise he would lose his position"*

The other way was to enact new detailed rules to support the implementation. Several new rules were quickly launched to ask end users to follow it. Strong commitment from top managements supported the implementation of the new rules. The CIO told us:

> *"We came out the new rules for using the new system. The top management widely demo their strong support for it. For example, one of our top management members omits one rule himself. He paid 100 Yuan as a punishment fee in front of many end users."*

The CTO continuously participated in the project operation. He had personal conversations with some product managers and senior engineers. He also frequently spoke with other top management. As a result of such extensive communication done by the CTO, other top management also showed their commitment to the project. For example, one member from top management paid 100 YUAN for his mistake of not following the newly designed rules. With the strong support from the CEO, the new system was the pilot case used in a new production line and it showed its powerfulness to shorten the new product development leading time and better process management.

Strong top management support and detailed delimited rules pushed the PDM project through several hard periods. Active and extensive user participation acquired the wide supportive critical mass for the project. The CTO successfully convinced top management and product managers to try the new customized system for a new product line, which later proved to be a successful pilot case. The CTO told us:

> *"We better start from a new product line as there is less organizational inertia to overcome. Moreover, it is easier to accept the results if it is not so good"*

The project team did a lot customization work on its own. They concealed the functionalities which were not needed to end users. For the necessary functionalities, they integrated them into certain packages, which meant a black box for end users. End users only needed to click the 'save' button when they finish their working tasks.

It took much longer than expected to finish this project (one and half years longer), but the long process achieved two excellent results as appraised by the CTO:

> *"First, we learn that end users actually need to do in this way; second, we can focus our effort and resources to develop the needed functionalities by them."*

Series of quick, effective visible results gradually helped the project acquire the critical mass of supporter at C5. The CTO pushed hard to try it in a new product lines. It is proved to be very successful.

The CTO proudly told us:

> *"I know at least 20 companies within Chinese aviation industry bought the XXX PM system, but only C5 succeeded in using it in the new product developing process"*

The CTO took the success story of the pilot cases to persuade other production managers to use the new system. The team members continued to coach new end users about different production lines. Later they transferred the training tasks to the IT department. The strategic importance of this group of people was realized and almost all of them were promoted. e.g. the CIO was promoted as deputy CTO. Some of members were promoted to department managers. They were further diffusing the new concept to the corners of C5. The CTO told us:

> *"HP want to hire one of our core team member, but we keep her and promoted her, and warn HP that we will stop business relationship if they continue to annoy our best employees."*

Currently, 5 product lines of helicopter are running using the new PDM system and the revenue per year increase about 20% compared with before. The ESI project was widely accepted at C5. One product manager told us:

> *"Without the new system, we cannot deliver the new product in such short time. I really appreciate their effort and the great achievement"*

Based on the success of these project and knowledge gained from it, a formal strategic roadmap for strategic information system adoption and implementation were developed. For example, a virtual e-collaboration project was in the initiation stage when we did interviews.

4.5.1 The managerial process facilitating the ESI learning

Table 26 summarizes the managerial process facilitating the ESI learning at C5.

ESI outcome	C5 learned and developed the capabilities of implementing ES project though this project. A strategic roadmap was an additional consequence of their capability enhancement.
Context	C5 possessed strong technical expertise. However, C5 lacked the organizational change experience. Hence, they ignored the consideration of organizational receptiveness at an early project phase, and thought that pure software translation is the whole content of this PDM project. Fortunately, with strong top management support and well designed flexible learning techniques compensated this weakness. The other good starting point they had was that there were some young and innovative elites who were promoted to the key strategic position through the previous two successful projects at C5. They were open minded and willing to learn the new ideas. They also they had a business and operational background, and knew the real user requirements.
Potential Pattern:	Strong technically driven learning activities at the early project phases. More balanced learning activities during the later project phase (since implementation phase)

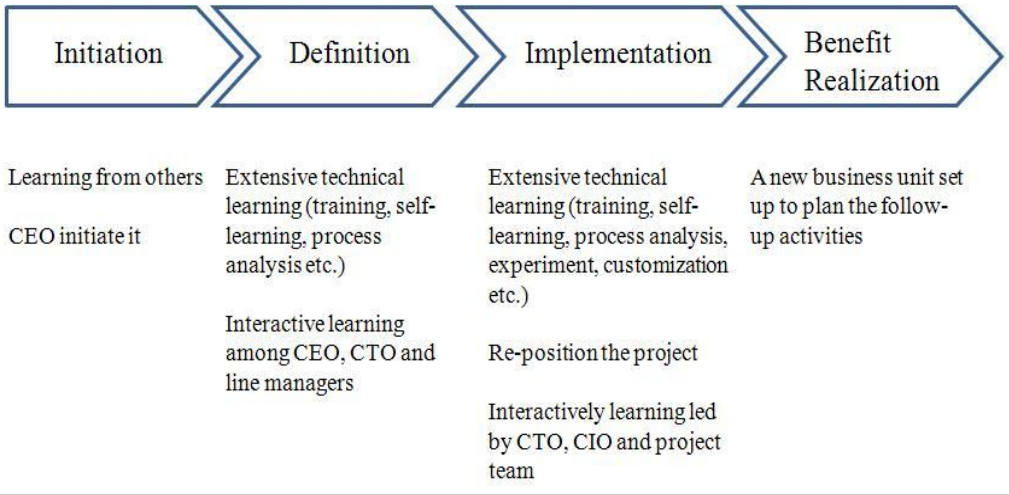


Table 26, the managerial process facilitating the ESI learning at C5

Table 27 shows the observable artefacts of the managerial process facilitating the ESI learning at C5.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from other companies Informal internal learning (self motivated learning of CTO, CIO and a small team)	Learn from others (vendors) Informal internal learning (CTO and his core team) Formal training Formal internal learning (process analysis, knowledge codification)	Formal Internal learning (experiment, process analysis, Pilot case, software customization) Formal training to end users with active user participation Informal internal learning; team members and personal coach to end users Formal internal learning: software	Formal and informal learning: coach to end users and product managers

			customization, basic data preparation	
(Organizational) Ambiguity Reduction		Interactive learning: (meetings with CEO, CTO and line managers) Mission statement: newsletter	Interactive learning meetings (unplanned) with the line managers, end users and CTO Personal dialogue with line managers and end users	Interactive learning meetings with product managers and end users

Table 27, the observable artefacts of the managerial process facilitating the ESI learning at C5

4.5.2 The managerial process communicating the ESI significance

Table 28 shows the overview of the managerial process communicating the ESI significance at C5.

ESI outcome	Complete organization buy-in of the PDM project and the core team members are promoted
Context	At the beginning, there is less significance communication leaded by the CEO. The CTO was the only one to actively push the initiative through the early project phases. Other top management members were not well informed about it.
Potential Pattern:	Little amount of significance communication at the early project phases. Extensive significance communication since the implementation

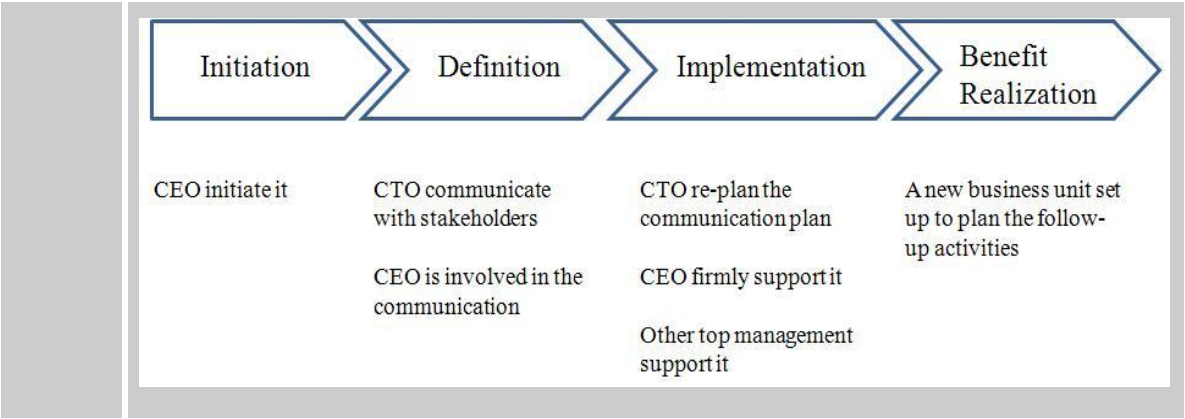


Table 28, the managerial process communicating the ESI significance at C5

Table 29 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C5.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	CTO organizes a core team with best employees from several departments. They have a meeting every week	CEO has meetings with CTO and CIO CTO has frequent meetings with product managers Project mission by CEO Organizational wide newsletter CTO as project sponsor, take the coordination role. CIO take the other part of coordination role	CTO has frequent meetings with product managers and senior users CTO frequently participate the project meetings and check the progress CEO frequently check the project progress	CTO continue to communicate with top management to wider deploy the system

Table 29, the observable artefacts of the managerial process communicating the ESI significance at C5

4.6. C6: A delayed and qualified ESI

C6 was a large state owned aviation manufacturing company with more than 16000 employees, and owned the production lines for helicopter, car, and other mechanic equipments. It was one of the 156 largest enterprises in China.

C6 experienced several rounds of large scale re-organization in recent years to match the external environment change. For example, C6 was re-structured as a corporation composed of 19 sub-divisions in 1999, e.g. C6 automotive, C6 aviation and C6 machinery and electronics. In 2002, C6 changed its ownership from being completely state-owned to the ownership of multi-shareholders, which absorb the asset from four other asset management corporations.

Recently, C6 increased international cooperation projects with French, U.S. American and Canadian partners on both aircraft and automotive products. For example, C6 became one of the two Chinese suppliers for Boeing's new 7H7 airplane. Expanded international cooperation made top management at C6 realize that it is strategically important to reduce the gap with western partners from the perspective of the management system, human resources, technology management, quality control and mechanisms. C6 believed that a solid technical base and human resource competence are the basis for a sustainable equal international cooperation.

C6 was well known for its technical competence. On the one hand, C6 gradually became the spears pin of AVIC II, and had strong government support to compete in the international market for its aircraft products. On the other hand, they relied on its strong technical competence and successfully entered the automotive market through forming a strategic alliance with one international partner.

The top management realized that C6 is still weak in its internal operational efficiency and lack the capabilities to respond to external changes. And therefore C6 has been making efforts improve since the late 1990s. C6 has succeeded in implementing an ERP system in its automotive business division. With the experience gained from it, C6 aimed at implementing the other ERP systems for its aircraft products, which is a harder task than the previous implementation.

C6 re-structured the whole organization in July 2001 to transform the organization from a deep hierarchical structure into a flatter organization. More than one third of organizational

administrative staff was cut. C6 became a project oriented matrix organization afterwards. Aircrafts has been the core product for C6 since its foundation in the 1950s. Hence, there was a larger workload and many more challenges to face than the previous implementation at the automotive division.

C6 initiated an ERP implementation project in June 2000, and planned to sign off the project in 2002. C6 succeeded in implementing an ERP system for its automotive business division, and gained the knowledge that the ERP implementation journey is not easy. The second ERP implementation occurred in its aircraft business division, which is even more complex than the previous implementation. Considering the strategic importance to C6, the CTO had several rounds of personal meetings with the CEO to discuss it. The CTO told us:

> *"It is a big investment if we decide to do it; no people can take the responsibility for more than 10 Million Yuan if the result is bad"*

They decided not to use the ERP system which was implemented within the automotive division. C6 made the decision to use a local software vendor who has strong background in the aircraft industry, even though its product was still in a pre-mature state. The new software vendor is a local one with a relevantly strong aircraft background, which is the best available alternative in Chinese market.

The CTO explain it as:

> *"The software is excellent with good Chinese translation. But it was too expensive for us, especially the implementation cost. Last time, they charged us 1000 $ per day per people. Second, aircraft products are more complex than automotive products. They do not have any experience on it."*

C6 adopted a step-by-step implementation strategy to reduce the potential risks and fill the knowledge gap. Two stages were defined: one was internal lab simulation and experiment period, which was from June 2000 to November 2001; second is a large-scale implementation at C6 from early 2002 to the end of 2002, aiming to implement it for each aircraft product line. The CIO explained it as:

> *"We decide to implement the ERP system in two big steps. The first step started from June 2000 to November 2001, and is to analyse, develop and customize it in a artificial lab environment as we still are not sure whether the software is appropriate for us or not. The second step is from early*

> *2002 to end of 2002, to implement it in a product line, and then fully deploy it since March 2003."*

The allocated budget for the first step was 0.7 million RMB, and 11 million for the second step. The first step of the project was lead by an IT department manager and supported by several employees from the affected departments. The second step of the project was lead by the CTO and chaired by the CEO on the steering committee with direct participation of department managers.

A small team was set up with members from relevant departments. Each member of the project team was on the behalf of certain departments and offered their understanding and insights of the relevant business processes to the software development team. The CTO himself organized the recruiting process as he said:

> *"The principle of selecting project team member is: first she/he is interested in joining this project and willing to work hard, but not compulsory; second she/he should have good performance and know the relevant business process well"*

The software vendor provided some introductory training sessions to the project team, and they spent a lot of time learning the system and its implication for their departments. Combined with their working experience, they developed new business processes based on the system, and provided the process models for the software customization. They also went back and forth to explain to their bosses and their colleagues. Fixed project meetings were held every one or two weeks, and were coordinated by the CTO. During the meeting, the core team members from different departments exchanged their ideas and facilitated a shared understanding of the project direction.

One core team member from purchasing department told us:

> *"We, every one or two weeks, assemble together, to discuss the latest progress of each other, co-design some cross-functional business processes… it is a valuable experience for me. Gradually I am able to understand the processes from the whole organizational perspective, not only within the department I work in."*

At the end of this phase, a new software prototype was developed with the concerted effort made by the whole project team, and presented to the CEO and the management board by the

CTO. The CEO was happy with the results and initiated a steering committee to support the further implementation.

Then the CTO lead the operational tasks. There were still a lot resistance and emerging issues during implementation despite the effort to facilitate a shared understanding among top management and line managers. The CTO told us:

> *"There are a lot of resistance or passive cooperation from the line managers and end users. We communicated and ask CEO's command to solve it."*

The CIO also remarked it:

> *"It is normal that the affected department does not actively cooperate with us. For example, product design department did not provide the data to engineering department using the system; standardization department did not know how to code the components and products using the system; financial department is not willing to change their working routines as they have to cope with external audit…"*

The core project team members codified their knowledge into several operational manuals to train their colleagues of each involved department. Some training sessions were held to train end users.

One team member told us:

> *"At that moment, the entire training classrooms are fully booked."*

However, there was still much unexpected resistance and passive cooperation attitudes toward the implementation from both management levels and end user levels. Open communication and command were the two methods to solve these issues. The CTO gave us several examples,

> *"For example, financial department strongly object the new system, it is out of my control scope, and I turn back to CEO at the steering committee. CFO told CEO they have to deal with external auditing in a certain way which is not possible by using the new system. CEO then said that for entire internal transactions, please use the new system. Financial department should scan all the activities related to external auditors, and then ask relevant departments to prepare a second copy for it."*

Continuous participation from top management, especially the CEO's, is regarded as the only weapon to solve the resistance at C6. The CEO was chair of the steering committee. Every two months, the CEO had a fixed steering meeting with others from top management and line managers to openly discuss and make major decisions. The CEO's sustained support helped the project greatly. The CIO told us:

> *"We are technicians. We know the problems, and some of them are out of our control. We then present it at the steering committee meeting, and then CEO made the decisions for them."*

The CTO attended the project team every one or two weeks. One team member remarked:

> *"CTO is an expert and on behalf of top management. We raised our concern and our proposals. He can explain which one is feasible and integrate our opinions quickly."*

Some organizational stakeholders found every excuse to reject the tasks. At those times, firm commands from the CEO made a difference.

The CTO told us:

> *"Several times CEO himself checks the progress of some involved departments without informing them in advance. For example, he went to inventory and ask operators to have a look at the ERP system, and asked them why they did not do it as he already command the department manager one week before… totally three employees were fired"*

The fact was that once the CEO was distracted by other issues, the implementation process was delayed as some people began to passively cooperate with the project team. The direct consequence was that the project team had to clean up the entire data once again, which negatively impacted the project progress and its future.

Due to the accumulated issues in past decades and highest accuracy requirements of the aircraft products, the working load for cleaning up basic data was extremely high, and made people feel easily exhaustive. The project team already repeated two times to clean up the data, as explained by one core team member:

> *"It is hard to clean up the data, but it is a pre-requisite for running ERP system. We have done it two times due to operator's mistakes. Recently, there was a working accident here. CEO and other top management shift*

> *their attention towards it and less attention on our project. Hence, some operators do not care about the data input anymore… it is very dangerous to the project as too many times of data mistake will lose people's confidence for the project."*

As a consequence of all these barriers, the implementation phase was delayed for almost one year. During our study, the CTO admitted its hardship to implement the new ERP system in C6:

> *"Sometimes, we need time, simply to say, we need new graduates to do the new job."*

> *"It is not realistic to implementation ERP system at large state owned corporations, like C6. There is a lot of work to do. Aircraft is a complex product and need strict quality control. Hence, extensive basic data collection is needed with highest accuracy. Moreover, changing processes takes time. For example, it took us one month to change one process."*

The CIO said:

> *"ERP implementation is notorious for its difficulty in implementation. I learned that the success rates in the western country are between 20-30%, and average implementation takes 5.7 years. In China, the success rate is less than 10%. Hence, it still need time to implement it."*

Until the interviews began, one product line was partly using the new system, and the project team was making effort to deploy it further. The CTO remarked:

> *"We successfully implement an ERP system at the automotive divisions, but to the aircraft division, only one product line is partly using it. It is a long term effort. It takes time to full deploy it".*

4.6.1 The managerial process facilitating the ESI learning

Table 30 summarizes the managerial process facilitating the ESI learning at C6.

ESI outcome	The ESI project was still in the implementation process and achieved certain business benefits, with a delay of almost one year

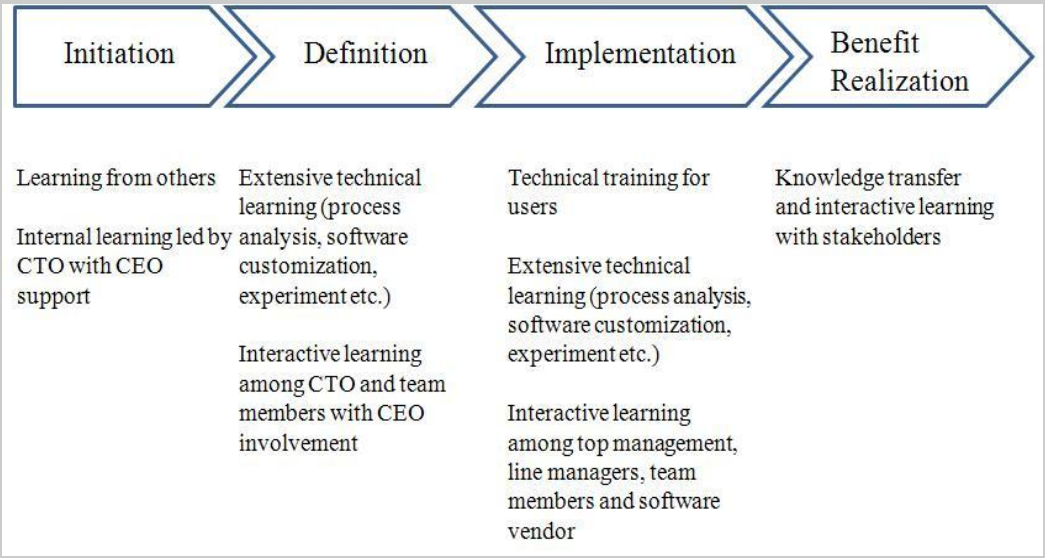
Context	C6 possessed strong technical expertise. The ERP implementation project is an unprecedented challenge for the aviation division. Much more attention is paid to co-develop the ERP with the vendor. Organization impact is ignored at the early phases. The strong top management support can help the project temporally. Once the top management lost its attention for the project. The project will halt because end users not really actively involved in the designing the business processes.
Potential pattern:	Strong technically driven learning activities at the early project phases. More balanced learning activities during later project phases (since Implementation phase) 

Table 30, the managerial process facilitating the ESI learning at C6

Table 31 shows the observable artefacts of the managerial process facilitating the ESI learning at C6.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from vendors Formal internal learning (from other division)	Learn from others (the potential vendor) Formal internal learning (Process analysis, experiment, software	Formal Internal learning (experiment, process analysis, Pilot case, software customization, operational manual) Formal training to end users with active	Knowledge codification

		customization Informal internal learning (project team) Formal internal learning (process analysis, knowledge codification)	user participation Informal internal learning; team members and personal coach to end users	
(Organizational) Ambiguity Reduction	Interactive learning (CEO and CTO)	Interactive learning: (CEO, CTO and project members)	Interactive learning meetings (un)scheduled steering committee meetings and project meetings Personal dialogue with top management and others Mission statement (newsletter and personal explanation)	Interactive learning meetings with other stakeholders

Table 31, the observable artefacts of the managerial process facilitating the ESI learning at C6

4.6.2 The managerial process communicating the ESI significance

Table 32 shows the overview of the managerial process communicating the ESI significance at C6.

ESI outcome	The ESI project was still in the implementation process and achieved certain business benefits, with a delay of almost one year
Context	The ERP project does support organizational strategy change. However, the aviation division of C6 has been stable for more than 40 years. Hence it is a challenge to solve issues for technical complexity and organizational impact in parallel. Strong and scheduled top management support during the implementation phase help the project

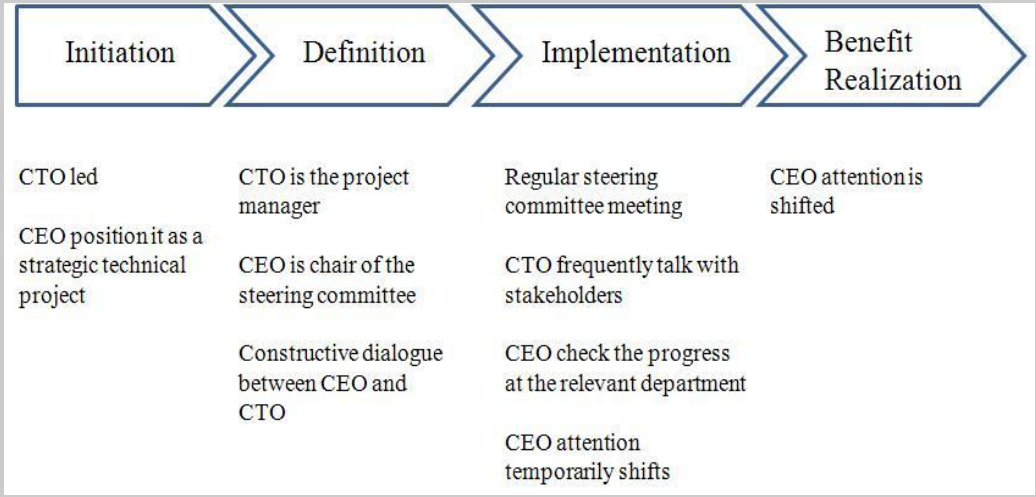
	solve most resistance. However, little end user involvement always impedes the organizational acceptance once the top management shift their concern to other urgent issues.
Potential pattern:	Little amount of constructive dialogue of significance communication among stakeholders at the early project phases, Extensive significance communication since the Implementation phase 

Table 32, the managerial process communicating the ESI significance at C6

Table 33 shows the observable artefacts of the managerial efforts communicating significance by top management at C6.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	A clear message from CEO that ERP is part of HF's strategy	CEO has meetings with CTO Best employees were recruited CEO as chair of the steering committee CTO as project manager Organization wide campaign to line managers and	Newsletter Regular steering committee meeting (2 months) Regular project meetings (1 or 2 weeks) CEO checked the progress of the affected departments (3-5 times)	CTO continue to communicate with line managers and top management CEO is distracted by other issues.

		top management	CTO frequently talk with line managers and top management	

Table 33, the observable artefacts of the managerial process communicating the ESI significance at C6

Cleverly designed implementation tactics and strong top management commitment carried the project through most of hidden barriers. However, organizational inertia was still there and required incessant top management active participation to gradually remove it. Moreover, the ignorance of end user requirements and their understanding of the strategic importance of the ESI project contained other hidden difficulties for the project. For example, two repetitions of data clean up verified this issue.

4.7. C7: a delayed ESI but with additional benefit

C7 is a large state-owned equipment manufacturer with more than 3,000 employees and was founded in 1984. It supplies several aviation electrical appliances to aircraft manufacturers, e.g. electrical magnetic relay, temperature relay, fire warn sensor and fire warn control etc.

In 1997, the Chinese central government issued the statement that only certain super large state-owned enterprises will still be financially supported, and C7 was not in the list. Hence, the existing market was not stable any more, and C7 must developed its own market strategy and compete with other companies.

Since 1998, C7 began to explore other civil markets based on their strong technical competence aggregated since last 15 years. A series of other products were developed, e.g. security protection facility, medical instrument, food & drink packing machine, electrical equipment and auto parts, and some of them even won the best product title at the province and national levels.

With the successful story, C7 decided to increase the investment for modern information technologies and systems. C7 already had an ESI plan for next five years. The PDM project was one of the essential elements of the plan. It was kicked off in 2002. The vice president told us that the establishing the plan is inspired by an accident occurred in 2001:

> *"In 2001, a Navy institute asked us that there is an urgent development task and whether we could deliver the required technical drawings within three days. I knew there are some other competitors for it. We delivered it*

> *within two days with very good quality using some of our electronic systems. The customer was very happy with that and we won the contract."*

The president acted as chair of the steering committee and the CEO was deputy chair. A vice president was the project manager. The science & technology department, product development department and techniques department and other departments provided support. To create a culture to encourage usage of new technologies, they set up a series of rules to support organizational learning.

For example, a vice president told us:

> *"First, we established certain incentives to reward those employees who made effort to learn it, then gradually, after some time, we set up policies to punish the people who did not make effort to learn it. Now, we have training sessions that each new employee has to pass the training exam to have the permission to work"*

To select the vendor, several potential vendors were invited to attend the seminars for the end user. The department manager of science & technology development department, who was later the assistant to the vice president for the PDM project, told us:

> *"We invite several PDM vendors to have some demo and concept workshops. We ask each department to attend them, to ask questions and to learn what PDM system can impact us. It is a warm-up phase for later implementation"*

He and the vice president did some investigation and evaluation on these vendors based on end users' comments. The top management also had several brainstorming meetings to discuss it. A cross-functional team was set up, and each affected department created a new part-time position called "PDM manager" to cooperate with the project team. These "PDM managers" acted as the bridge between the functional departments and the PDM project team. A steering committee was also established with the president and the CEO being co-chairs it.

One the software was selected, a detailed project plan was developed. Newsletters were distributed organization widely. The CEO and other stakeholders attended the kick-off meeting and the CEO stressed the strategic importance of the project. The vice president organized several meetings with attendees from all affected line managers, and supported by technology development department, to analyze and discuss the business processes. The vice

president coordinated the decision making process to meet most of the raised concerns by attendees. The process prototypes were defined before the implementation phase.

The technology department managers told us:

> *"It is good to first decide the prototype of the business process, otherwise, end users will confuse without it at the implementation phase."*

The vice president actively coordinated the project dissemination and operational tasks. For each decision, he always organized a meeting with stakeholders. With his effort, almost all the stakeholders understood the project mission. Series of organizational standards and rules shaped an organizational environment where trying the new technology is encouraged and formally allowed.

Later during the implementation process, end users were consulted about the new processes and their comments were considered to make them feel more comfortable. One "PDM manager" told us:

> *"We propose something to end users, and asked whether he likes it or not. If not, we asked his prefer, and then we try to collect all these requirements and discussed and solve them."*

The software vendor provided strong support for the implementation and it helped the project a lot. The technology development manager told us:

> *"The software vendor is good. They have strong technical expertise. They always reply us very quickly. It helps us to solve the emerging issues efficiently. End users are satisfying with that"*

Certain resistance or passive cooperation from end users and certain department managers were still emerging during the implementation process. The vice president and other team members continued to make effort to facilitate users' understanding and mastering of the new system. One project team member told his tactics:

> *"I understand end users, some of them did not touch computer based system before, and his working task is already quite heavy. Hence, in some cases, we can not press them too much. It takes time for them to learn."*

Top management included PDM training courses into the training sessions offered for the new employees. Some incentive policies were enacted to rewards earlier and quicker adoption

of the PDM system. Later when most end users mastered the new system, they changed the relevant policy to punish end users who still did not use the new system.

With the strong top management checks and relevant policies, end users gradually learned the new system and got accustomed to it. The PDM was half a year behind the original plan. One team member who was responsible for contacting effected departments told us:

> *"It takes more time than our expectation, some young end users who are interested in it learned fast, but to some old engineers, we must allow some time for them to learn. Sometimes, they are occupied with their own operational tasks, no time for the new learning."*

The new PDM system was in a pilot usage case when we did interviews. The vice president told us:

> *"It is a little bit late than the project plan. We will make effort to apply it in more product lines at the end of years. Now we will first apply it to the coming new products."*

4.7.1 The managerial process facilitating the ESI learning

Table 34 summarizes the managerial process facilitate the learning of ESI at C7.

ESI outcome	The PDM implementation took half a year longer but with good organization acceptance
Context	C7 has been making effort to create a hospital environment for new technology adoption. Top management's shared understanding and strong involvement in the PDM project helped the project run smoothly, except during the early implementation phase. C7 created opportunities for each user to learn the new system. Incentive policies are enacted to support the PDM implementation
Potential pattern:	Balanced learning activities for both technical uncertainty reduction and ambiguity reduction along all project phases

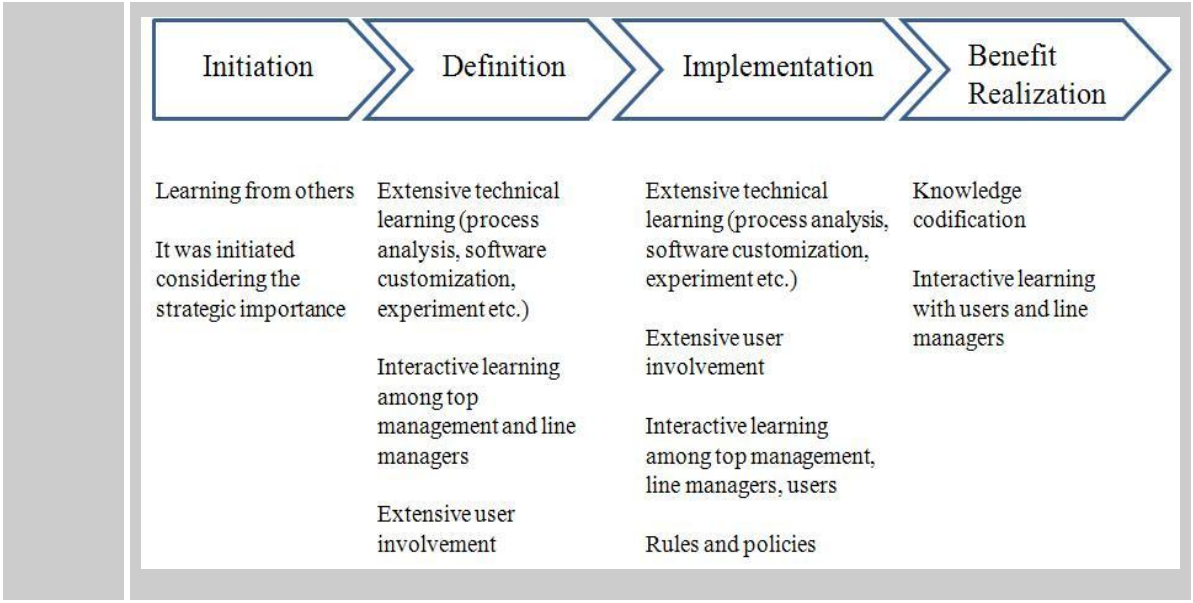


Table 34, the managerial process facilitating the ESI learning at C7

Table 35 shows the observable artefacts of the managerial process facilitating the ESI learning at C7.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learn from other companies	Learn from others (the potential vendor and consultant) Informal internal learning (vice president and technology department manager) Formal training, active end user involvement Formal internal learning (Process analysis, experiment, knowledge codification)	Formal Internal learning (experiment, Pilot case) Formal training to end users with active user participation Informal internal learning; team members and personal coach to end users Learning from others (vendor support)	Formal and informal: coach end users and line managers

(Organizational) Ambiguity Reduction	Interactive learning (CEO and vice president) Rules for new system use	Interactive learning: (CEO, president and vice president and line managers) Mission statement (workshop, newsletter)	Interactive learning meetings (un)scheduled with users and line managers Personal dialogue with end users and line managers Rules and policies	Interactive learning meetings and personal dialogue with end users and line managers

Table 35, the observable artefacts of the managerial process facilitating the ESI learning at C7

4.7.2 The managerial process communicating the ESI significance

Table 36 shows the overview of the managerial process communicating the ESI significance at C7.

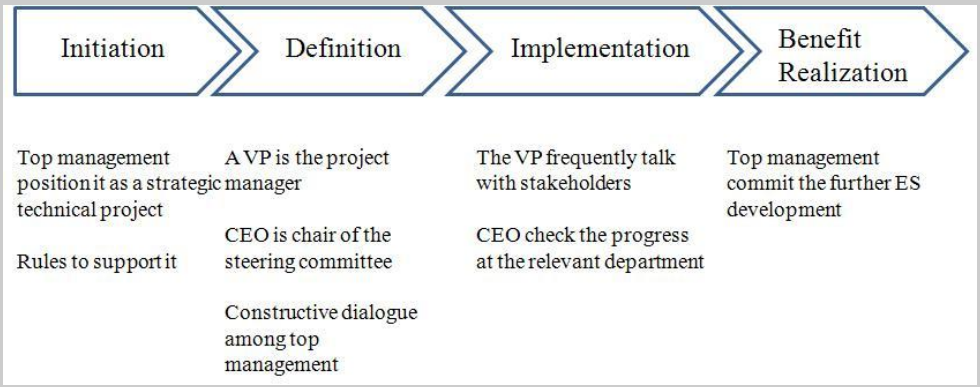
ESI outcome	A innovative environment of accepting ES is created
Context	The PDM project is strongly linked with the organization strategy. There are shared understanding among top management members that the project must be finished successfully.
Potential Pattern:	Combination of a one-way mandate and rules, two-way rationale communication and multi-process constructive significance communication along the project phases. Some compulsory rules are set at the early project phase. 

Table 36, the managerial process communicating the ESI significance at C7

Table 37 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C7.

	Initiation	Definition	Implementation	Benefit Realization
Communicating significance by top management	A clear message from CEO that PDM is part of C7's strategy A set of rules to encourage the new system usage.	Vice president is project manager and take the overall coordination tasks Best employees were recruited CEO as chair of the steering committee Organization wide campaign	Newsletter CEO regularly checked the progress Vice president frequently talks with line managers and end users.	Vice president commit to further deploy the system

Table 37, the observable artefacts of the managerial process communicating the ESI significance at C7

4.8. C8: learning from a failed ESI

C8 is a state-owned cosmetic company with more than 1200 employees, and ranks among the top five cosmetic enterprises in China market. According to the figures published by the State Statistical Bureau in 1997, the sales volume of C8 cosmetics produced ranks No.1 in the China skin care market. There are 157 sale agencies in 27 provinces.

In the cosmetic field in China, C8 is very famous for its high quality products, the assortments of its products are complete and the quality is excellent. Some of its products have won the national and international medals several times.

C8 has a failed ERP implementation experience in 1998 and 1999. They wrote to court and succeeded in asking for a pay-off at the end of 2000. C8 learned a lot from this failed experience. The project manager contributed the implementation failure to following three reasons:

> *"First, the* translation *is not good as (1) the manual is still in English; (2) online help is in English; (3) error information is in English. Second, some formats are not consistent with Chinese usage habit, e.g. -1 vs. 1- etc. Third, the implementation team is a junior, cannot support us."*

The second ERP implementation started in May 2001. The project manager was the finance department manager, and was now assigned as director of a newly established IT department. He had a clear understanding of internal business operation and the impact of the ERP system, as he was involved in several IT implementation projects in other companies before he returned to C8. End users trusted the project manager as he designed the first internal information system for C8 ten years before.

The project manager was very cautious due to the experience from the previous project. He did a careful study about potential software vendors and he also asked software vendors to install demo versions and did testing on the software.

He also organized the representatives from functional departments to attend software demonstrations and evaluate its usefulness for their business. He told us:

> *"It is reported that some companies spend one year to select the software, I think it is worthwhile, a careful and wise selection is good start point and reduce much potential risks"*

He also tried to acquire strong top management commitment. He said:

> *"I told top management board that I can only promise 50% success, and I need their support"*

The CEO acted as chair of the steering committee and launched an organizational wide newsletter to show its strategic importance at the early phase. The project manager signed certain internal contract and rules with the CEO before the official kick off, in order to obtain the continual commitment from top management. He told us:

> *"I told the top management before the ERP implementation. He has to personally coordinate the cross-departments conflicts if I cannot solve it. I can propose the best solution for it, but he must do it… Later at the implementation phase, he helps me to solve one conflict between departments"*

The legal unit of C8 and several line manager representatives were asked to be involved in the negotiation process with the software vendor. The project manager hoped that the line managers and the vendor knew their responsibilities. Two million Yuan was allocated for this project: one million for the software, 0.3 million for servers and 0.75 Million for computers. The IT department lead the project with support from the affected functional department.

The project manager and the project team frequently went to each involved department to learn the business processes and asked about the end users' and line managers' requirement and expectations. The software vendor also organized several training courses to the project team. The project manager coordinated the user requirement analysis and software capacity analysis process.

He believed that the key of an ERP project is to find the acceptable balance points between system processes embedded in the ERP software and the organization's existing business processes. He told us:

> *"The software is based on certain ideal situation. C8 has been keeping market leading position in China for some many years. We have many unique advantages. Hence, completely transform the organization into the idea situation system required is not impossible. On the contrary, it is not possible to customize the system completely as well. Hence, I think it is very important to combine these two aspects, and finally the software can be operated."*

The project team analyzed existing business processes and the specific expectations of relevant departments. Then they developed prototypes for the new business processes, and conducted experiments using real business data. After that, they contacted the business department again to exchange ideas on whether and how they should adjust to finalize the processes.

A step-by-step implementation strategy was used, which meant implementing each of the 10 ERP modules one by one. The project manager organized several meetings among the affected department managers, and aimed to achieve the shared understanding on some cross-functional business processes. He said:

> *"I collect requirements from the affected departments, and then I combine these opinions and make a reasonable* compromise *proposal based on my knowledge, and organize meetings with the line managers to discuss it and make the decision about it."*

End users were also inquired about their feelings about the new system and their specific expectations of the project team members. One project team member told us:

> *"It is very important to make the new process convenient for end users in the long run. Otherwise, they will create inconvenience for us in the future."*

The project manager believed communication and coordination are vital for the successful implementation. He introduced his experience:

> *"We are peer colleagues. I cannot force them to obey me, or directly ask the top management's support without well communication before hand. Otherwise, no people are willing to cooperate with you!"*

Occasionally, top management was asked to solve departments' conflicts if the project manager thought it was necessary. He would then present a report to the top management to introduce current situation, and his proposals regarding it.

Though the implementation approach was adjusted with lessons learned from the previous implementation, the project manager still found the second implementation annoying. He told us:

> *"We found a new software vendor who is willing to customize the software to the large extent. But still two things sometimes drive me into crazy: first are conflicts between departments; second is that the software could not deliver what I expected."*

The project manager believed that top management support should be stronger to make things better. He explained it to us:

> *"Top management support is ok for me. But if they can be a little bit more decisive. We can implement some other modules this time. One line managers strongly reject our project, hence, the implementation of two modules were cancelled this time."*

Despite the challenges the project team faced, the project team succeeded in implementing the new system within 12 months, and 10 ERP modules were implemented. Top management was considering doing a second round of implementations for other four modules when we did interviews.

4.8.1 The managerial process facilitating the ESI learning

Table 38 summarizes the managerial process facilitate the learning of ESI at C8.

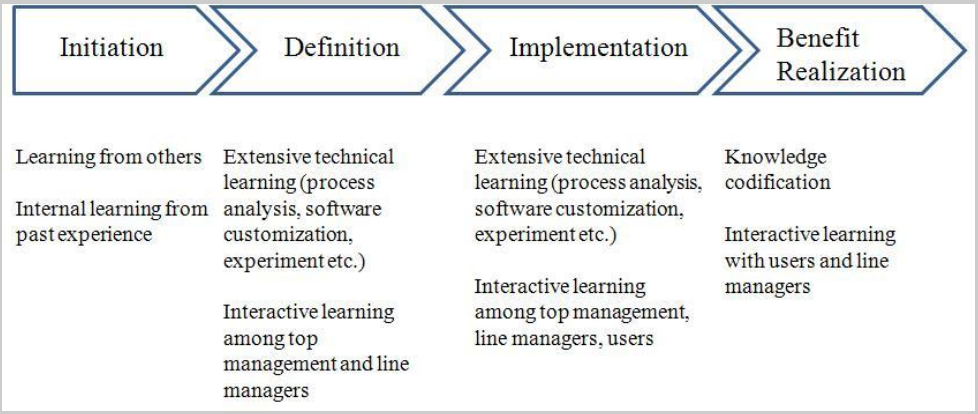
ESI outcome	10 modules were implemented within the budget and timeline.
Context	C8 experienced a failed ERP implementation between 1998 and 2000. With the experience gained from it, the project manager changed the implementation strategy for the new ERP project, which was verified as appropriate for C8.
Potential pattern:	Balanced learning activities for both technical uncertainty reduction and ambiguity reduction along all project phases 

Table 38, the managerial process facilitating the ESI learning at C8

Table 39 shows the observable artefacts of the managerial process facilitating the ESI learning at C8.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Internal learning (previous experience) Learn from the potential vendors	Learn from others (the vendor) Formal training, Formal internal learning (Process analysis, experiment, knowledge codification) Informal internal learning (project	Formal Internal learning (experiment, user input) Formal training to end users Informal internal learning: personal coach to end users Learning from others (discuss	Formal and informal: coach end users and line managers

		team)	with the vendor)	
(Organizational) Ambiguity Reduction	Interactive learning (project manager, top management and line managers)	Interactive learning: (top management and line managers) Mission statement (newsletter)	Interactive learning meetings (un)scheduled with line managers Personal dialogue with line managers	Interactive learning meetings and personal dialogue with end users and line managers

Table 39, the observable artefacts of the managerial process facilitating the ESI learning at C8

4.8.2 The managerial process communicating the ESI significance

Table 40 summarizes the managerial process communicating the ESI significance at C8.

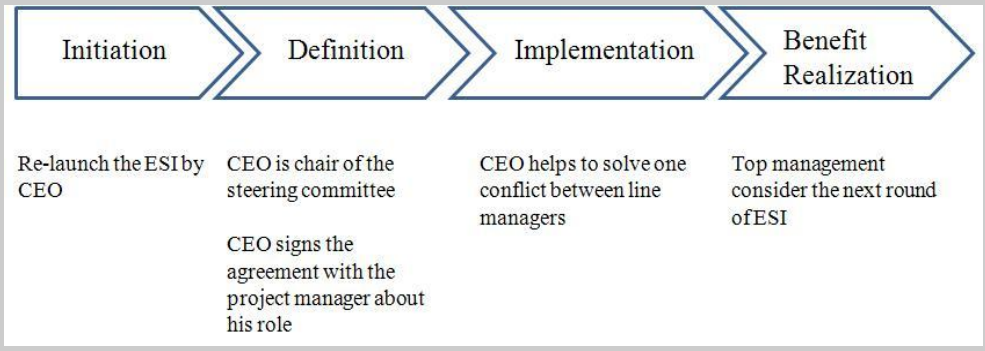
ESI outcome	10 modules are implementation and C8 consider the second round of the implementation
Context	The top management support the ESI implementation. The EIS is aligned with the business strategy. One top management member act as the project supervisor. The top management signed the agreement about their supposed contribution to the ESI project with the project manager.
Potential pattern:	Mix of one-way mandate and rules, two-way rationale communication and multi-process constructive significance communication along the project phases. Some compulsory rules are set at the early project phases. 

Table 40, the managerial process communicating the ESI significance at C8

Top management commitment was cleverly acquired due to the techniques used by the project management at the implementation phase. Four other modules were left for the next

round of ERP implementation because it would have been pre-mature to implement it at that time. The project manager contributed some of these delay as: (1) it is still too pre-mature to implement it, (2) strong resistance from certain line managers, (3) top management commitment was still not strong enough.

Table 41 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C8.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	Re-launch the new ERP project by CEO to show its importance	CEO as chair of the steering committee CEO signed the internal contract with the project manager about CEO's supposed responsibilities Newsletter	CEO directly solve a conflict between departments	Top management consider the second round of the ERP implementation

Table 41, the observable artefacts of the managerial process communicating the ESI significance by top management at C8

4.9. C9: learning from successful ESI

C9 is China's leading developer of broadcast-quality digital solutions for video editing, archiving and networking. C9 is a young high-tech company, which has the organizational culture remarked by the software vendor as *"eager to explore new innovative ideas"*. It is the most recognized professional manufacturer of broadcasting products and services in China, with 400 employees. C9 has sponsored the Asian Sport Game in 1990 using its broadcast products. The company is based in Beijing with additional R&D centres in Shanghai and Tianjin. International sales and marketing headquarters are located in Hong Kong.

C9 decided to enter into the international market based on its success in China. The diversified customization requirement cannot be met by current information processing system. It is urgent to implement an ERP system to meet the customer demand.

C9 had a successful ERP implementation in 2001 with an older software version. The studied ERP implementation was the second step of its long-term ES plan. The first implementation did not connect the finance department with other departments, which was the key challenge of the second ERP implementation. Moreover, the first implementation was started from scratch, no organizational routines changes were needed, since no systematic routine existed before that. On the contrary, the second implementation challenged their working habits established since the last three years.

C9 decided to use XX ERP software in March 2003 because the vendor´s good electronic industry experience. The implementation was planned for 3 months with one additional month for process analysis of both the ERP software and existing organizational processes. It took 4.5 months to finally finish this stage of implementation, which included business information warehouse, material management, and production planning and sales modules.

The ERP implementation was initiated by a senior manager from the finance department, and later, he was assigned as the project manager since he had working experience with three different departments and knew the organizational process quite well.

He told us:

> *"I am one of the project initiator. At one manager meeting, some people raised certain existing organizational problems, e.g. too many accountants… then I propose to consider buy software to solve them… CEO and CFO also participate this meeting and they thought it was a good idea."*

The project was co-led by the CFO and the production planning manager, and the CEO act as chair of the steering committee. The ERP project had a strong business rationale as pointed out by the CFO:

> *"First, there is an increasing customisation demand from our customers. It will create huge negative impact to later production process if there is no effective system to support it; second is that we need clearly know the numbers of inventory and information flow to support define specific performance evaluation metrics for each department."*

Once the core project team was set up, an experienced professional who had been working at the vendor was hired for the project team. Together with the CEO and the CFO, the project team decided to adopt the one-by-one implementation strategy. He told us:

> *"After discussion with top management, we think it is better to use a stage-implementation strategy to do it in such a short time. CEO and CFO know which part should be done immediately, and which should be changed in the future and which we should keep it…we need to satisfy our real requirement, but not think it from sky"*

First the project team focused on learning the functionalities and process offered by the software and considered how to best match the software with the existing organizational business requirements.

The project manager also designed certain mechanisms to help the top management to learn the business impact of the ERP project.

The project manager drafted several reports to top management and showed the potential conflicts between the new system and the existing organizational rules and policies. He directly asked the top management commitment at this phase. He told us:

> *"After analysis of the processes and the new system, we draft a report to CEO and CFO to inform them these are potential organizational change needed. If they agree, please sign it now, otherwise, we do no implement these processes."*

With the reports, top management had several meetings with stakeholders to communicate and inform them of the potential changes they must confront. The CFO told us:

> *"I have meetings with line managers. I told them there probably some changes to several departments. They should consider from the perspective of the whole organization. Top management will allocate new resources to some of them if it is really needed."*

End users were invited to participate in the analysis process to facilitate the shared organizational understanding on the project mission. Top management and the project manager believed that end users´ involvement is for the project. The CFO understood that the ERP market in China was still at the early development phase. Hence, the software must be customized to meet specific requirements. C9 can be a good strategic partner with XX software vendor and XX can take the opportunities to further develop the ERP software. She said:

> *"The software must be further developed with input from practical usage. For example, programmers maybe only concern about the operational of*

> *certain functions. But to end users, it is different, and they care more about the convenience of the software. They prefer to click one button, but not three buttons for one function because they will click hundreds of times per day"*

The project team member spent days and nights staying with end users and coached them on how to use the new system. The detailed operational manual was also developed to support end users' learning.

The project team had a lot of personal conversations with end users and line managers to communicate the project mission. End users also understood the strategic meaning of the new ERP system to C9, and some of them even volunteered to learn it in the weekends. One project team member told us:

> *"I do not think it is relevant with education level people have, it is relevant with organizational culture. Some old woman never used computer before the implementation, but they still master it quite well. One operator who is more than 60s and in charge of one inventory asked me that whether I could coach her on Saturday."*

There were still a number of line managers showing strong resistance during the implementation process. Direct involvement of the top management helped solve most of these conflicts, but some of them still could not be solved within the short time and are left until the next implementation. The project manager gave us one example:

> "*The business department* manager *strongly refuses the new processes proposed by us. It was very flexible for them to deal with customers before the implementation. Now the new system recognize them as only a functional department and asked them directly connect each of deals with our central financial system. They refused to do it. We did not have concrete results even after top management meetings. So we leave it for the next implementation"*

There were also some continual efforts with technological issues. With the concerted organizational effort, the ERP implementation was finished almost on time (15 days after the deadline). The project manager told us:

> *"The software can not satisfy all the expectations. 80% is ok, and means a good software"*

A new ERP implementation plan was considered by top management, and a strategic unit was established to conduct this long term implementation mission. The CFO told us:

> *"It takes time; we were* considering *the next steps to extract valuable information from the data collected in the new system."*

Finally, around 15% of the software was customized to meet specific user requirement. Top management of C9 were planning the next 3 months implementation stage, which would extract more intelligent information from the implementation project. The CFO told us:

> *"We still have a lot of tasks to do at next steps. Now the data is collected in the new system. We still need to consider how to analyse, summarize these data to make it more valuable to us."*

4.9.1 The managerial process facilitating the ESI learning

Table 42 summarizes the managerial process facilitating the ESI learning at C9.

ESI outcome	Successful implementation with 15 days delay. The plan for the next ESI project is an additional outcome.
Context	C9 has a successful smaller ERP implementation experience two years ago. The whole organization is well communicated about the strategic importance of the new ERP system. With the gained experience, business managers take the leadership of the project and end users are actively involved in the development process.
Potential Pattern:	Balanced learning activities for both technical uncertainty reduction and ambiguity reduction along all project phases

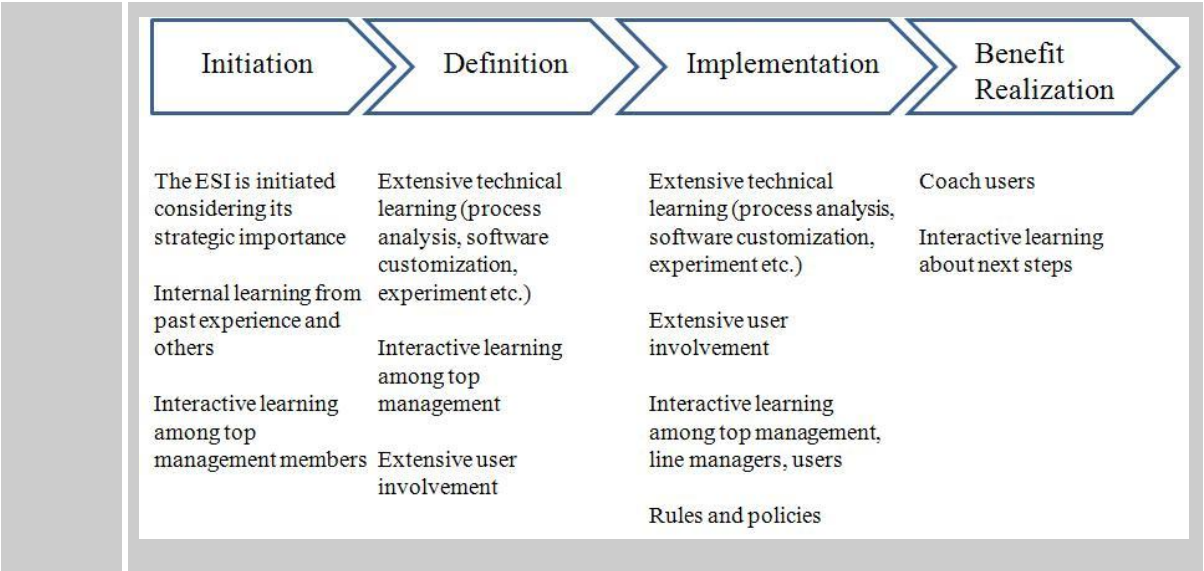


Table 42, the managerial process facilitating the ESI learning at C9

Table 43 shows the observable artefacts of the managerial process facilitating the ESI learning at C9.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learning from other companies and the vendors	Learn from others (the vendor, the consultant) Formal training, Formal internal learning (Process analysis, experiment, knowledge codification with strong user participation) Informal internal learning (project team)	Formal Internal learning (experiment, user manual) Formal training to end users , with active user participation Informal internal learning: personal coach to end users Learning from others (discuss with the vendor)	Formal and informal: coach end users and line managers

(Organizational) Ambiguity Reduction	Interactive learning (CEO, CFO and management board members)	Interactive learning: (CEO, CFO and project team) Mission statement (newsletter, workshop)	Interactive learning meetings (un)scheduled with line managers and users Personal dialogue with line managers and end users Rules and Policies	Interactive learning meetings about next steps

Table 43, the observable artefacts of the managerial process facilitating the ESI learning at C9

4.9.2 The managerial process communicating the ESI significance

Table 44 summarizes the managerial process communicating the ESI significance at C9.

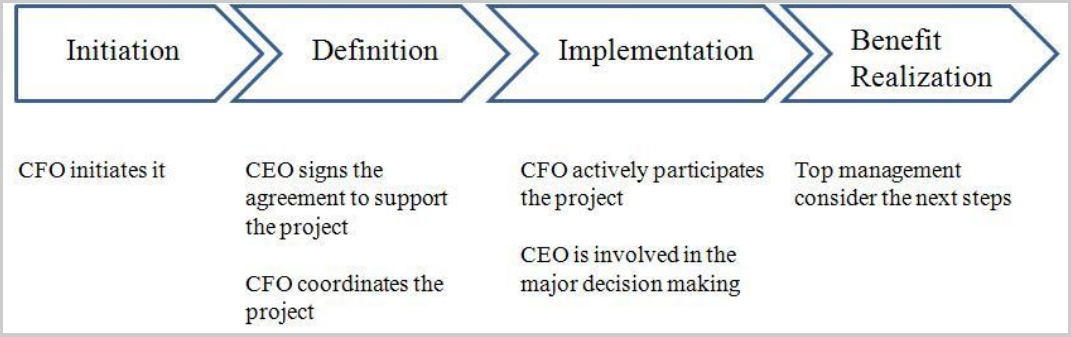
ESI outcome	Successful implementation with 15 days delay. There is a plan for the next steps of ESI.
Context	The ERP project was initiated by one senior manager of the finance department at managerial board meeting. The CEO and CFO were attracted by it as its potential capability to support the organizational strategy. They had several meetings to define the basic tune of the ERP initiative. The project initiator was asked to do the pre-study with the support of the production planning department manager. The project manager succeeded in signing the internal contract about delimiting the responsibilities of the CEO and CFO in the coming implementation process.
Potential pattern:	Mix of one way mandate and rules, two way rationale communications and multi-process constructive significance communication along the project phases. 

Table 44, the managerial process communicating the ESI significance at C9

Table 45 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C9.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	Initiated by CFO Set up the project team headed by CFO	CEO signed the internal rules with the project managers to commit certain responsibilities Organizational wide workshop for the project kick off CFO coordinate the implementation strategy Newsletter	CFO actively participate the operational tasks CEO review the report and participate the major decision making and coordination meetings	Ask the project team consider next steps

Table 45, the observable artefacts of the managerial process communicating the ESI significance at C9

During the implementation phase, the CFO helped the project team to extensively mobilize end users and line managers to actively contribute to the project, and helped them understand the project's urgency and strategic importance. On the other hand, she insistently asked the project team to try their best to absorb end users' requirement. If it was not possible at current phase, and so she asked the vendor to consider it in the next software version, asking the project team to communicate with end users to find ways to satisfy their requirements. She also coordinated with line managers to show the confidence to the project from the top management's perspective, and listened to specific difficulties from them. If it was really difficult for certain departments, the related implementation was postponed to the future implementation plan.

The project manager told us:

> *"It is not unrealistic to implement 100% planned modules. Top management should have the capabilities to decide which part must be implemented now, and which part can be postponed to next implementation."*

To support data input tasks in the implementation process, the CEO and CFO mobilized the whole organization to spend four days to calculate the business operational status and cleaned up data used for the new system. One strategic unit was established to plan and implement strategic information system projects for C9 in the future. The top management showed strong commitment for further information system implementations.

4.10. C10: well prepare for a successful ESI

C10 is a medium sized state-owned high-tech company with more than 100 employees, designing and manufacturing electronic and communication equipments for the local and international market, e.g. mobile telecommunication equipment, tax payment control system etc. C10 has certain production development capabilities and possess good production line equipment because of its aerospace manufacturing background. The production is characterized by having short product development life-cycle (within one week) and with production-on-order. The production process is a simple workflow with less than 10 working tasks involved.

C10 must explore its own way in order to survive in both international and local markets due to the new government policy on small state-owned enterprises active since 1998. Relying on its well-known electronic equipment production line, C10 has succeeded in building up the reliable partnership with several international customers to provide electronic components. C10 is also required to update its internal operational management system to keep up with large customers' strategic development change.

The CEO of C10 began to investigate the feasibility of implementing an ERP system since 1999.

Then, in early 2000, one large international customer required an ERP system as one of the pre-requisites to be a tier one supplier. Hence, C10 officially launched the feasibility study for an ERP system in April 2000. C10 spent six months to select an appropriate software vendor who has strong experience with implementations for the electronic industry.

Half a year of extensive pre-studying about ERP implementation helped managers of HX become equipped with a shared understanding on the necessity and impact of an ERP system.

The CEO led the learning activities at this stage because of both its strategic importance and his personal interest.

At the end of this phase, one ERP software vendor was selected. The CEO told us the reasons why:

> "*First, the software* vendor *has the electronic industry implementation experience. Second, we visited two of its customers who has similar requirement with us, they both implemented it successfully; third, BNT helps us to evaluate the software, and his evaluation report confirm its applicability to C10; Fourth, they promised to customize the software for our specific requirement."*

Then the software vendor provided two training courses for top management and line managers for two reasons. First it served to help them to understand what ERP is and second, to allow them to collect their business requirements. The CEO also led some communication activities to line managers and end users about the strategic importance. The project manager told us:

> *"The whole organization* has *the shared understanding that the ERP implementation is vital to us after several rounds of communication activities led by CEO"*

A cross-functional team was set up. The CEO acted as chair of the steering committee, and the manager of plan & financial department was assigned as the project manager who is the responsible for coordinating with stakeholders. One best performing IT employee was asked to support her for operational tasks. There were eight task teams, each with 1-2 employees and led by relevant department managers.

Figure 16 shows the project organization.

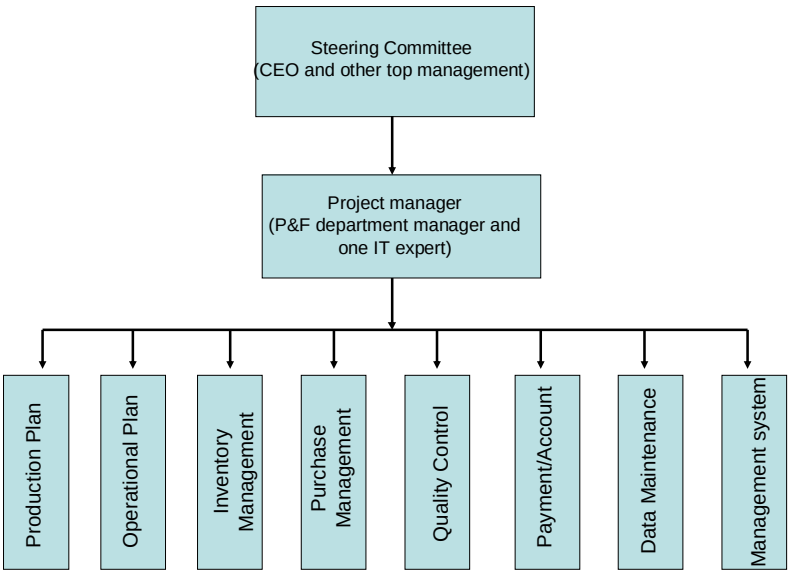


Figure 16, the project organization of C10

After the selection of the members of the project team, the second round training sessions were conducted at all organizational levels, including: top management, line managers and end users. One experiment lab was set up to for the testing of the customized software. Together with end users, the project team collected the user requirements and propose a customization report to the software vendor.

The entire organization shared an understanding towards the strategic urgency of the ERP implementation. The CEO told us:

> *"We did a lot of work* before *the implementation started. All the top management and line managers understood the project urgency quite well before the implementation. My only concern is about whether end users are able to accept it quickly or not"*

At the end of this phase, the customized version of the software was installed at the experimental lab. 50% of the software was customized to meet specific usage requirements.

Prior to the official implementation, the project team, together with end users, tested the software, and to make sure there were no problems. One end user from production planning department told us:

> *"The project team is* very *good. They tested it before use it in the formal operational lines. Some of us participated in the test process"*

The eight modules were implemented step-by-step. Due to the intensive effort made during the early phases, there was not much organizational resistance that occurred at this phase. End users continued to actively stay involved in the implementation process, and contributed their requirements to the project team and the software vendor. One user from inventory department told us:

> *"We could not raise* some *questions before we used it. Hence, I raised several concerns when it was implemented"*

The software vendor and the project team also actively reacted to these requirements. Most of them were solved during the implementation process. The project team members coached end users one by one, to make sure that the new system was implemented optimally. The CEO also frequently talked with the project team and supports the enactment of a set of organizational rules to institutionalise the new system usage. End users were organized together by the project team to discuss the new processes and relevant responsibilities, thus, to have a holistic understanding about the whole system and their operational impact on others.

The ERP project was implemented even one month earlier than the original plan. Communication with end users and stakeholders were not stopped after the implementation. There are three main concerns summarized after certain a period of usage. The CEO told us:

> *"First is data statistics function, second is that user interfaces are still too complex; third is the flexibility"*

In early 2002, three additional modules were added to the ERP system as a response to a single dominant customer's requirement to change from production by order operational model to production by prediction model.

4.10.1 The managerial process facilitating the ESI learning

Table 46 summarizes the managerial process facilitating the ESI learning at C10.

ESI outcome	The ESI was finished one month early than the original plan
Context	C10 must implement an ERP system to become a tier one supplier for an international corporation. The CEO has been interested in performance improvement enabled by an ES for a long time. Detailed organization preparation work is done before implementing an ERP system.

Potential pattern:	Balanced learning activities for both technical uncertainty reduction and ambiguity reduction along all project phases

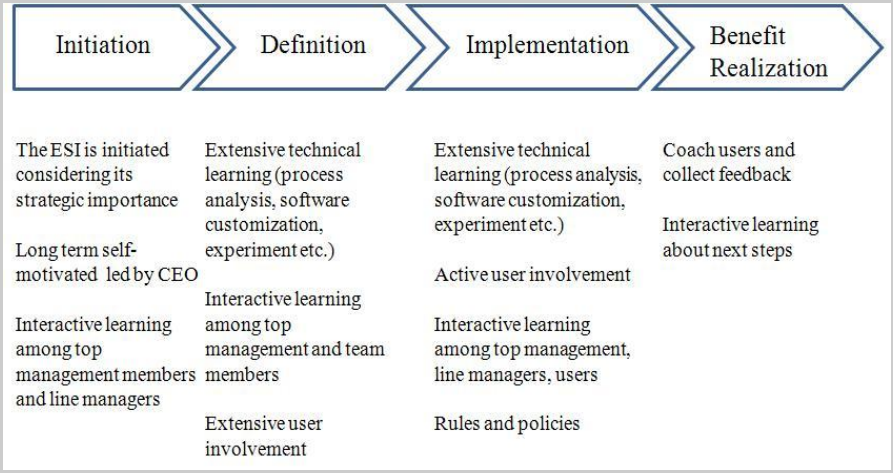


Table 46, the managerial process facilitating the ESI learning at C10

Table 47 shows the observable artefacts of the managerial process facilitating the ESI learning at C10.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
(Technical) Uncertainty Reduction	Learning from other companies and the vendors Internal learning (CEO and plan& financial department manager)	Learn from others (potential vendors) Formal training (vendor to top management and line managers and end users) Formal internal learning (Process analysis, experiment, knowledge codification) with strong user participation	Formal Internal learning (experiment, user manual) Formal training to end users , with active user participation Informal internal learning: personal coach to end users Learning from others (the vendor)	Formal and informal learning: coach end users and line managers, collect user feedback

(Organizational) Ambiguity Reduction	Interactive learning (CEO, top management and key line managers)	Interactive learning: (CEO, and other top management and project manager) Mission statement (newsletter)	Interactive learning meetings (top management, line managers and end users) Rules and Policies	Interactive learning meetings about next steps

Table 47, the observable artefacts of the managerial process facilitating the ESI learning at C10

4.10.2 The managerial process communicating the ESI significance

Table 48 summarizes the managerial process communicating the ESI significance at C10.

ESI outcome	Successful implementation of the ERP system in time within budget. Follow up improvement as well is done.
Context	C10 must implement an ERP system to become a tier one supplier for a international corporation. The CEO has been interested in performance improvement enabled by an ES for a long time. Detailed organization preparation work be done before implementing an ERP system.
Potential pattern:	Mix of one-way mandate and rules, two-way rationale communication and multi-process constructive significance communication along the project phases. 

Table 48, the managerial process communicating the ESI significance at C10

Table 49 shows the observable artefacts of the managerial process communicating the ESI significance by top management at C10.

	Initiation	**Definition**	**Implementation**	**Benefit Realization**
Communicating significance by top management	Initiated by CEO CEO lead the feasibility study	Training to top management Top management meetings CEO lead the communication to line managers and end users CEO participate in defining the implementation approach Newsletter	CEO actively participate in project operation and decision making CEO review the report and participate the major decision making and coordination meetings	CEO collect user feedbacks and consider next steps

Table 49, the managerial process communicating the ESI significance at C10

Top management actively lead the ERP implementation project. The CEO's strong communication activities helped the whole organization understand the business meaning of the ERP project.

With the long-term continual effort made by the CEO, C10 was ready for the new ERP implementation. The CEO spent a long time on strategic planning and preparation for the new ERP project. Due to the strong strategic alignment and well-designed learning activities, the whole organization understood the business meaning of the new ERP system. Hence, it is not surprise that even end users could tell us it is important to know the overall relevant business processes, and how their task has an impact on the tasks of others. As a consequence of the good organizational preparation and understanding, we can understand why C10 successfully implemented the other three modules that were not in the original ERP software package, which were also developed from scratch.

5. CROSS-CASE ANALYSIS: THE PATTERNS OF ESI

5.1. The patterns of managerial process to facilitate learning of ESI

All studied case firms execute managerial processes to facilitate the organizational learning for ESI. While they are expected to be used to reduce the technical complexity and foster the organizational acceptance, several patterns are identified among these companies, which can explain the similarities and difference of ESI outcome.

The pattern identification process is an iterative analytical process. Firstly each case is analyzed and illustrated using the designed pattern template. The managerial techniques of each case are classified and clustered along the phases of the pattern template, and based on the theoretical constructs defined in Chapter 3. Then comparisons among the individual cases are done to extract the emergent patterns. During the process, there is constantly back-and-forth between theory and data –iterating towards resultant process patterns that closely fit the data. Thirdly, the meta-theory (structuration theory) is used to explain the patterns to be logically coherent. In the next sub-sections, these patterns are described.

5.1.1 Pattern 1: Unguided Missile

Name	**Unguided Missile**
Context	The ESI projects are positioned as traditional technical projects. Top management are convinced by the technical competence brought in. Hence, these projects are started in a hurry considering the perspective of understanding business and organizational impact. As a consequence of the project position, there is little resource for business and organizational impact oriented learning. The projects are managed by technicians, typically from IT department, not much strong commitment from others. There is no interactive learning occasions created for the top management in order to have a shared understanding.
Pattern:	Organizational efforts facilitating the ESI learning are focused on filling out the technical knowledge gap. Little learning activities are executed for achieving shared organizational understanding and acquiring stakeholders' buy-in along the project phases. Even if they realize the importance of organization impact learning, they are incapable of adapting the project plan or mobilize the organizational resources for it

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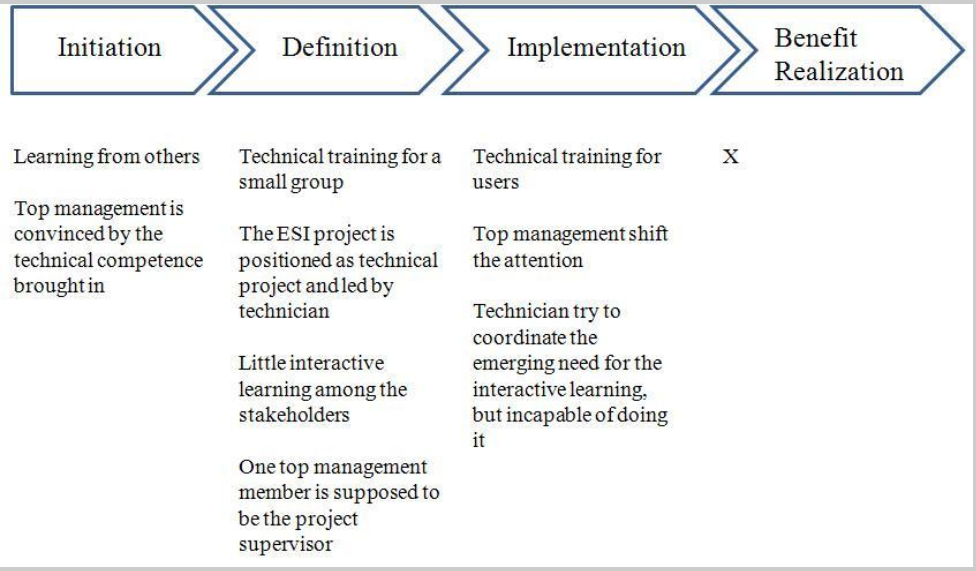
<tr><td></td><td> 
</td></tr>
<tr><td>Consequence</td><td>The ESI shoots at no target and are lost like an uncontrolled missile.</td></tr>
<tr><td>Examples</td><td>C1, C2, C4</td></tr>
<tr><td>Related Patterns</td><td>Pattern 2: learning harvesting technological innovation

Pattern 3: mindful transformation</td></tr>
</table>

Table 50, Unguided Missile

These technology oriented learning activities are led by certain technology departments, and these learning activities can be smoothly deployed during early project phases, e.g. initiation and definition phases. However, they did not make progress at the implementation phase. The typical outcome of this pattern is project failure.

C1, C2 and C4 are the members of this pattern group. These ESI projects were initiated as technical projects. Assumed success factors by these companies were: quickly mastering the new system, installing the system in a short time, and automating the relevant organizational processes using it. For example, the ERP project at C2 was planned to be finished within three months with little organizational change consideration. In fact the project lingered around for 14 months without any progress. Similarly, a project team member of C1 told us:

> *"We are very confident with the project as we have gained successful technical competence from the previous MIS project. We think we can successfully implement it"*

The result is that the ERP project of C1was stopped for more than half a year without any indication when it would be re-started. The project team of C4 proposed many recommendations to top management, but almost all of them were not considered and adopted. The project manager from the software vendor told us:

> *"I proposed several new processes to them and did a lot of communication with them. But I do not know where these reports are stored. They do not at all adopt our proposals despite the fact that they admit these proposals are better than those existing"*

Few managerial efforts are deployed to achieve the shared organization understanding. While top management routinely acts as chairs of the steering committees, as their presence is needed for a complex cross-functional technical project. There is no learning occasions created to facilitate the shared business impact understanding among top management members. Meanwhile, top management does not clearly know how to support the projects. It is visible in these cases that top management commitment disappeared soon after the project definition phase.

5.1.2 Pattern 2: Learning harvesting technological innovation

Name	Learning harvesting technological innovation
Context	Typically companies possess strong technical expertise, while they lack the organizational change experience. These ESI projects are regarded as technological innovation project. The projects typically managed by a member of management board considering the technical complexity. Hence, they ignored the consideration of organizational receptiveness at an early project phase, and thought that the only task is to solve the technical challenges. Later in the implementation phase, they realized the necessity of the organizational impact learning. With the strong involvement of the technical director and their visible powerful position in such technical corporations, the ESI project are re-positioned and

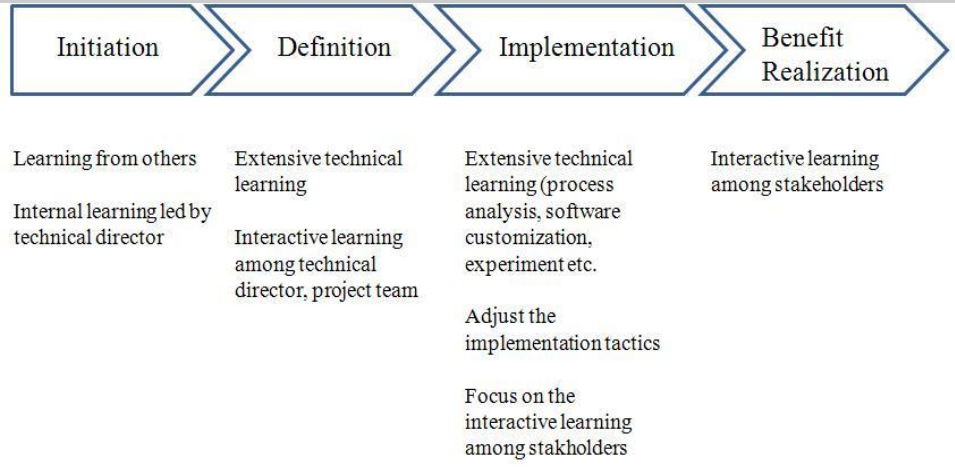
	organizational resources are re-allocated to solve the organizational challenges. But it takes longer time to re-divert the project path.
Pattern:	Technical complexity reduction oriented learning activities are evenly deployed along project phases; and before the implementation phase, there is insufficient learning efforts facilitating organizational understanding, and extensive organizational ambiguity reduction oriented learning activities at the implementation and later project phases 
Consequence	The ES projects are postponed to some extent, but achieve the expectation
Examples	C5, C6
Related Patterns	Pattern 1: Unguided missile Pattern 3: mindful transformation

Table 51, Learning harvesting technological innovation

The typical outcome of this group is that projects are finished, but exceeds the original budget and deadline. C5 and C6 can be classified into this group. In these two cases, the CTOs directly lead the project operation. Top management at these case firms admits the technical challenges for an ESI. The CTO of C6 told us:

> *"Implementing ERP at aircraft companies is an unprecedented challenge, at least to Chinese companies as no one did it before and aircraft products are as complex as no existing ERP product can satisfy the requirement completely."*

In order to accomplish an ESI, it is necessary to solve these technical challenges. It is unrealistic to solve all technical issues during the early phases. Managers must be ready to

solve emerging issues, and if needed, external resources and knowledge must be obtained to guarantee the project progress. The CTO of C5 told us:

> *"There are always issues emerging out of the project progress which cannot rely on the software vendor. We must develop the capabilities to deal with these challenges."*

Best performers from the relevant functional departments at C5 are recruited onto the project team. One core team member told us:

> *"It is vital for such enterprise system implementation to be leaded by the business departments, not by IT department. It shows the determination of C5 to put more than 20 best performers from business departments into the project team."*

Without effective learning techniques distributed along the entire project life cycle, it is impossible to finish the project from a technical perspective. The diversified learning techniques which include both internal knowledge creation and external knowledge acquisition are used to create the necessary knowledge base to cope with the technical complexity.

There is limited organizational effort towards facilitating the shared organizational understanding during the early project phases, which can be attributed to several reasons: (1) the technical complexity issues attract people's attention; (2) people including the project team and top management have no time to consider the other issues besides technical difficulties; (3) at large state-owned Chinese corporations top management believes their commitment is enough until the Definition phase; (4) at an early project stage, most of the stakeholders keep an observant attitude towards the project. It creates an illusion that organizational commitment is good and the project can be operated as planned.

The fact is that strong organizational resistance emerges with the progress of the ESI projects, especially when it begins to change and/or touch some key stakeholders' power base. Stakeholders gradually understand its impact to their work routines. Some of them adopt either a strong resistance or passive cooperation attitudes toward the project team; and some of them are out of the control scope of the CTO. The CTO needed to make additional effort to communicate and coordinate with them.

Luckily, the projects have high **strategic priorities** at C5 and C6 and the CTOs had strong positions on the management board. The CTOs have the opportunity to coordinate with the

CEOs and other top management members. Coordination of acquiring organizational commitment cost additional time and effort. The CTO of C6 said:

> *"Such coordination needs time. We have a top management steering committee meeting every two months. At that time, I can present some unsolved issues to them and we made decisions about them"*

Some rules and policies came out of these top management meetings and were communicated to organizational stakeholders. Careful sustained communication is needed for the whole organization to understand and absorb them. The CTO of C6 told us:

> *"It is difficult to solve issues of passive cooperation attitude, and some of them cannot be raised at the managerial board meetings as they do not refuse our project proposals."*

5.1.3 Pattern 3: Mindful transformation

Name	Mindful transformation
Context	The ESI projects are positioned as an instance to support organizational strategy. The projects typically are initiated by business merit and managed by them with support from IT departments. Top management keep eyes closely on the implementation project during the implementation process. Extensive interactive learning about business and organizational impact are organized at the early project phases. A shared organizational understanding is achieved at the early project phases. Some rules and policies are enacted as well to support the implementation.
Pattern:	Technical complexity reduction and ambiguity reduction learning techniques are well considered and evenly deployed along the entire project life-cycle.

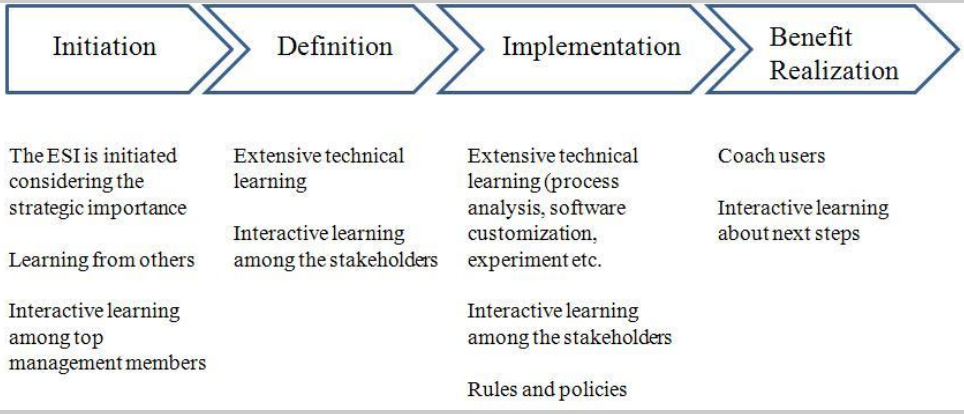
	
Consequence	The ES projects are finished almost in time within planned budget.
Examples	C7, C8, C9 and C10
Related Patterns	Pattern 1: unguided missile Pattern 2: learning harvesting technological innovation

Table 52: Mindful transformation

The typical project outcome of this pattern is that projects accomplish most of the expectations and (almost) within budget and planned deadline.

C7, C8, C9 and C10 can be labeled as the members of this pattern.

One of the similarities among these cases is that the ESI projects are defined as the business-driven projects that are lead by business department. Among these four cases, C7, C9 and C10 were directly lead by senior business managers, and C8 is lead by a senior manager who has a diversified business working experience, and supported by one top management member.

The other similarity among these cases is that all these project managers knew the business impact quite well and extensively communicated with key stakeholders about it before the implementation phase, especially with top management. Furthermore, the technical oriented learning was also well considered, and all of them remarked that the software cannot fully meet the business requirements. The project manager of C9 told us:

> *"Sometimes I am quite disappointed with the software as it cannot achieve what I am expecting"*

The project manager of C8 shared this opinion:

> *"There are two issues driving me despair. One of them is that the software cannot deliver what is expected. The other is conflicts among departments"*

These companies extensively negotiate with potential software vendors before making the official going decisions. C8 and C10 succeeded in convincing the software vendors to promise a high-level of customization service. C7 and C9 selected the well-known ES software vendors who have a good reputation in China. C8 experienced a failed ERP implementation before. The project manager invited the relevant line managers to evaluate the software. C7 and C10 adopted similar tactics when they selected a software vendor. As a consequence, some stakeholders of C7, C8 and C10 already knew the software and its business impact. C9 implemented a smaller scale ERP project two years ago, and this time, they decided to use the same software.

The careful selection of the software vendor decrease the workload of the project managers, as the project manager of C8 told us:

> *"I understand now why some experts claim that it is necessary to take half a year or one year to select a competent software vendor. It is worthwhile to do that"*

Despite these considerations before hand, there was still need for sustained technical oriented learning since new issues inevitably emerged that was not controllable. People's understanding about the technical complexity and organizational impacts were also changeable in the implementation process. Consequently, it was not possible to fully articulate clear and exhaustive user requirements during the early project phases. One end user told us:

> *"We cannot exhaustively raise our concern at the starting point. We need to try and operate it, and find the problems and then report to the project team"*

These project managers began to acquire key stakeholders' commitment from the early project phases. The project managers of C8 and C9 succeeded in conveying the message of the business importance to the top management. Before the official project kick-off meetings, they signed an internal agreement with some key stakeholders about the responsibilities, e.g. the CEO and CFO of C9 and the vice president and the CEO of C8. These push top management to understand the project's intention, its strategic meaning and its resource demands. The project manager of C8 told us:

> *"It is not wise to completely rely on top management involvement. Otherwise, the peer colleague will rebut with passive cooperation. Thus, we need to carefully balance these mechanisms"*

One of the top management members directly coordinated the operational tasks at C7 and C10. They openly coordinated the stakeholder's tasks.

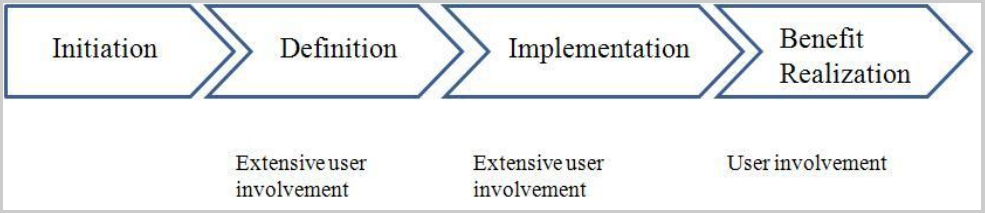
The vice president of C7 told us:

> *"I coordinate all the process related issues. I organize meetings with the affected line managers, and then we openly discuss how we should proceed."*

With the effort to acquire organizational buy-in, the stakeholders gradually accepted the ESI projects and even became advocators of the projects.

5.1.4 Pattern 4: User engagement ESI

A further investigating those cases that finish ESI (C5, C6, C7, C8, C9, C10), there are two other different patterns are found out when classified by the main target group who received the organizational learning opportunities.

Name	Use engagement ESI
Context	End users are mobilized to actively contribute to an ESI project. They are involved in the projects at the early project phases to help select the vendor, propose user requirement etc. Users` comments are well incorporated into the ESI project. They help to design the process and provide feedback to customize the system.
Pattern:	End user is the main target group of the managerial efforts for organizational learning. 
Consequence	The project achieved long term benefits besides the traditional project deliverables.

Examples	C5, C7, C9 and C10
Related Patterns	Pattern 5: User as passive receiver

Table 53: User engagement ESI

Within this pattern group, the ESI learning is especially designed to create channels to acquire end users' active involvement.

C7 created many end user targeted learning activities along the entire implementation life cycle, e.g. End users were asked to evaluate the software, and end users are extensively inquired about the new business processes etc. The ERP implementation strategy of C9 was to mobilize end users to actively co-design the new business processes. Organizational knowledge is best synergized to create 'best' new business processes. End users understand well the difficulties of implementing an ES. Hence, they can tolerate some temporary operational difficulties. The project team and top management exerted pressure towards the software vendor to solve these issues quickly in a newly updated version. End users of C10 were mobilized to actively contribute to the project development. The project team of C5 did not consider too much of end users' demands in the original project plan. Later, they reflected that it is unrealistic to implement a ESI without extensive inquiry of end users. Hence, they adjusted the project plan and created many learning occasions to facilitate end users' active participation into the ESI project.

These projects generate long term benefit besides the project deliverables. C7 creates an innovative organizational culture. They developed several organizational policies and standard working routines during the new ESI. C7 also developed a long-term development plan for the future ES adoption. C9 has established a strategic unit in charge of the next ESI plan after this project. C10 gained the capabilities to flexibly adjust their organizational processes to meet the customer's requirement.

5.1.5 Pattern 5: User as passive receiver

Name	User as passive receiver
Context	End users are mainly regarded as passive command receivers. Line managers and top management are considers to be the key stakeholders. End users are completely ignored, and their trainings are limited to mastering the operational tasks. Their contribution is not

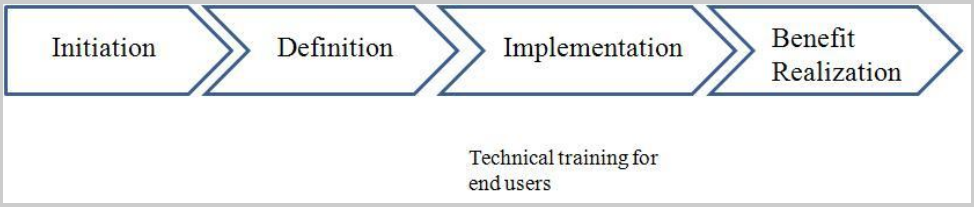
	appreciated.
Pattern:	Technical complexity reduction and ambiguity reduction learning are not concentrated on end users, but on other stakeholders (e.g. line managers and top management level). 
Consequence	The projects achieve no/little long-term benefits besides the traditional project deliverables
Examples	C6, C8
Related Patterns	Pattern 4: User engagement ESI

Table 54: User engagement ESI

C6 and C8 are the members of this pattern group. C6 achieved some of the project deliverables with more than a one year delay, and C8 had a failed project experience and then successfully deliver the implementation tasks on time for the second ERP implementation.

The project managers and sponsors from C6 and C8 both think that line manager and top management are the key stakeholders who impact the project outcome. Hence, the ambiguity oriented organizational learning are specially design to target line managers and some top management and end user are completely ignored in this sense, and their trainings are limited to mastering the operational tasks. In C6's case, each department sent one of their senior end users to join the project team.

The representative coordinated with the line managers about the department's requirement and so on. All the other end users only had the permission to touch and learn the new system after implemented. They could not raise any concerns from their own perspective. The CTO of C6 told us:

> *"It is not necessary for end users to know the organizational impact. They only need to learn how to use it afterwards."*

Similarly in C8's case, the project team proposed the new business processes regarding the new system and existing organizational processes. They did some investigation of user requirements. Then, the project team invited line managers to fix the new processes and then coach end users. End users were also regarded as passive receivers.

The direct consequence of lacking user driven learning has a two-fold meaning: (1) end users do not enhance their acceptance capabilities towards new ES through this project, and they only know it will change their working habits and it takes time to learn it and nothing more than that; (2) some end users are inclined to adopt passive attitudes or observant attitudes towards the project, and they are not willing to make effort on it until they see that it cannot be avoided.

The ESI projects had the possibility to go through with strong top management support and line manager buy-in. For example, the CEO of C6 informally checks the project progress, and took measures to force end users and line managers' acceptance. Two end users were fired due to their passive cooperation attitudes with the project team. However, once the attention from top management was distracted by other issues, the cooperation from end users and line managers quickly disappeared. One team member of C6 told us:

> *"During the implementation process, there is no big event attracting the top management's attention. Hence, end users begin to lose their attention and the failure rate of the basic data increase dramatically. We have to go back again and clean up the data. Now there are some indicators that the data will become worse again. If it is yes, it will fatally strike our confidence, and furthermore impact end users' acceptance."*

Without achieving real end users' buy in, end users could not contribute their knowledge to the project. The team members also do not have feel like the project was credible, and lost their confidence in participating for the future projects. One team member told us:

> *"Anyway I will leave C6 soon, it is very difficult to do such job again at C6 as it is so old and large state owned company."*

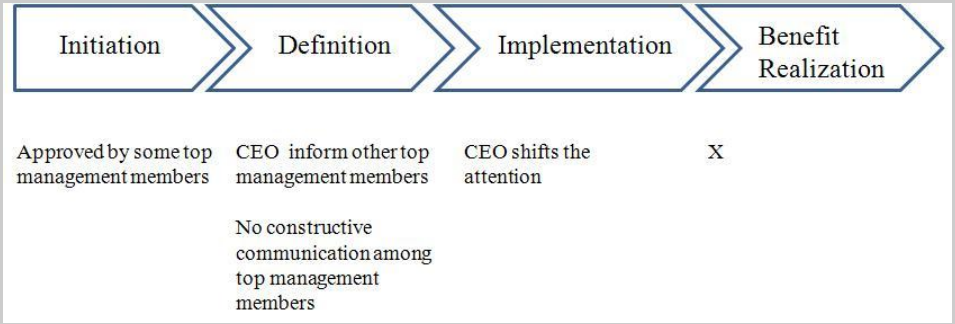
As a consequence, even if the project delivers its specific tasks, it did not change people's mindset concerning ESI. They still do not know the strategic importance of ESI projects for the company.

5.2. The managerial process communicating the ESI significance

Top management involvement in all cases proved to be important and it is not a surprise that two different patterns of communication occur depending on whether top management was operatively involved in communicating the significance for the project or not. In six cases, top management was directly involved, and in four cases it was not, e.g. the CEO of case firm C10, who initiated the ERP implementation project at his small high-tech company, believed in the strength of business rationale for the project:

> "*We have to use ERP to meet the specific requirement from our international customers, thus, I communicated with employees that we have to change, otherwise, we would lose the opportunity to be supplier to the customer*".

5.2.1 Pattern 6: Significance eclipse

Name	Significance eclipse
Context	The top management do not really involve into the project definition and operational phase. They approved the ESI project as a traditional technical project. Top management commitment disappear at the implementation phase There is no shared understanding among the top management members about the objective of the ESI either because the significance of the project is not communicated or because the importance of the communication is not realized.
Pattern:	The limited communication activities done by top management are mainly one way communication and occur during early project phases, e.g. initiation or definition phase, and stopped before/during the implementation phase. 
Consequence	The projects are stopped and cannot proceed

Examples	C1, C2 and C4
Related Patterns	Pattern 7: Significance re-orientation Pattern 8: embedded significance

Table 55: Significance eclipse

The typical project outcome of this pattern is that projects could not be finished on time, and were stopped. C1, C2 and C4 are the pattern members. The CIO (IT department leader) led the communication activities at case firm C1. They are not a member of top management and do not have access to the management board.

These projects are defined as complex technical project; hence, cross-functional project teams were set up during an early project phase. The similarity among these cases are: (1) only some of top management members showed commitment and interest in the projects, e.g. CEO of C1, vice president of C2, CEO of C3 and CEO of C4; there is not sufficient communication with other top management members, (2) the limited top management support is stayed until the definition stage. The project managers of these cases have a shared opinion about the support from top management. The project manager of C2 summarized it as:

> *"They are leaders of a large state owned company. They get used to pay attention to only two points of a project: funding a project and checking the final results. They think it is enough for support."*

Without sustainable top management significance signalling among stakeholders, the project manager found that it was difficult to make any further steps at the implementation phase. The project manager of C1 told his story:

> *"I tried to have some meetings with stakeholders and top management, but it is difficult to arrange it without strong top management command. They all excuse that they are occupied by…"*

The project manager of C1 told us:

> *"The project was stopped somewhere after half a year, no progress; we could not get the budget for further development."*

5.2.2 Pattern 7: Significance re-orientation

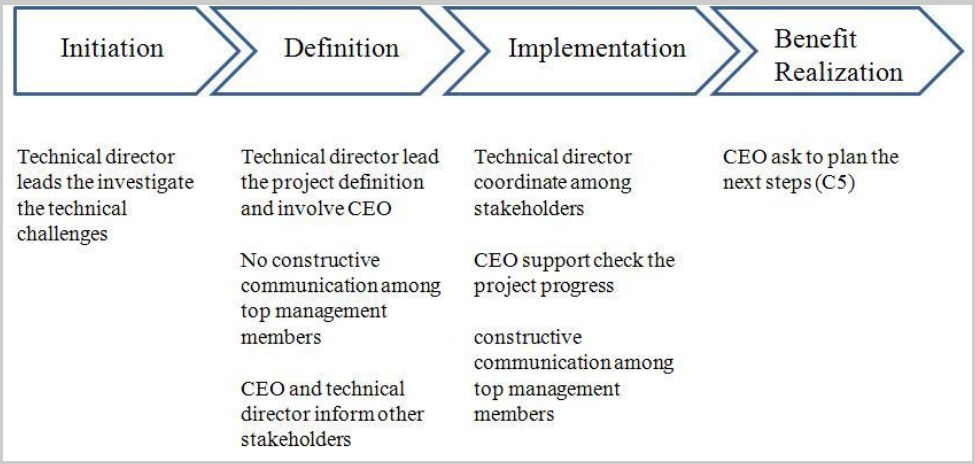
Name	Significance re-orientation
Context	The ESI projects are started as a "technological innovation". Communication of significance is about the serious technical complexity of the ES projects. Top management aware the organization and business significance during the implementation phase. The rationale of the ESI projects are re-defined and communicated. As a consequence, focus of communication of significance are shifted along the ESI phases
Pattern:	Most of the communication of significance is prepared for technical issues at an early project phases. The sudden emergence of extensive constructive dialogue about business significance during the implementation phase. 
Consequence	The projects are finished but with several months delay
Examples	C5, C6
Related Patterns	Pattern 6: Significance eclipse Pattern 8: embedded significance

Table 56: Significance re-orientation

At the beginning, technologist believed technical significance (technical innovation) and therefore created a project structure of internal work packages, methods used, and contracts with the other departments which mainly focused on the support of technical tasks.

Consequently, very little provision was made during the project definition phase to allow for organizational or business change activities. Later, however, all technically driven projects of those firms encountered were all organizational and business challenges that top management needed to address. C5 and C6 both are high-tech firms with strong technical expertise in the cases where projects where successfully started in firms.

The communication of significance activities are mainly one way communication (e.g. newsletter, command etc.) with a small number of two way rational transaction communication (e.g. receive and evaluate report etc.), and are implemented until the project definition phase. There is little or no constructive multi-way dialogue communication during these project phases.

At the implementation phase, project members become aware of the organizational and business significance of the project and the necessary organization changes. For example, the manager of the ESI project at C5 remarked:

> *"I have thought it is just automation of existing processes, not much organization change, and then I found I was wrong, we had to change… but some people did not like it…"*

At this phase, the project structure is changed due to top management commitment and active involvement in the communication loops in the firms. The two cases cited above assumed that involvement of top management in the project would make a difference when a business and organizational rational needs reintroduction and in order to launch organizational change activities. The CTO and project leader of the ESI project at C6 said:

> *"There was some resistance from affected department managers who are out of my span of control. First I would communicate with them directly but sometimes, it did not work. Thus, I had to communicate via other executives at the management board, you know, it always took time for such re-negotiation. Fortunately the CEO consistently supported the project. Finally, we went through all these resistances…"*

Extensive dialogue style of communicating of significance among stakeholders is typically what happened during the implementation phase and later during the benefit realization phase. Considering the nature of top management driven projects in this pattern, there is a possibility that re-structure and shift of the focus of communication of significance can be successful, but it needs significant effort for it.

5.2.3 Pattern 8: Embedded significance

Name	Embedded Significance
Context	The ESI projects are positioned as business projects by the management board. Shared stakeholder understandings are achieved during early project stages. Business and organization significance is well communication along the all phases. There are extra communication and coordination effort, e.g. negotiation with vendors about additional customization of the software, communication. Adoption ESI becomes a part of the organization culture.
Pattern:	Top management is frequently formally and informally involved in the operative project phases. 
Consequence	The projects are finished on time or with little delay
Examples	C7, C8, C9, C10
Related Patterns	Pattern 6: Significance eclipse Pattern 7: Significance re-orientation

Table 57: Embedded significance

C7, C8, C9 and C10 are the members of this pattern group.

At early project phases, business and organizational significance is widely communicated to the key stakeholders through the ESI concept training, focus group discussion among key stakeholders, or organization-wide newsletters from the CEO. The ESI projects are positioned

as business projects by the management board. The management board members were directly involved in the communication of significance activities.

The top management involvements were defined at the early project phases. The selection of means to secure commitment is different from technology driven projects, as said in the previous example with the use of written internal contracts.

The project managers of this pattern were aware of the required organizational change that was triggered by ESI and put more effort in the acquisition of organizational power and resources. They assessed the organizational stakeholders and adapted the project plan to make it more realistic. In the words of the project managers of case firm C9, technology as a critical issue is clearly identified:

> *"…sometimes it did upset project members that they have a good idea, but the software simply does not support them."*

In this situation, it rather is the project team that undertook extra communication and coordination effort for the technological issues, e.g. negotiation with vendors about additional customization of the software, communication with stakeholder for additional cooperation and contribution, initiating further business processes optimization, mobilizing users, or launching additional business and software system trainings. Project managers reported that the project team did work overtime in that phase and contributed to the mobilization of all actors for effective organization-wide communication of significance.

The effective communication of the ESI significance by top management helps to reduce the workload of the project team. Then project team can allocate their resources to the challenges.

Three of the interviewed business driven ESI projects achieved their objectives and finished on time and within budget. One of them (C7) was delayed for half a year because they understood that they needed more time to create an organizational culture change using the new ESI project and they were not completely satisfied with the planned deliverables, and pursued other strategic benefits.

6. DISCUSSION OF RESULTS AND THEORETICAL IMPLICATION

6.1. Understanding the patterns from the structuration perspective

Those projects (The pattern 1: unguided missile) are led by technicians who typically pursued advanced technical challenges, and ignored the social context that they are embedded in. They hope to construct an ideal organizational governance structure using an ESI project without considering the gaps between the reality and the goal. However, few learning effort are designed to facilitate the transition between these two sets of organizational structures.

It is clear from structuration models that it is impossible to introduce a new concept or idea to an organization without using effective managerial modalities. As a result, these expected project outcomes can only be kept in the minds of these technicians without any possibility of being accepted by other organizational stakeholders, e.g. top management, line managers and end users. These technicians do not have the power to allocate the needed organizational resources. Hence, these projects work well at the early project phase but not at the implementation phase because the social structure cannot be changed.

The difference between the pattern 2 (Learning harvesting technological innovation) and the pattern 1 (unguided missile) is that projects within the pattern 2 group were strongly aligned with the organizational strategy and led by top management members (e.g. CTO) with technical background. Hence, these projects have ‘significant” position and the CTOs can access organizational resources (dominance) to establish a certain ‘legitimacy’ to support the project operation.

The CTOs who have technical background always ignore other issues except technical challenges. They can attract best engineers to cope with technical issues. They do not know how to effectively design and execute learning techniques to facilitate the shared organizational understanding, and sometimes, even do not think it is necessary.

Once the CTOs are aware of the criticalness of organization buy-in and the business impact of the ESI projects, there is a chance for them to mobilize organizational resources and use appropriate ‘modalities’ to change the project structure. Such re-structuring process takes time and effort to make it real happen.

New sets of rules are needed to be enacted to facilitate the whole organizational acceptance. Once new “dominance”, “significance” and “legitimacy” are accepted by the organization, the project team can focus on reducing technical complexities.

For the projects labeled as the pattern 3 (Mindful transformation), business significance is well communicated with stakeholders when an ESI project is proposed. Well executed managerial techniques (e.g. internal rules and responsibilities for top management) help to keep the 'significance' of an ESI project during the project life cycle. Top management is also happy because the clearly defined rules saved them a lot of time and they could focus on solving critical issues. Furthermore, the consistent exposed 'significance' from top management easily conveys 'legitimacy' and increase the priority of the project (dominance). The four firms (C7, C8, C9 and C10) adopted 'step-by-step' implementation approach with a series of small visible achievement every a short period. It helps to acquire the organization buy-in and enhance organization understanding and reinforce the projects' strategic position

The pattern 4 (user engagement ESI) means end users are considered as the key stakeholders of an ESI. They are mobilized to actively contribute to an ESI. Wide participation of end users can facilitate a hospitable environment for an ES experiment. Participation an ES projects is highly credited, furthermore, active contributors are promoted. A team member of the ESI project at C5 told us:

> *"Frankly to say, we can the candidates of top management of C5 in the next generation. We know much better how organization operate than other colleagues, now most of them are promoted to several strategic positions at C5"*

End users' active participation as well facilitates a shared organization understanding about the "significance" of the ESI project. It then naturally enhances the strategic priority of the ESI project and increases its "dominance" position within the organization. Organization rules and norms will prefer to support the project if it is advocated by the majority of the stakeholders. In this sense, the critical mass advocating ESI are gradually achieved with the wider end user participation. It is not a surprise that all these cases of the pattern 4 plan to start a new ESI project afterwards.

For those "non end user centric" ESI projects (The pattern 5: end user as passive receiver), the ESI significance is well communicated to top management members and relevant line managers, but not to end users. As a consequence, top management supports the project team to acquire resources and enact 'norms' for the project. No 'interpretive schemes' are presented to end users, they are 'commanded' or 'forced' to change their working behavior without knowing why they must change their actions.

In these cases, there is only 'superficial' organizational acceptance. Once top management involvement ceases, other organization members will change their behavior also. On the other hand, without active end users' participation, the implementation simply becomes "white" or "black" for end users. There is no 'structuration' interaction process which offers 'reflexive' occasions for all stakeholders. Hence, even the project deliver the deliverables, there is little organizational learning and capabilities enhancement. End users still do not know how and why an ESI can help the organizations, and top management cannot receive strong positive feedback from end users about the project; the organizations still did not know how to manage an ESI project etc.

The pattern 6, 7 and 8 offer the other lens to understand an ESI. Without a clear 'significance' signal among stakeholders, there is little chance for a successful ESI (The pattern 6). Each stakeholder will has own "interpretation" for the impact and goal of an ESI. Hence, organization resources cannot be smoothly allocated to the ESI project. There will be a lot of conflict and discussion during the ESI. Without a concerted support from top management, norms and rules as well are difficult to be established. The "modalities" are not in place, the expected structuration process will not occur.

Sustained top management involvement is a pre-requisite condition for a project success. Structuration change process takes time, and it is necessary for top management significance to signal at the appropriate time when the change process confronts some challenges at certain points. The social system (in this case, the organization) change needs top management involvement to timely allocate resources and enact norms to institutionalize the change, as there are windows of opportunity for change during the implementation process (Orlikowski, 1996), which is shown in these cases.

Moreover, existing organization structures and defined project ambition also can impact the project outcome. C7 aims at not only successfully implementing the new system, but also at achieving the organizational culture change through this project. Hence, it takes longer time.

6.2. Enhance the understandings of ESI

The study shows that several best practices are commonly used by these companies, e.g. top management commitment, a cross-functional project team, a steering committee team chaired by top management members, clear organizational demand, matching between the ES and the organization processes, and a strong team leadership etc. However, the ES projects of C1, C2, C3 and C4 failed.

The research results indicate that **practitioners do not know exactly how these static critical factors should be entailed in an ESI**. For example, all the interviewed top management members believe that they already showed strong commitment for the project. For example, the CEO of C4 actively coordinated the initiation and definition stage, and then left the operational tasks to the project team. He thought that he fulfills his duties already.

It is clear that top management commitment can be embodied as communication of significance. The further cross-case analysis identified three different patterns (The pattern 6, 7, 8) for communicating significance by top management: significance eclipse, significance re-orientation and embedded significance. It can be executed in different way along the phases of an ESI.

Similar to the 'top management commitment' factor, other critical factors can also entail in a different way along the implementation process. For example, user participation is verified as a critical factor for the performance of an ES implementation (Sabherwal & Robey, 1995). In this study, three user participation patterns are identified among six case firms who have finished ESI (The pattern 4, 5). It is shown that user participation exerts more long term return than on the traditional project deliverables, at least at the research setting of Chinese companies. It is also shown that organizational learning and training courses can be configured into different patterns with different impacts on ESI projects' outcome.

This study demonstrates that the process patterns add dynamic elements to static critical factors research. It offers a new way to understand the real impact of critical factors. The results can help managers develop own managerial processes keeping in mind of the specific organizational context.

Strategic alignment is verified as a necessary condition for the success of an ESI from this study. It is widely admitted by the managers of these case firms that ESI project must be tightly coupled with organizational strategy and organizational business requirement. The results are consistent with statements from the strategic alignment research stream (Hirschheim & Sabherwal, 2001). The ESI project at C1, C2, and C4 failed because these projects are not strategically aligned.

However, strategic alignment alone cannot explain the variation among cases. C3 has a clear strategic alignment between business and the CRM system. The management board cancel the CRM project considering incapability of C3 managing a radical process change. C5 succeed in finishing the PDM project with more than a one year delay. C9 and C10 implemented the ERP system within a short time and had satisfying results. They all had clear strategic objectives.

Even if an ESI is admitted to be critical to business performance (Das et al., 1991), it as well must achieve periodic milestones visible to stakeholders. Strategic alignment is no longer a match between business strategy and ES strategy at certain point; rather it is an ongoing process (Henderson & Venkatraman, 1993; Hirschheim & Sabherwal, 2001). Such visible benefits can heighten managers' awareness, and accumulate a unified "interpretive themes" for the organizational stakeholders.

The analysis reveals that a historic path does matter in an ESI process (Teece et al., 1997; Eisenhardt & Martin, 2000; Sydow et al., 2005; Staber & Sydow, 2002). C8 has experienced a failed ERP implementation, and learned much from it. C9 has a smaller ERP implementation experience. Both the project manager of C8 and C9 adjusted the implementation tactics for the second ERP implementation. The project manager of C8 told us:

> *"We carefully select the second software vendor whose location is in Beijing for better service at the later implementation phase, and also we signed the very detailed contract about meeting our customisation requirement. We* learned *from the last ERP implementation that it is impossible to do a radical change just by one ERP project…"*

Both the project managers of C8 and C9 told us that it is not possible to implement the ERP project successfully without experience and knowledge gained from the previous implementations.

For example, the project of C9 remarked:

> *"The previous implementation project helps us a lot and we started it from scratch at the first project two years ago and did not* connect *with financial department. The first project help the whole organization understand what are an ERP system and its business impact to us. With benefits gained from the first implementation, end users are more active to contribute at the second implementation"*

From the structuration perspective, a historic path means a set of static organizational structural properties, and in other words, it is a starting point for an implementation journey. Certain configurations of structural properties can have a positive impact on an implementation project, but an ESI is a long ongoing process. To be successful, managers must design sets of managerial efforts to steer organization change process. Managing an ESI

is not a linear straightforward approach. Managers should reflexively observe and analyze reactions of other actors, and flexibly adapt the implementation tactics.

In my eyes, the historic paths of organizations can help us to explain and predict some risks in the course of managing an ESI. It cannot tell us why certain organizations with similar backgrounds may experience different implementation outcomes, e.g. C1 and C5, C2 and C8, C3 and C4, C5 and C7 are able to create a relevant organizational culture to welcome an ESI; C8 and C6 do not.

Conceptually the different outcome can be attributed to organization (dynamic) capabilities of managing an ESI (Clark & Cavanaugh, 1997). A set of managerial processes (operationlised dynamic capabilities) can help organizations to manage an ESI though organizational 'historic paths' and organization governance impact the performance of these managerial processes.

The dynamic capabilities research is still in the stage of lacking a strong theoretical foundation (Eisenhardt & Martin, 2000) and lack of research applied in the ESI research field. Indicated by structuration research and supported by other dynamic capabilities and strategic alignment research (Eisenhardt & Martin, 2000; Zollo & Winter, 2002; Hirschheim & Sabherwal, 2001), it seems more important that organizations should know the way to build the capabilities based on 'history' and 'context' associated with them (Griffith & Northcraft, 1996).

It is clearly shown in the studied case firms that they have been learning the ways of developing capabilities. C7 made a great effort to re-build the organizational culture that welcome the trial of new enterprise systems. C5 adjusted their implementation approach to put additional effort. It takes about one additional year to do it, but an additional strategic roadmap comes out of this project. On the contrary, C6 and C8 did not put effort into these capability building activities.

The modalities within the structuration framework provide a solid theoretical instrument to discover the source of these capabilities. Managers should observe the reactions from stakeholders about the executed managerial activities. They respond to emerging issues promptly and design effective managerial techniques to deal with it (Prahalad & Krishnan, 2002; Piderit, 2000). Static or inflexible managerial techniques could lead to the other outcome: project failure (Griffith & Northcraft, 1996; Griffith, 1999). Effective managerial techniques can help re-gain the organizational support and avoid the escalation of commitment (Keil & Robey, 1999), which is the case of C5.

Two specific managerial processes are selected by analyzing structuration theory in this study. The first one is managerial process to create organization learning, and the second is communication of significance by top management. It is consistent with existing research that learning is a source of organization dynamic capabilities (Eisenhardt, 2000; Zollo & Winter, 2002). The process of communicating significance can vividly show how the "significance" and "dominance" structure change with an ESI.

These two managerial processes are further operationalized into actionable managerial efforts. Supported via the pattern recognition approach developed in this study, eight dynamic patterns are identified. These patterns can be used to analyse and understand the dynamics of an ESI process. They can support practitioners to design managerial processes for an ESI.

6.3. A new criteria for an ESI performance

In this study, the definition of "success" of an ESI needs to be re-studied. An ESI project is different from traditional technology adoption projects, as it involves strategic, organizational structure and process change at the same time. It can be conceptualized as a controlling instance for organizational strategic transformation process. Hence, it can be called a success when envisioned change has been achieved, not only because of the IT, but also because of the business process (Ribbers, 2002).

Typically, the success of an ESI pertains to the implementation process (project success), and to its results (product success) (e.g., Miles & Snow, 1992; Sage, 1995; Schoo, 1999). For example, Ribbers (2002) measures product success through the indicators: level of use of the new ERP system and procedures, and, level of contribution of the deliverables to the company - and project success through level of adherence to the time plan and level of adherence to budget.

This thesis creates empirical findings which contribute to a complementary understanding of the definition of an ESI performance. In principle, the success of an ESI should be not only decided by operative criteria like typical technology projects, but also should be judged by the strategic impact achieved from an ESI project. Figure 17 shows performance criteria we extracted from the ten case studies.

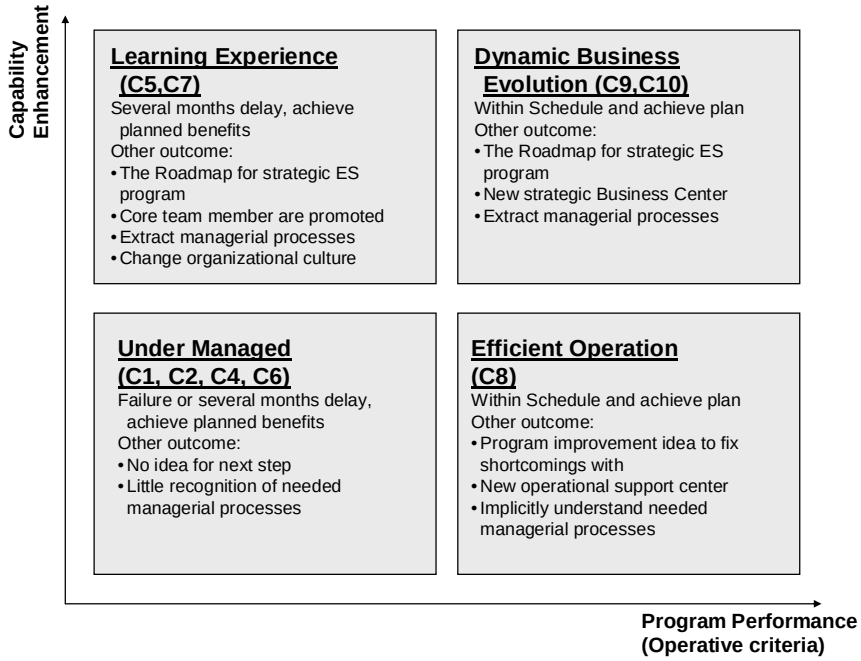


Figure 17, the performance classification framework

The thesis supports the identification of the underlying forces that create the subtle outcome differences among these cases, and they are indiscernible if only judged by traditional operative criteria. For example, C5 and C6 has similar implementation outcome when sights are focused on these operative performance, however, the difference is hidden underneath the surface. The research shows that creating learning occasions for end users made C5 more successful than C6 from a strategic perspective. Similarly, it was also the case between C8 and C9.

6.4. A contribution to process research: an application process pattern recognition approach

Practitioners and variance oriented researchers have been criticizing the incapability of creating actionable results from process oriented studies. Meanwhile, process research is at one critical juncture point: it is labelled by default with 'intensive research effort needed' and 'difficult to analyse piles of process data' (Langley, 1999). There has been little process progress achieved until now.

Exiting pattern identification studies rely on data induction alone (Sabherwal & Robey, 1993; Van de Ven, 1992; Van de Ven et al., 2000), though it is admitted that there is a crucial link between the deductive elements of specifying theories of method, meta level analytical framework, and character of generic propositions at conceptual level (Pettigrew, 1988). On the one hand, their trials lose the critical elements of process research of context richness, but

on the other hand, they do not reduce the data collection workload of typical process research despite the fact their results only make use of small parts of collected data.

The proposed process research method in this thesis contributes to solve the dilemma. It emphasize that process research should have strong theoretical elements inside it, otherwise, it can only create volume of stories without a clear focus (Sabherwal & Robey, 1993). It is also verified from these 10 in-depth case studies that the developed process approach is powerful in explaining the variance, which cannot be answered by variance approaches and other process studies.

The process pattern recognition method used in this study is an iterative approach and combine both inductive and deductive elements. Structuration theory is selected as a sensitizing device as it incorporate the critical elements of an organizational change phenomenon and can interpret the dynamic interaction process within a social system

It is selected as a "sensor" for the process recognition method which warrants data collection of the salient internal structure of the studied phenomenon: an ESI. Feature parameters are extracted from "modalities" within the structuration framework, which represent the intrinsic dimensions of the studied subject. These two layers of filter effectively overcome the difficulties that traditional process research is confronted with: (1) it help reduce the data collection workload, and avoids data overload; (2) It narrows down the research focus to the core skeleton of the phenomenon, but keeps the critical elements of a process research.

There are no existing pattern categories for an ESI that can be used as a classifier machine for this process pattern recognition study. Pattern class identification is a critical intellectual process for all researchers engaged in longitudinal comparative case study work. Here, it is not just something that occurred during and after data collection and it does not rely on induction alone. In this pattern recognition method, the deductive elements of specifying theories, meta-level analytical framework, and the character of generic patterns play a key role in developing pattern class from multiple data sources.

The eight patterns out of this study show that the process research method works well and achieved its claimed research objective. Critical components (contextual, historical and processual characteristics) of a process research are covered by this method, and the data collection workload is reduced with an appropriate use of a meta-theory. The operationalization of the meta-theory into several salient discriminator feature (managerial techniques aimed at facilitating organizational learning and significance communication mechanism), together with a well designed pattern template successfully reduced the complexity of analysis within a social science study.

The results of this study have certain predictability and interpretive power. The managerial process patterns can predict an ESI outcome to some extent, as it considers both the historical path impact and managerial action sequence. It has strong interpretive power since by nature; the selected meta-theory (structuration theory) offers a convincible explanation of these patterns. It is well known that structuration theory offers a powerful device to understand the underlying forces behind (technology based) organizational change (Jones, 1999; Edwards, 2000; Contu & Willmott, 2003) and path dependence and creation (Sydow et al., 2005; Staber & Sydow, 2002).

The data does support the described process pattern, not only within each case firm, but particularly across different case settings. The research results confirms that a general process structure (for which we used the four phases) is useful, but that those phases are separated by breakpoints with only a limited probability of entering into the next phase. The cases C1, C2, C3 and C4, for example, did not reach phase four, benefit realization, because they were abandoned before that, while C5, C6, C7, C8, C9 and C10 did. Significance communication as a top management activity and deliberate organizational learning techniques do allow variance among these case firms.

The credited strong interpretive power of structuration theory is kept, but enhanced in this study. The two selected managerial processes (significance communication and organization learning) constitute a core thread going through the entire implementation process. The premise of structuration theory is that human actors are knowledgeable and reflexive about their behavior, and they will adjust their behaviors based on reactions from other relevant human actors and the feedback from the social system they are embedded in. The thread developed in this study should not be exclusive, but should compose of many important aspects of management interventions for managing ESI.

Overall, the research results of several analytical process patterns with the convincing interpretive text from structuration perspective keep the traditional power of a process study and verifies that process research also has predication capabilities, which is conceptually declared several times by researchers (Markus & Tanis, 2000), but not yet verified by extant process studies.

6.5. Implication for the future research

The main contribution of the thesis to the academic community is four-fold: (1) the thesis designs a complementary pattern recognition method for conducting process studies. The method considers both generalizability and context richness elements. Compared with existing descriptive and interpretive oriented process studies, it has strong capabilities to create generalizable and actionable research results. On the other hand, the method has a

strong theoretical foundation. It means that it can create research results using a simple method, and with a realistic research effort for data collection; (2) A set of process patterns are identified. These patterns clearly show the predictive power of the process studies; (3) an innovative way to operationalize structuration theory. The 'modalities' embedded in the structuration framework are operationalized as specific set of managerial techniques which is observable and actionable. (4) New insights into the performance criteria of a strategic ESI project.

The eight analytical patterns created out of this study provide a solid foundation for future quantitative studies. From the pattern recognition perspective, this study verifies that the entire mechanism of the new process pattern recognition method works well and is capable of guiding pattern recognition studies, meanwhile, the results established the prototype of a "pattern classifier machine".

The pattern recognition process conducted in this thesis can be named as an unsupervised classification, since the data are not labeled before the study, and the author sought to find groups in the data and the features that distinguish one group of another. Once a set of patterns can be considered as a known class, an unknown pattern may be allocated to a certain class membership that is so-called "supervised classification", which means we have a set of data samples with associated labels, the class types. They are used as exemplars in the classified design.

Based on the pattern types developed in this thesis, the data collection effort required for the further quantitative statistic pattern recognition is extensively reduced. The "feature discriminators" and "pattern classifier prototype" are all in place to simplify the additional research workload. A well designed semi-structured questionnaire based on knowledge gained from this study plus one or two interviews should be enough for the statistics pattern recognition. Then, a standard statistic pattern recognition method may be used to achieve the research expectation. Based on the presented results, more quantitative studies can be undertaken to generalize the findings. The explorative research results of the process patterns can be an intermediary research step and input for a large sample survey.

The designed method also has a good general applicability. Hence, other researchers can use it to study ESI in other countries and compare the results. It will facilitate further exploration whether national culture and other external factors impact the ESI and to which extent. Doing so is a valuable contribution to ESI research area, as there is an urgent research need for doing international organizational change comparison (Pettigrew, 2001), and we should not simplify the national culture impact on the ESI outcome and process.

The method can also be used for other social science oriented management studies. Based on the mehtod, it is possible to create valuable process insights with less extensive data volume than required by existing process methods (Van de Ven et al., 2000; Sabherwal & Robey, 1993). From this perspective, the thesis explores a more feasible process method, which can attract more researchers' attention for process research, due to the research effort needed. The step-by-step process method can help process researchers find a way to concentrate their research effort, and then reduce the data collection workload, without losing the crucial elements of process research: historical, temporal and contextual elements.

6.6. Recommendation for practitioners

For project managers who take the responsibilities of managing an ESI project, from this study, they can learn: (1) That an ESI project is different from traditional technology development and adoption projects as it involve many organizational stakeholders and impacts organizational strategic, structure and business process. (2) That managing ESI is not a one-stop task, rather a long-term dynamic process. (3) That specific set of dynamic managerial processes (organizational learning and significance communication techniques) can help project managers tackle issues that emerge out of a dynamic implementation process. (4) Eight managerial process patterns out from 10 in-depth cases present a reference database for program managers positioned in their own projects. (5) A new insight to understand ESI project performance, that clearly differentiates the operative performance from capability enhancement oriented performance. (6) The dynamic managerial processes that support to achieve different goals (operative deliverables vs. strategic impact oriented results)

Project managers not only learn why certain generic factors are important, e.g. top management commitment, significance communication, organizational learning and stakeholder motivation etc. From this study, they also know which aspects of ESI project these factors impact, and how they should deploy certain managerial techniques to overcome emerging barriers along ESI project phases. Moreover, they also know the sequence of certain managerial techniques, so they can better predict the outcome of certain actions, and to adjust their managerial tactics based on the dynamics embodied in ESI projects they are managing.

The package of managerial processes and eight dynamic patterns of them equip project managers with an effective weapon arsenal for managing an ESI project. Project managers, on the one hand, can use it to reflect their own situation and then select the appropriate managerial techniques to smooth out emerging issues along the implementation process; on the other hand, these patterns help them become clearly aware of the potential issues they will confront. Accordingly, they can usher the ESI project towards the expected pattern by using appropriate managerial techniques.

For top management members who are in charge of supervising an ESI project, the practical recommendation is that top management support should not be limited only until the project definition phase.

Top management should be aware of the different phases in which urgency for communicating significance with key stakeholders arises and adjust the messages accordingly. One way significance communication methods (e.g. command, newsletter etc) is incapable of covering all communication needs. Two way rationale communication (e.g., receiving and review reports etc.) and multi-way constitutive dialogue should be used to complement one way communication. Changing structural properties of a social system (here is organization) should be mediated by diversified ways of communication to achieve a shared understanding and concerted actions from stakeholders.

The thesis also indicates the ways of how to position end users in an ESI: end user driven project or not. An end user driven project means managers must extensively communicate the strategic importance of ES, and motivate end users to actively participate in different phases of ESI. The study shows that end user driven projects create more strategic benefits than those that do not emphasize end user motivation, though sometimes there is no obvious difference if considering operative performance only.

Overall, managing an ESI project is a task which is neither a traditional technical project nor a pure business project. By nature it is incorporating multi-disciplinary sub-tasks, such as having technical knowledge gap and organizational understanding gap, making necessary organizational structure and process changes, having strongly communicated strategic alignment, and holding a sufficient number training sessions. Hence, the final recommendation to practitioners is that they should be clearly aware these tasks, and flexibly use managerial techniques to mobilize organizational resources and overcome these diversified challenges.

It is a dynamic and social interactive process, hence, a dynamic, process oriented, and reflective set of managerial processes is needed!

7. CONCLUSION

To conclude, process research in the management studies has always been a minority, by and large academic researchers have not accommodated process research on what, how and why research questions (Weick & Quinn, 1999; Langley, 1999; Pettigrew, 2001).

The central challenges are: first of all, capturing the complexities of the real world, and then making sense of it. Process research typically includes the tasks of collecting overwhelming weight of information, structuring and clarifying them, and intellectual inductive conceptualization. The results is always "death by data asphyxiation – the slow and inexorable sinking into the swimming pool which started so cool, clear and inviting and now has become a clinging mass of maple syrup." (Pettigrew, 1990, p: 281)

A process pattern recognition method is developed and validated with a 10 in-depth empirical study in this thesis. It offers a candidate method to solve the dilemma. With a well designed "sensor" and "feature discriminator" (here is operationalization of structuration theory), the heavy burden for collecting process data will be released and the research will be more focused. Hence, process data analysis is not only an inductive conceptualization, but is an iterative process with both inductive and deductive elements within it. This method can effectively support collecting data which is process, comparative, pluralist, historical and contextual; meanwhile, it presents a way to structure the data step by step to achieve the research objectives.

The managerial process patterns identified in the thesis verify that besides the well known interpretive power, process studies can also create generalizable and actionable results with high predictability (Markus & Tanis, 2000). These patterns can support practitioners to be better aware the dynamics embedded in an ESI, assess their own situation based on the eight reference patterns identified in the thesis, and reflexively use most appropriate managerial techniques along the implementation journey to manage large scale ESI projects.

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CURRICULUM VITAE

Xiaofeng Ma was born on May 12, 1975 in Shanxi, China. In 1993, he attended Taiyuan University of Technology to study Electrical Engineering with a focus on Automation Control. In 1997, he graduated with B.Sc. In 1997, Xiaofeng entered into Tongji University to study Electrical Engineering, graduating in 2000 with M.Sc. During his studies, he initiated several research projects on intelligent robotic control and trajectory planning at the Intelligent Robo Control lab at Tongji University. In 2000, Xiaofeng joined Huahong Integrated Circuits Design Ltd. in Shanghai; he was the core team member for China National ID chip card design.

In 2001, Xiaofeng joined CeTIM (Center for Technology and Innovation Management) as a researcher. He registered as a PhD candidate at Leiden University in 2006. With a special interest in organizational strategic transform and strategic IT alignment, actively participating several international research projects (e.g., BEST, eGovRTD2020 and ROADiBROM). Xiaofeng co-authored several academic publications in the area of strategic IT alignment and enterprise-system implementation, either in international journals or international conferences. For example:

- B. Katzy, X. Ma “Strategic Alignment of Enterprise Systems – a Dynamic Capability Perspective”, IAMOT Conference 2006, Beijing
- X. Ma., H. Loeh, “Closing the gap: How should Chinese companies build the capabilities to implement ERP-driven process innovation? “ International Journal of Technology Management 2007 - Vol. 39, No.3/4 pp. 380 - 395,
- X. Ma, S. Lombardo, E., Sciaba, “Learning mechanisms in a technology based organisational change programme: an exploratory study between Chinese and Norwegian corporations International Journal of Technology Management 2008 - Vol. 41, No.1/2 pp. 75 - 95