



Päivi J. Tossavainen

TRANSFORMATION OF ORGANIZATIONAL STRUCTURES IN A MULTINATIONAL ENTERPRISE

THE CASE OF AN ENTERPRISE RESOURCE PLANNING SYSTEM UTILIZATION

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ABSTRACT

Due to constant changes, multinational enterprises (MNEs) are interesting phenomena to study. An MNE has several units across separate geographical locations with different degrees of freedom in their activities. Hence, an MNE is geographically, time-wise and environmentally (both externally and internally) diverse. As the information used in managing an MNE originates in different locations, it is fragmented. Some of the new information systems are developed to integrate this fragmented information. For example, enterprise resource planning systems (ERPs) are developed to integrate operational data with logistics business processes. This research examined how a leading multinational enterprise in the telecommunication industry managed an enterprise resource planning system to support its operations and logistic business processes globally.

The increasing application of complexity sciences in the field of MNE management motivated the research. Moreover, the ambiguity of ERP research, and especially the notion of failures in implementing ERPs, provided further motivation. The dissertation identifies an organizational research problem: the influence of ERP in the transformation of organizational structures. In the study, the implementing organization structure was analyzed. This doctoral dissertation answers the following research question: Does enterprise resource planning system have impact on the implementing organization? The main thesis of the dissertation is that to enable long-term ERP use requires fundamental changes in the implementing organization structure and governance. A new permanent organization structure that integrates business and information technology (IT) domains is needed to accomplish variety of tasks related to the ERP system.

The argumentation for this is the following: because the implementing organization defines ERP, it must reflect the MNE strategies and management. Therefore, new organizational capabilities are required for the implementing organization to achieve the promised benefits associated with the ERP. These capabilities include business knowledge such as the MNE form and its implications, how MNE uses ERP as a control and coordination mechanism, and business operations, activities and processes. Likewise, the capabilities include information technology knowledge such as ERP utilization dimensions, integration level, and their implications. Moreover, the organizational capabilities include self-organizing capability. Hence, the conventional view of organizing ERP utilization is applicable but less valid with a single instance ERP in an MNE. The single instance ERP refers to a universal ERP solution for the focal MNE in which only one ERP system (i.e. instance) is used throughout the enterprise.

The present research examined through a single case study, how an ERP system has influenced the implementing organization structures of an MNE contributing to the formulation of novel implementing organization structures. It analyzed the rare case of a single instance enterprise resource planning system. An empirically driven and application-oriented study was conducted. Empirical evidence from a single case was collected with multiple methods: participant observations, secondary sources of data, semi-structured interviews (qualitative), and electronic survey (quantitative).

The research makes several contributions. To conclude, the main findings are as follows: first, the management of the utilization of the enterprise resource planning system was addressed from the organizational perspective. More specifically, from the implementing organization perspective. Second, the research developed a conceptual model for utilizing an ERP system in an MNE from the organizational perspective. According to the model, the utilization of an enterprise resource planning system in an MNE can be explained by the following elements: 1) organizational awareness, 2) imperfect autonomy, 3) change orientation, 4) transformation triggers, 5) ERP system impact, and 6) successful performance. Third, the research defined two constructs. To enable *the long-term use of the ERP system* i.e. utilization, was defined through five dimensions of initial implementation, enhancements, deployment rollouts, support of the use, and upgrades. In addition, *the integration levels of the ERP system* were defined. The research discovered that both these constructs influence the organizing. Fourth, the study identified two types of organizational transformation: guided and self-organized. Fifth, the research revealed that the organization structures evolved from temporary to permanent. The evolutionary path of the organization structure followed the typology of chaotic, flexible, planned, and rigid forms. The reasons for the movement on the transformation trajectory were discussed. The self-organizing is pivotal. The highest level of self-organizing was observed during the chaotic and flexible forms. The increase of rigid ness decreased the self-organizing capability. On the actor level, the transformation resulted in hybrid managers and hybrid teams, which aimed to close the gap between the business and the IT domains. Their capability to self-organize contributed to the success of the ERP case. Based on the case study results, the dissertation suggests changes in the organizational mechanisms.

Keywords: multinational enterprise, transformation, organization structures, enterprise resource planning system, self-organizing, case study

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Tapiola, May 2005

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TABLE OF CONTENTS

Abstract.....	3
Acknowledgements	5
Table of contents.....	7
List of figures.....	9
List of tables	10
1 Introduction	11
1.1 Research gap.....	14
1.2 Research problem, questions and objectives.....	17
1.3 Limitations of the research.....	20
1.3.1 Perspective on organizations	22
1.3.2 Assumptions related to the unit of analysis.....	23
1.3.3 Assumptions related to information systems	24
1.3.4 Summary of the limitations.....	30
1.4 Research framework, strategy, and design.....	30
1.4.1 Research framework.....	31
1.4.2 Research strategy: the inductive research approach.....	32
1.4.3 Research design.....	37
1.4.4 Validity of the research	39
1.5 Thesis structure.....	41
2 Organizational structures of the case company and their transformation.....	43
2.1 Introduction of Nokia Mobile Phones.....	43
2.1.1 History of organizational changes in the case company	45
2.1.2 Logistics strategies for the period of analysis	48
2.2 Organizing enterprise resource planning system utilization in Nokia Mobile Phones.....	54
2.2.1 The baseline implementation of enterprise resource planning system	54
2.2.2 Introducing the enhancement and the deployment dimensions.....	55
2.2.3 Evolution of organizational architectures.....	62
2.3 Summary of the case company ERP experience	71
3 Exploration of the research for the model development.....	75
3.1 From complexity theories to complexity sciences.....	76
3.1.1 Key concepts in complexity sciences	82
3.1.2 Theories incorporated into complexity sciences	90
3.2 Managing multinational enterprises	93
3.2.1 Organizational archetypes of the contemporary MNEs	95
3.2.2 Coordination and integration of an MNE.....	100
3.3 Transformation literature	103
3.4 Impacts of enterprise resource planning systems on MNEs	110
3.4.1 Overview of enterprise resource planning systems.....	115
3.4.2 Enterprise resource planning system implementation strategies.....	122

3.4.3 Organizing enterprise resource planning system implementation	133
3.5 Development of conceptual model.....	137
4 Case study analysis	145
4.1 Secondary sources.....	145
4.2 Participant observations	146
4.2.1 Transformation of the implementing organization structure on department level	148
4.2.2 Transformation on actor level.....	152
4.3 The interviews.....	156
4.3.1 Interviewees	156
4.3.2 Conducting the interviews	157
4.3.3 The results of the interviews	159
4.3.4 Issues outside the semi-structured interviews	162
4.4 The survey	163
4.4.1 The survey design	163
4.4.2 Univariate and bivariate analysis results	171
4.4.3 The multivariate analysis results	179
4.4.4 Groupings of emerging themes - factor interpretations	181
4.5 Summary of the case study analysis.....	183
5 Conclusions	190
5.1 Summary of the research	190
5.2 Main research findings	196
5.2.1 Evaluation of the quality of the research.....	200
5.2.2 Revisiting the conceptual model.....	202
5.3 Theoretical contributions	205
5.4 Managerial implications	207
5.5 Suggestions for further research.....	210
References.....	212
Appendix 1 – ERP vendors listed in rank order	230
Appendix 2 – SAP AG introduction.....	231
Appendix 3 - Facts and figures of Nokia and NMP	232
Appendix 4 - List of SuLo documents.....	233
Appendix 5 - Nokia master plan for SAP R/3 projects.....	234
Appendix 6 – Role descriptions.....	236
Appendix 7 – Global Support Model.....	238
Appendix 8 - Semi-structured list of questions.....	239
Appendix 9 - Survey Instrument.....	240
Appendix 10 – Systems theories and complexity sciences characteristics.....	243
Appendix 11 - The correlation matrix.....	244

LIST OF FIGURES

Figure 1.	Conventional approach in ERP implementation from organizing perspective	15
Figure 2.	Time horizon and different perspectives	21
Figure 3.	Levels of integration of ERP	29
Figure 4.	Research framework	32
Figure 5.	General process of building theory from case studies	34
Figure 6.	Communalities framework for the inductive research approach	36
Figure 7.	Research overview	38
Figure 8.	Core processes of the case company	47
Figure 9.	Logistics development roadmap	48
Figure 10.	The replaced information systems	50
Figure 11.	Status of the 1995 broken processes	51
Figure 12.	SAP R/3 implementation, enhancement and deployment project schedules	56
Figure 13.	Global logistics processes and major interfaces between sub-processes	57
Figure 14.	Dimensional layers of the principles defined in 1999	62
Figure 15.	Concept areas and respecting project team structure set 1997	64
Figure 16.	Roles after the scope change of ERP implementation became global	67
Figure 17.	Number of ERP users in the case company (estimated in 1997)	70
Figure 18.	Theoretical background	76
Figure 19.	Characteristics compared with systems theories and complexity sciences	77
Figure 20.	Theories comprising the sciences of complexity	81
Figure 21.	Illustration of complex adaptive system/ complex evolving system	86
Figure 22.	A Typology of Alternative Flexible Forms for Coping with Hyper competition	99
Figure 23.	Collapsing the value-added chain	105
Figure 24.	Five levels of IT-enabled business transformation	109
Figure 25.	The enterprise resource planning system industry market shares	117
Figure 26.	ERP implementation approaches	123
Figure 27.	The PPM model of ERP implementation	127
Figure 28.	Categorization of identified critical success factors	131
Figure 29.	The starting point for the model development	142
Figure 30.	Proposed conceptual model	143
Figure 31.	Organizational evolution high level	149
Figure 32.	Survey instrument logic	165
Figure 33.	Implementation of success measures	174
Figure 34.	Organizational transformation events	176
Figure 35.	Regional distribution towards the satisfaction of the rewards	177
Figure 36.	The importance of the new roles	178
Figure 37.	Comparison of self-organizing attributes among regions	179

Figure 38.	Alternative flexible forms and case company structures	185
Figure 39.	Conceptual model revisited (the final model)	202

LIST OF TABLES

Table1.	Unit of analysis.....	23
Table 2.	Summary table of tactics increasing the quality of the study.....	40
Table 3.	Case company figures	44
Table 4.	ERP activities according to the dimension of utilization.....	61
Table 5.	Concepts constituting the sciences of complexity.....	83
Table 6.	The five causalities framework.....	84
Table 7.	Coordination mechanisms.....	101
Table 8.	Period of evolutionary patterns.....	102
Table 9.	International business orientations and configurations.....	111
Table 10.	ERP total revenue and share by revenue type, 2000-2001.....	116
Table 11.	Examination of the empirical case studies of the ERP implementation.....	121
Table 12.	Critical success factors from the ERP literature.....	130
Table 13.	The list of interview participants.....	157
Table 14.	Summary of the factor analysis applicability criteria.....	167
Table 15.	Kaiser-Meyer-Olkin and Bartlett's tests results.....	167
Table 16.	Total variance explained table.....	168
Table 17.	Respondents summary table.....	169
Table 18.	Responding tenacity summary table.....	170
Table 19.	Descriptive pretest data summary table.....	173
Table 20.	Factor loadings summarized.....	180
Table 21.	Factor labels summarized.....	189

1 INTRODUCTION

A multinational enterprise (MNE) has several units across separate geographical locations with different degrees of freedom in activities. Hence, an MNE is geographically, time-wise and environmentally (both externally and internally) diverse. The business units, headquarters – subsidiary relations or the business processes and operations in the units are heterogeneous. Furthermore, local legal requirements or market conditions create differences in business activities. The complexities of internal and external factors have a significant influence on the management of an MNE. Particularly challenging for multinational enterprises is the balance between demands from business units worldwide and the advantages of capturing cross-business synergies. Information used in managing an MNE originates in different locations. Thus, information is fragmented in an MNE (Davenport, 1998). Scott Morton (1991) proposed that all dimensions of an organization should be reexamined due to the promises of the new information technologies (IT). Bartlett and Ghoshal (1987) were concerned that there is little research on the practice of exploiting IT for the coordination of globally managed firms. Managing those emerging technologies may require organizational capabilities different from those of most current IT departments. Since the information-based mode will be increasingly important in the global integration of business functions (Kim, et al., 2003), corporations would benefit from a broader analysis.

This study examined how a leading multinational enterprise in the telecommunication industry managed an enterprise resource planning (ERP) system¹ to support the firm's operations and logistic business processes globally. The local restrictions and laws were taken into account, but economies of scale directed definitions and decisions related to the implementation. The implementation took several years and was done on a rolling basis. It started from a business unit in one region and then proceeded to other regions. The implementing organization structure evolved in response to challenges from those business units. A novel implementing organization structure emerged with new organizational roles during the deployment. Furthermore, novel organizational capabilities were created. The implementing organization suggested changes to the existing business processes and operations, defined the system specifications and implemented them throughout the firm. Respectively, it enabled the use of the ERP. Standardization of business processes, local autonomy reduction and centralization of decision making were questioned in each business site during the implementation.

¹ Note. Enterprise resource planning system, in Finnish, toiminnanohjausjärjestelmä

Information systems, such as enterprise resource planning systems, require integrated efforts and decisions. The nature of the ERP is to integrate data used in the focal firm. Data integration requires business process integration. Business process integration requires organizational integration. The data processed during various business processes are stored in a database and used within the firm. Therefore, each business process needs to be identified, analyzed, defined, and agreed upon. Subsequently, they are reflected into the ERP system. The requirements may be different for the same business process across the firm. However, the ERP system requires standardization within the firm to ensure operational efficiency. Hence, activities, business processes, and operations become more standardized. The autonomy achieved within operational units of an MNE may therefore be reduced. Furthermore, the time spent on ERP implementation is relatively long in MNEs, mostly a matter of years, if the implementation takes place on a rolling basis. The future business decisions pose further challenges. Changes in business strategies, processes, operations, or activities need to be reflected in the ERP system after the implementation. In consequence, the firm has to be capable of meeting these updating challenges. This affects the implementing organization. The implementation of an ERP is a great challenge for a firm that has operative units across geographical boundaries. Introduction of an ERP system into an MNE becomes complex due to the multi-site environment. Differences are common in areas such as management, markets, culture, and language. The headquarters' requirements for the ERP include economies of scale whereas subsidiaries may demand local responsiveness. This contradiction remains. The ERP requires integration and standardization not necessarily inherent in an MNE. All the decisions regarding operative units, locations and sites, legal requirements, and historically formed processes are not necessarily resolved together simultaneously.

The purpose of the present research was to acquire a deeper understanding of why the enterprise resource planning system has been successful in the case company while predictions in the literature regarding such success are not encouraging. The main thesis of the dissertation is that to enable long-term ERP use requires fundamental changes in the implementing organization structure and governance. A new permanent organization structure that integrates business and IT domains is needed to accomplish variety of tasks related to the ERP system. New organizational capabilities for the implementers are required to achieve the promised strategic, business or technical benefits associated with ERPs. Therefore, more focused attention to the implementing organization enabling the use of the ERP is suggested. The dissertation also argues that the implementing organization is dynamic and evolves over time into a new permanent organization structure.

The argumentation for this is the following: because the implementing organization defines ERP, the system must reflect the strategies and management of the MNE. Therefore, new organizational capabilities are required for the implementing organization. These capabilities include business knowledge such as the MNE form and its implications, how MNE uses ERP as a control and coordination mechanism, and in business operations, activities, and processes. Likewise, the capabilities include information technology knowledge such as ERP long-term use dimensions, integration level, and their implications. Moreover, the organizational capabilities include self-organizing capability. The conventional view of organizing ERP implementation is applicable but less valid especially with a single instance ERP in an MNE. The single instance ERP refers to a universal ERP solution for the focal MNE in which only one ERP system (i.e. instance) is used throughout the enterprise. A different implementing organization structure would be more beneficiary. IT research considers these matters less. The research shows that IT department/ function needs to change in order to support the increasingly complex social and technological system of which an ERP system is a part. In order to do so, the IT functional role needs to be more closely incorporated with the business organization. The new implementing organization structure needs to be permanent. The research shows that there is a relationship between transformation of implementing organization structures and ERP utilization². The data were analyzed in an extraordinary manner; a longitudinal in-depth analysis providing several significant contributions to contemporary research was conducted.

A multidisciplinary research setting was established and inductive research strategy was applied. The study analyzed the rare case of a single instance enterprise resource planning. An empirically driven and application-oriented study was conducted. Empirical evidence from a single case was collected with multiple methods: participant observations, secondary sources of data, semi-structured interviews (qualitative), and electronic survey (quantitative) in order to form a rich and detailed case description. Furthermore, the study applied complexity science concepts to theoretical orientation, transformation process, and to interpretation of the results. The results of the study include rich case description, the construction of the conceptual model, and determination of reasons for movement in the transformation trajectory.

² Definition of the term utilization is provided in chapter 1.3.3. pages 23-24.

1.1 RESEARCH GAP

Information system (IS) research emerged in the 1990s in the international context (Deans, et al., 1991). Until then, information systems had usually been seen as a domestic issue and there was only a little research on the MNC level (Roche, 1992). Likewise, Hagström (1991), who studied location activities in MNEs subsequent to information systems, argued that there were only a few empirical studies in an MNE context. To a lesser degree, research linked especially to information sciences has materialized within the MNE management research streams. Therefore, there is a clear gap in the current research on MNEs, which creates an interesting research opportunity.

The relationship between implementing organization structures and their transformation related to information systems is an emerging topic, firstly because of increasing investment in ERP systems, secondly because of reported failures in ERP system implementation, and thirdly because implementing organization structure changes and ERP are seldom combined in research.

In IT research, there are surprisingly few studies of the long-term changes that enterprise resource planning systems may create for firms. The existing research focuses on the adopting organizations, e.g. the end-users in the line organizations. In early research on ERPs, the long-term impacts of ERPs on IT support and maintenance, and on other elements of any participant organizations were unknown (Baskerville, et al., 2000). However, the existing literature (for instance Davenport, 1998, 2000, Hall, 2002) acknowledges the management, organizational structure, and corporate culture changes associated with ERPs. Again, this is mostly associated with the end-user organizations and the end-users of the system. Further research have been conducted (such as Baroudi, et al., 1986, Feeny, et al., 1996, Whyte, et al., 1997, Kawalek & Wood-Harper, 2002) from the perspective of the end-user, i.e. the adopting organizations. Little research has been focused on the implementers and related organization, especially in the ERP context. Ferguson and Khandelwal (2000) in their review on IT and international operations pointed out that little is reported on the structure of the IT organization in MNEs or as what form the IT function would take in an MNE. Hence, the characteristics and evolvement of the implementers' organization, typically referred as IT organization, have not achieved enough recognition.

The research on highly complex and integrated technology implementation has less focused on implementing organization i.e. implementers, their roles, and organizational structures (see extensive discussion in chapter 3.4.). There is less focus on how the various roles are

linked to each other or on how knowledge transformation and learning take place. The existent research (Bancroft, 1996, Wassenaar, 1998, Bingi, et al., 1999, Baskerville & Pawlowski & McLean, 2000, Davenport, 2000, Skok & Legge, 2001) on ERPs suggests the following organization for the ERP implementation (see figure 1). This conventional approach (author's conceptualization) is characterized by 1) the technical lead of the projects by the existing IT function or department. 2) It is characterized by three groups of implementers: a large number of external consultants, members from the IT department, and some business experts as key-users from the line organizations representing business operations and the adopting organizations. The external consultants may be from the information system provider, or independent application or business consultants. 3) The organization is temporary by nature, e.g. after the implementation is finished the actors return to their original positions and tasks. The contracts with external consultants are finished and they provide their services to other customers.

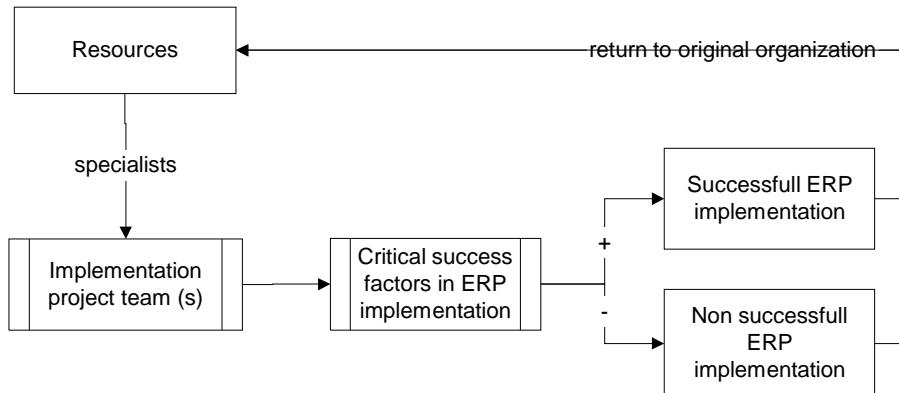


Figure 1. Conventional approach in ERP implementation from organizing perspective (Author's conceptualization)

The conventional approach illustrated in the figure above does not consider the firm configuration (MNE type) or the information system (ERP) reflections. Knowledge creation, share, and transfer have been considered less. The persons working in ERP system implementation are generally described as a project team. Hence, the longitudinal perspective on ERPs is implicitly disregarded. Consequently, there are vague and general references towards the organization structure and characteristics of the project team (Bancroft, 1996), including managers, developers, users, and consultants (Skok & Legge, 2001) or various descriptions for different roles (McKersie & Walton, 1991, Davenport, 2000). Mere references to cross-cultural teams or specialized roles do not adequately describe the challenges MNEs are facing; several units across separate geographical locations with different degrees of freedom in activities are during the deployment of the ERP

integrated. It may not be easy to agree on business activities and ERP use in different units or on geographic mandates in an MNE. The ERP configuration decisions affect the way an entire MNE operates. Also, an MNE needs to ensure that the ERP is kept from falling behind. The conventional implementation organization model does not provide explanations for these matters. Other explanations are required. A more comprehensive analysis is needed. Therefore, the implementing organization needs to be examined. Based on this discussion of the research gap, this research focuses on how business domain is integrated to the IT domain during the ERP implementation and thereafter. The research analyzes the management of an ERP system in an MNE, and follows the development of the implementing organization.

Much of the research resulting in implementation models has dealt with process phases and tasks for ERP implementation, focusing typically on pre-activities and go-live. The models are causal. They hardly discuss the organizational challenges within each phase. There is also very little information on the implementation challenge with time. The ERP system evolves to meet changing business needs. Only recently, the models have acknowledged the post-implementation phase and the organizing perspective. This is an important factor when an MNE is implementing an ERP. Seldom can all sites participate in implementation simultaneously. The implementation needs to be separated into deployment projects over a longer time span, i.e. implementation takes place in rolling phases. None of these models or implementation team descriptions consider their management and organization structures. The rare investigations (Bingi & Sharma & Godla, 1999, Skok & Legge, 2001, Hedman & Kalling, 2002) of organization that implements and provides long-term support for the ERP use, suggest that there is a need for more detailed research on this specific area of ERP systems, e.g. the implementing organization.

Multinational enterprises require information for decision-making such as coordination and management of the firm. ERPs are information systems designed to provide operational and financial information about business operations and processes. The coordination mechanisms in MNEs may include information systems such as ERPs as coordination devices. As such, ERPs can provide a complementary mechanism to institutionalize integration (Doz & Prahalad, 1984) and coordination processes in a multinational enterprise. Therefore, examination of how such a coordination device can be successfully managed in an MNE provides justification for this research.

This research argues that to enable ERP use in an MNE requires fundamental changes in the implementing organization structures and governance. There is little research on how the

IT organization structures are affected by technology development (Cross, et al., 1997). The few investigations of an organization that implements and provides long-term support, suggest a need for more detailed research on this specific area. The argument of limited focus on human-related factors and collaboration in information system projects was recently acknowledged (Kotlarsky & Oshri, 2005). Although impacts of the technological changes are typically noted for the user organization – implicitly or explicitly - in the literature, the impacts on other parts are less analyzed. As noted by Doherty and King (2005), relatively little attention has been paid to the operation of globally distributed development teams, the human, and organizational aspects of such distributed teams. Although, this notion is not directly linked to the ERP projects, it certainly stresses the value of analyzing the socio-technical and organizational issues. Therefore, a clear gap in research is noted; little attention has been paid to the individuals, teams or organizations that implement ERP system in a focal firm and keep the system up-to-date. Being a strategic investment with a long-term use frame, ERP's value comes not only through successful implementation, but also through the long-term use of the system. Managing ERP system is the core activity for the successful use of the ERP. Therefore, organizing that activity becomes one of the enabling factors in a long-term perspective. The current research on ERP implementation does not duly note this perspective. Neither does the ERP literature deal with implementing organization issues on that extent (except recently Koch, 2002b). It either excludes the implementing organizational perspective or considers the organization a homogenous business line organization or IT department. The rare investigations (Bingi & Sharma & Godla, 1999, Skok & Legge, 2001, Hedman & Kalling, 2002) of organization that implements and provides long-term support for the ERP, suggest that there is a need for more detailed research on this specific area of ERP systems. The discussion above clearly shows a gap of implementing organization research in the current mainstream research on ERPs.

1.2 RESEARCH PROBLEM, QUESTIONS AND OBJECTIVES

Transformation of implementing organization structures in the context of ERP system is examined through a longitudinal, explorative, and descriptive analysis of an MNE. Drucker (1988) envisioned in the late 1980s that organizations would change dramatically in forthcoming decades. He predicted the coming of a new type of organization that would be based on information and constructed with knowledge specialists. This change would be actuated by information technology. The combination of knowledge assets and information dependency will require more sophisticated information technology advances to fully exploit and manage information-based knowledge within a firm.

The organizational structures of a firm may even be constantly evolving. Enterprise resource planning systems are more stable. This creates a paradox in an international business organization. The present study has noted the evolution of the structural forms of MNEs towards less hierarchical forms (Marschan, 1996). Because of the corporate level organizational structure is based on corporate strategies, they are reflected in the department level organization structures. Therefore, the corporate structure, i.e. MNE type, and their development need to be addressed. Because the complexity theories have influenced on evolution of less hierarchical MNE types, it is examined whether they influence the structure of the implementing organization. Multinational enterprises provide a wide variety of research topics, and the role of the information systems such as ERPs can be approached from different perspectives. This study has chosen to focus on the transformation of the organizational structures.

Therefore, **the research problem** of this study is identified as an organizational problem: the relationship of an enterprise resource planning system and the transformation of implementing organization structures in a multinational enterprise.

Following the research problem, **the main research question** can be formulated as follows:

Does enterprise resource planning system have impact on the implementing organization?

The discussion from the organizational perspective includes the implementing organization as the starting point. Consequently, the investigation focuses on organization and management instead of technology. Discussed are the roles and the structure of an implementing organization. It is assumed that the organization will facilitate the success with ERP. Furthermore, it is expected that this organization will evolve during (successful) enterprise resource planning system use in a multinational enterprise. If the ERP system has impact on the implementing organization, e.g. the IT domain, further sub-questions are to be answered.

The main research question is thus further divided into **sub-questions** as follows:

1. Why does enterprise resource planning system has an impact on the implementing organization structure?
2. How does transformation occur in the implementing organization structures linked to the enterprise resource planning system in an MNE?

3. What are the key characteristics of the implementing organization structures within an MNE?

These research questions are considered within a successful case of ERP system. The success measures are discussed later in the report. The main research question is approached by first studying the ERP implementation from the organizing perspective. A case of ERP implementation is investigated, described and analyzed, focusing on the organization structures and their transformation. Then this discussion is extended to cover the ERP management after the implementation. The sub-questions are examined by analyzing the case company ERP experience and comparing the results with the existing research on ERPs.

The research objectives

The objective of the research is to answer the identified research questions. The purpose of this dissertation is to draw attention from the technology to organizational issues, and to further clarify the essential role of organization structures. The evolution of less hierarchical MNE forms and their reflections into information systems is discussed. An explanation of the emerging organizational structures and their transformation requires a deeper analysis of the enterprise resource planning system implementing. The research examines also whether the organizational structures remain temporary. Based on the researcher's observations of a multinational enterprise since 1994, the present research contributes to an understanding of what triggers organizational transformation related to ERP. It develops a conceptual model for utilizing an ERP system from implementing organization perspective. The case company analysis provides empirical evidence for the model development. Based on a case study conducted in a large multinational enterprise, the research identifies the trajectory of organizational transformation. With the representative case, the changes in MNE and factors for organizational transformation are analyzed. The objective is to examine whether the implementing organization structural transformation explains the achievement of ERP benefits. On the practical level, the dissertation illustrates a successful ERP implementation. Furthermore, it extends the analysis from mere implementation to the utilization of the system. This research seeks to understand the factors related to these events. On more generic level, the present research aims to create an understanding of the relationship between organization transformation and information systems.

1.3 LIMITATIONS OF THE RESEARCH

The chapter defines the limitations and assumptions for the research.

Organizational structures are used to define how tasks are formally divided, grouped and coordinated within firms. The organizational structures are designed by using six key elements. These elements are work specialization, departmentalization, chain of command, span of control, centralization and decentralization, and formalization. The design options vary from mechanistic models to organic models as the two extremes. The organizational structures to increase efficiency in organizations are the team structure, the virtual (network, modular) organization and the boundaryless organization. (Robbins, 1989)

The present research views organizations as organic, open, dynamic, and nonlinear systems (Thierry & Forges, 1995). Furthermore, organizations are seen as complex adaptive systems (CAS) and evolving systems (CES) (Fuller & Moran, 2001). Therefore, the perspective chosen is from the organization rather than from without (Knowles, 2001). McDaniel and Walls have stated that (1997:380):

"Traditional views of organization have focused on ways to simplify things in an effort to get control. We now understand that simplification leads to error in complex adaptive systems."

This offers an integrated framework to understand the dynamics in enterprises: how systems emerge and evolve, and how order emerges from disorder.

The learning perspective is noted, but not acted on as one of the key perspectives in this research. It is also understood that relatively little can take place in human activities without some kind of learning taking place, whether explicitly or implicitly. The study assumes that learning takes place and thus increases the knowledge assets in the focal firm. Tightly linked to learning, knowledge creation and management are acknowledged. The study agrees that knowledge transfer takes place and may have positive implications similar to those of learning. Consequently, the role of organization structure is noted in knowledge creation and transfer. This is supported by Nonaka (1994), who found that heterarchical or self-organizing teams trigger knowledge creation and knowledge acquiring processes.

Organizational transformation is the behavior in the focus

Organizations change over time, either purposefully or otherwise. This study makes a distinction between change (purposeful) and transformation (emergent). The term

'engineered change' is used when purposeful organizational change is discussed in order to distinguish the concept with the generic use of the term change. According to the understanding of the research, engineered change is something purposeful, which is planned ahead by managers. It is based on strategic decisions. Prediction about the end state of the engineered change is defined. Actions and measures are defined according to the plan and are carried out accordingly. The success of the change is also measured.

Transformation has dynamic and emergent properties. Furthermore, it implies that the change has not necessarily been planned and guided with predetermination as in the case of the engineered change, which typically includes a planned change program. Hence, transformation, in contrast to engineered change, is something that happens without specific planning. Instead, it occurs unintentionally. Due to this distinction, in the context of organization, the terms engineered change and transformation are not interchangeable. The discussion of the terminology use is continued later with the literature review.

Consequently, the term organizational transformation is used instead of organizational change throughout this research. This is also due to the point of observation. The longitudinal research described in the case chapter will highlight this approach. There was an engineered change plan for the adopting organization but not for the implementing organization. The point of observation allows backward - forward perspectives.

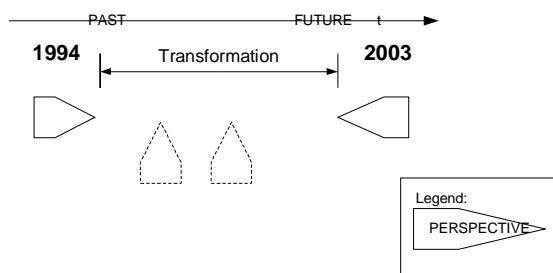


Figure 2. Time horizon and different perspectives
(Author's conceptualization)

The transformation from the different perspective offers several choices of observation (see figure above): the standpoint can be of 1) before the transformation, 2) at any point during the transformation or 3) at the end the transformation. The researcher has been employed by the case company from 1994 onwards. The researcher has had an opportunity to follow up the case of ERP from the beginning. The researcher participated in the ERP projects from 1997 until 2002. This allows participant observations over time from different perspectives. The ERP was in use in all sites in 2002. The researcher continued

employment with the case company but in different position. The position allowed continuing follow-up of the organizational transformation. The research analyzes the organization structure development before, during, and after the enterprise resource planning system. The organizational transformation was observed from 1994 until 2003. The timeframe provides enough revelatory data for the research.

1.3.1 *Perspective on organizations*

The starting point for the investigation is to acknowledge the difference between adopters and implementers. To simplify the difference of these groups, the former uses the ERP system, whereas the latter enables the use of the ERP system. Both of these organization types influence the ERP, and the ERP similarly influences these organizations. The study is limited to cover how the ERP system influences the implementers and their organization structures. The perspective of how the ERP system influences the end-user organization structures (i.e. adopters) is excluded. For the purpose of the present study, the organization perspectives are defined as follows:

The adopting organizations refer to the line organizations. Some of the line organization members are the end-users of the ERP system. For example, sales assistants, warehouse operators or production planners use the information system in their daily operations. These actors are generally called end-users or users. Therefore, organizations in which they belong to can also be called **end-user organizations**. Some of the actors in adopting organizations may be directly involved with the implementation of the information system. This is the business line organization, i.e. the business domain.

The implementing organization includes those actors involved in the implementation of the ERP system. This organization is generally referred to as an implementation project, project team or implementers. The actors in this organization use the information system on a daily basis but differently than the members in various adopting organizations. They enable the ERP use: they define, design, configure, program or do other activities to ensure that the ERP is available for the end-users. Historically this organization has been technically oriented. For instance, information technology specialists and IT departments constitute this organization. This is typically known as the IT domain.

The terms adopting organization and adopt were chosen instead of the IT terminology, because they fit better to the research dealing with management and organization. The

generic terms supports the approach of the research (see chapter 3 for further discussion of the topic).

The implementing organization servers the various adopting organizations. The number of adopters is larger than the number of implementers. The distinction on the perspective of the organization is justified. The changes in the implementing organization structures on actor level and on department level will be analyzed. The transformation of the implementing organization structures will therefore cover new team constructs, hierarchy and geographical analysis.

1.3.2 *Assumptions related to the unit of analysis*

The unit of analysis in research on organizations varies and is based on the level at which the phenomenon is explained. The possible levels are (Scott, 1998): 1) the actor (individual participant) level and the interpersonal relations within the organization, 2) unit level, which includes several actors, teams, or departments and 3) corporate level, which is a collective entity operating in a larger system of relations. The corporation level in this study refers to the MNE. This corporate level organizational structure has became more complex and networked, thereby requiring information systems that facilitate internal information flows (Marschan, 1992). However, the research concentrates on the organizational transformation on unit, e.g. on department level. This is the implementing organization. In line with this, actor level is included to the analysis. The actors included are the implementers in the implementing organization. The examination on different levels, the terminology used and the core discussion areas related are illustrated in the following table 1.

<i>Unit of analysis level</i>	<i>Example</i>	<i>Theory elements, focus (examples)</i>
Corporate/ company	MNE, Nokia, Nokia Mobile Phones,	MNE organizational forms (transnational, heterarchy,etc.), IT configuration (enterprise resource planning system)
Department	Implementing organization, IT department, project team/ organization	organizational transformation, self-organizing, complex adaptive system
Actor/ role	implementer, concept owner, configuration owner, end-user, key-user,	individual behavior (self-organizing)

Table 1. Unit of analysis

The table depicts the potential units of analysis. The corporate level of analysis is used merely as background information. It forms the wider organizational context for the research. Organizational transformation on a department level is based on actor behavior. Therefore, both of these levels (department and actor) are included in the research.

1.3.3 *Assumptions related to information systems*

Information technology and information system are broad generic terms used constantly in the existing literature. To narrow the view, only enterprise resource planning systems are analyzed in this research. However, the literature review will partially deal with the generic categorizations of IT and IS because not all literature specifies the context. The technology of the ERP is beyond the focus of this research. The “process to produce” an information system is also excluded. Firms use several other systems alongside the ERPs. The importance and necessity of them is neither minimized nor disregarded. Yet, they are excluded from the present research.

Definitions related to information technology

The present study focuses on phenomena related to the management of information science, information technology, and information systems. For the purpose of this research, short descriptions are provided.

Information technology, IT, is understood to be converged technologies of information technology (computers, software and information systems) and communication technology (including computer networks and telephone networks) to support people, organizations and businesses in communication and processing data. (Hedman & Kalling, 2002)

An information system, IS, is a computerized set of organized procedures, which when executed, provides information to support processes, decision making, and control in the organization (Lucas, 1990). Hirscheim et al. (1995) note that an information system is traditionally defined from two perspectives, which relate either to its function or its structure. Whyte et al. (1997) postulated that as information system is a service, it monitors the product (the information system) and the process (development, implementation and operation).

Enterprise Recourse Planning system, ERP, refers to a large information system that is a set of application programs built in modules that all fit together. ERPs are designed to support

operational activities, such as logistics business processes (Madnick, 1991). They are expensive systems and are usually created by a vendor. Integrated systems, in short, include a set of coupled databases and software, which are intentionally built to support each other and to use the same logic, resources, and databases. All of the selected modules use and work with the same data that is defined the same way and stored in a common database. A business transaction performed in one of the application modules will flow through the entire system, updating all relevant data values. Hedman and Kalling (2002) categorized ERP systems as value chain and organizational systems due to their relation to value chain activities. ERPs can be understood as information technology and as information system.

Several technical terms are therefore used in the context of ERP. For the purpose of this dissertation, the following definitions are made:

Utilization illustrates the longitudinal perspective towards ERP systems. It means the enablement of the long-term use of the system. It includes all of the ERP related activities (implementation, support, rollout, upgrades, maintenance, and various enhancement activities) from the first implementation of the system until the system is retired. Therefore, it is an overarching term used specifically in the research for the whole lifecycle of the ERP.

Implementation The term implementation refers to the installation of a specific information system into a focal firm. It implicitly implies also to the capability to use the system, i.e. the assumption of the implementation is its usability in the long-term. Implementation comprises activities in getting new software or hardware operating properly in its environment. The terms adopt, install and introduce can be used as synonyms for implementation.

Support refers to the activities during the utilization. Support activities are directed towards the end-users (adapting organizations) or the technical environment.

Rollout refers to the implementation activities divided into smaller grouped tasks that can be done separately, for example grouping of modules implemented or grouping sites introducing the system at the same time. It refers to implementing the system in sequential and parallel order throughout different sites. Rollout means the **deployment** of the system. Hence, the terms can be used interchangeably.

Upgrade refers to change packages for the ERP system developed by the original vendor. They can be technical and content specific. Typically, changes suggested by the application provider are accepted to expand the lifecycle of the system.

Maintenance refers to fine-tuning of the system after it is implemented. Britton and Doake (2000:8) state "*the term maintenance should refer to the introduction of enhancements to delivered software, however, it is frequently used as a euphemism of finding and correcting errors that were not detected while the system was being built*".

The terms related to the system change activities include configuration, customization, and modification. They are defined as follows:

Configuration. When introducing the system, it has to be configured, e.g. the general functionalities are adapted to the focal firm operations (Hedman & Kalling, 2002). Configuration can be

Customization is a typical change in programming to support activity not included in the original software package (Hedman & Kalling, 2002) according to the vendor's guidelines and restrictions but done by the customer.

Modification means that the software is changed after the original development either by the customer or by the vendor. Modification is a system functionality the focal firm needs to build in the ERP. By modification, the focal firm adapts the system better to fit into firm specific operations.

As specified above, the term utilization is chosen to cover the whole set of activities needed with the ERP system. The coverage is from the implementation of the system until to the retirement of the system. This means that the term utilization for the context of the study includes those ERP related activities that enable long-term use of the ERP system. Utilization in more generally refers to the management of the ERP system.

An enterprise resource planning system utilization as empirical context

This research concentrates on the enterprise resource planning systems that are used in customer order/ delivery processes, i.e. the order fulfillment process or logistics processes. The empirical context is the replacement of several information systems with an enterprise resource planning system in a multinational enterprise. The choice to focus on ERP systems was motivated by several reasons. It was chosen because of the recent trend of firms to achieve competitive advantages and carry out global strategies through the use of information systems (Boynton, et al., 1994, Earl & Feeny, 1996). The literature review will show that from the beginning of the 1990s onwards, ERP systems have been in the spotlight of information systems to ensure competitive advantages (see annotated biography from Estevez & Pastor, 2001). As the ERP system utilization provides the technological environment for the analysis, the technology itself is excluded from the study.

Dimensions in a long-term use of ERP systems

The time perspective is also an important assumption in this research. Five distinctive **dimensions in enabling a long-term use of ERP systems** (i.e. the utilization) are herewith identified and defined (see figure 5). They represent the utilization approach applied in the research. The dimensions are:

1. (Initial) implementation. This provides a baseline for the ERP use and management in a long-term perspective.
2. Rollout of the system into the other sites, i.e. deployment.
3. Support and maintenance of the ERP system. This includes the technical environment and setting up support processes for the end-users.
4. Enhancement of the system. The underlying assumption in this research is that ready-made, i.e. off-the-shelves information system packages provide a platform for

installation, but due to the turbulence and changes in the MNE and its environment, the application package requires constant redevelopment and fine-tuning both during the implementation as well as after the implementation. The focal firm manages of enhancement. This includes customization and modifications of the system based on the needs of the focal firm. The more enhancements are done, the more work is required in the upgrade phase.

5. Up-grades. The application provider also develops the ERP package on a continuous basis. The technical and/ or content upgrades are introduced on regular basis. These upgrades are generally adopted. These are only standard application upgrades. Any specific enhancement made by the focal firm is not included in these upgrade packages. The focal firm is responsible for testing its own enhancements and their functionality during the upgrade.

Each of these dimensions requires different type of capabilities. Typically, these activities are organized in project form such as implementation projects, rollout projects, enhancement projects, and up-grade projects. The support and maintenance related activities are more constant activities. Therefore, from the focal firm's perspective the lifecycle of the ERP is considered long. Different categorization exists, for example, Estevez and Pastor (2001) have included the pre-activities and the retirement in their ERP life-cycle framework. The retirement activities of the ERP are not included in the present study because it would require a different research scope. Based on the dimensions categorized here, the utilization perspective assumed includes the initial implementation, rollouts, enhancements, maintenance with support, and upgrades.

Integration level of the ERP

If the information system is fragmented (distributed), the information system is comprised of a variety of independent applications, software, and hardware combinations that can be implemented and modified separately. As a consequence of the logic of fragmentation, these entities do not necessarily require a simultaneous or corporate-wide approach. In the case of an integrated information system, such as ERP, the situation is the opposite. However, an enterprise resource planning systems can be implemented with a different level of integration among the systems. This refers to the number of instances of ERPs (in an MNE). This possibility is hardly discussed in the literature. Hedman and Kalling (2002) distinguish the different levels of adaptability of the system. Only recently, Swanton (2003) reported that the most common approach is to have three instances separated by time zones to Americas,

Asia, and Europe. There are different possibilities among the depth of the ERP system integration, which is an important factor in MNE context. Therefore, it should be addressed.

The figure 3 illustrates hypothetically potential levels of integration of an ERP to highlight the number of instances used in an MNE. In the lowest level of ERP integration, each site, business unit or country has its own ERP instance (system). This is the lowest level of integration of ERP. It is actually a network of separate ERP systems. It is close to the fragmented systems while each ERP instance can be implemented and managed as a separate entity. In the middle level, some business units, or some sites or some countries may have a common ERP instance. Hence, the coordination requirement increases. The level of integration is higher among those sites, since the level of standardization of the business processes embedded in the system increases. Each separate ERP instance (here 3) can be implemented and managed separately, but those grouped in countries, business units or sites require standardization as suggested by Swanton (2003) for example. The highest integration level of ERP can be achieved by single instance solution. Only one ERP system (instance) is used throughout the enterprise. It is a universal solution in the focal MNE. Consequently, the level of standardization is highest. In the highest level of integration, all countries, sites and business units of an MNE use the same (one) ERP instance. It is noteworthy that when the level of integration increases, the odds against successful implementation and management of the ERP increase. The risks are higher.

The levels of ERP integration are illustrated in figure 3. They are closely related to the management of the MNE. The form of the MNE and its characteristics determine what level of integration is desired. It is important to notice that different variations for MNEs exist. The higher the level of integration and standardization the higher are the risks and coordination efforts. The integration level selection must be based on focal firms' strategies. This conceptualization is in line with Markus, Tanis and van Fenema (2000), who pointed out that corporations can actually implement ERP systems without really integrating the data and processes throughout the enterprise. That would indicate the lower level of integration illustrated in the figure. Several different ERP systems are used in entities comprising an MNE.

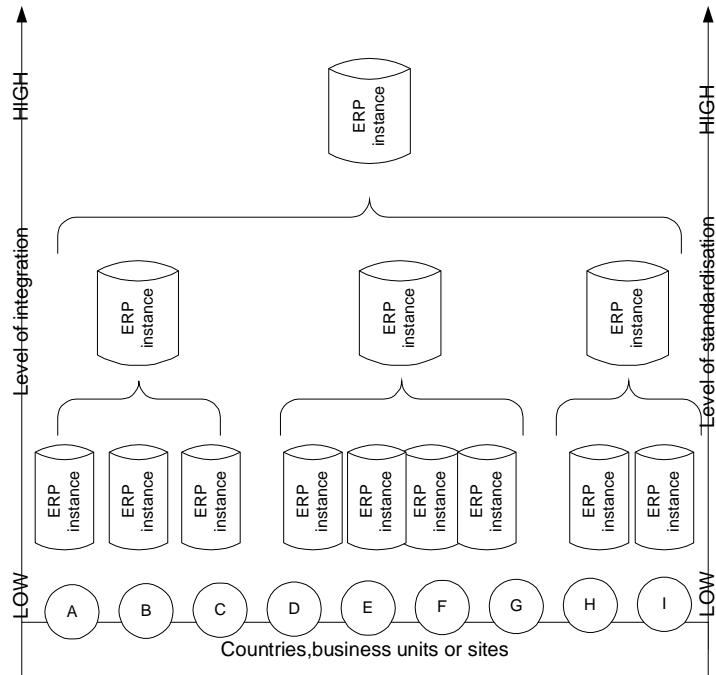


Figure 3. Levels of integration of ERP
(Author's conceptualization)

This research analyzes only the situation with the highest level of integration; one single instance is used in the MNE worldwide. Despite the promises of ERP systems (see exhaustive discussion Davenport, 2000), the selection of a single instance is, however, an unlikely situation (Markus & Tanis & van Fenema, 2000, Sarkis & Sundarraj, 2003, Swanton, 2003). The single instance means that all operating units regardless of their geographical location and thus all end-users of the system would use the one universal system. The user interfaces are to a certain extent the same. Only one language is used throughout the system regardless of the country of the end-user. This will increase the similarity of the day-to-day business operations (e.g. standardization) in an MNE, bringing an important perspective to implementation: all standardization needs to be agreed. The business processes in an MNE-wide implementation has to be standardized. Coordination of activities is higher and requires centralized activities. Standardization can improve the use of information and increase corporate cohesion (Hagström, 1990). This leads to the question of managing the ERP. Global integration is sought, but local adaptations are needed for several reasons such as different laws and regulations.

1.3.4 *Summary of the limitations*

Due to the magnitude of an MNE, only a part of an MNE is included in the study of organizational structural changes. This study is limited to include the analysis of the organizational transformation of the implementing organization in an MNE. The changes of the adopting organizations, departments, tasks, business processes, and the users of the enterprise resource planning system are excluded from the analysis. The unit of analysis is limited to both the implementers and the implementing organization itself. Moreover, the analysis of the implementing organization transformation over the years of 1994 - 2003 includes hierarchical and geographical analysis. The study is limited to included only enterprise resource planning systems. Furthermore, strategic decisions are excluded from the scope of this research. This research perceives the strategy chosen as given, and will not challenge its content. Separate strategic decisions such as the overall business strategy and incorporated information management strategies may be described briefly, but no evaluation or judgment is given on the content of the strategies. The implementation of the ERP took less than the observation period defined for the organization. More specifically, the study is limited to a single instance ERP system implemented globally to the case company. This represents the highest-level integration of the ERP systems.

1.4 RESEARCH FRAMEWORK, STRATEGY, AND DESIGN

This chapter discusses first the research framework and then the research strategy used in the study. Furthermore, the research process was designed and the stages described are included. The chapter synthesizes existing research traditions in social sciences (Glaser & Strauss, 1967, Brinberg & McGrath, 1985, Eisenhardt, 1989, Alasutari, 1991, Yin, 1994, Pettigrew, 1997, Thietart, 1999, Silverman, 2000) in formulating the design. From the epistemological perspective this research assumes an interpretivist understanding over the positivist (Thietart, 1999). For the purpose of this research, an inductive research approach is defined. In addition to the research approach and design, the chapter discusses validity. The research is a) explanatory, b) longitudinal, and c) descriptive by nature. This allows illustration and analysis with an empirical case. The longitudinal approach in studying organizational change has been supported (Dawson, 1997, Pettigrew, 1997, Armenakis & Bedeian, 1999, Fuller & Moran, 2001). This is because a longitudinal perspective provides a descriptive sense of the change, it attempts to provide objective assessment of initial conditions, and it concerns a trajectory of development and how it is perceived, and

influenced by the agents in the system. Finally, it concerns the actors' perspective of the system in which they operate.

This research follows the principles of **qualitative research**. However, it applies both qualitative and quantitative methods in examining the phenomenon (transformation of the organizational structures). This dual use of methods has been supported by Alasuutari (1991), Glaser (1992), and Silverman (2000). Qualitative research allows a wide variety of methods, as does the inductive research approach, which will be discussed later. Therefore, the juxtaposition of the quantitative and qualitative approaches is diminished. The research seeks to contribute a conceptual development and therefore the qualitative research method is valid.

This study is based on a **case study methodology**. The main objectives of case study designs (Eisenhardt, 1989) can be to describe, to test a theory, or to generate a new theory. The level of analysis can be from a single case to multiple cases, or different levels in a single case setting (Yin, 1994). A single case study was chosen as the research methodology because this study introduces practical knowledge into the academic level of generalization. This allows introduction of an emerging, real, and complex phenomenon. Furthermore, the case study method supports analyses of a phenomenon in a temporal context and due to the complex interactions between phenomena. Yin (1993, 1994) continues that the strength of the case study methodology is also its ability to deal with multiple sources of evidence such as documents, artifacts, interviews, and observations although they can also be limited to quantitative research.

The case company selected is Nokia Mobile Phones. It is a large international, complex, multi-unit organization that needs to coordinate and control synergy among business units while keeping the firm continuously aligned with constantly evolving market opportunities. The case company is a major division of Nokia Corporation. Nokia is a Fortune 500 company and a telecommunication industry leader. The case company is introduced in chapter 2. Access to the case company was agreed and made available. However, certain company confidentially restrictions are applied in reporting.

1.4.1 *Research framework*

This chapter develops the research framework distinguished from the limitations. The research framework is drawn from the 'MIT 90s' framework (Scott Morton, 1991), which seems to be based on Leavitt's diamond model for an organization (see for example Scott,

1998). Like Leavitt's diamond model, the MIT model includes organizational components of strategy, technology, social structure, individuals and roles, and goals within the organization boundary. The phenomenon studied in this research is the transformation in organizational structures in the context of an MNE. Furthermore, the role of information system (here the ERP) is investigated. Therefore, the research assumes that the phenomenon cannot be studied without looking into three dimensions and their relationships integrated in the research context: organization structures, business processes, and information systems. The relationship between the MNE organizational structure and information technology is acknowledged (see extended discussion in Roche, 2000). The research framework is illustrated in the figure next.

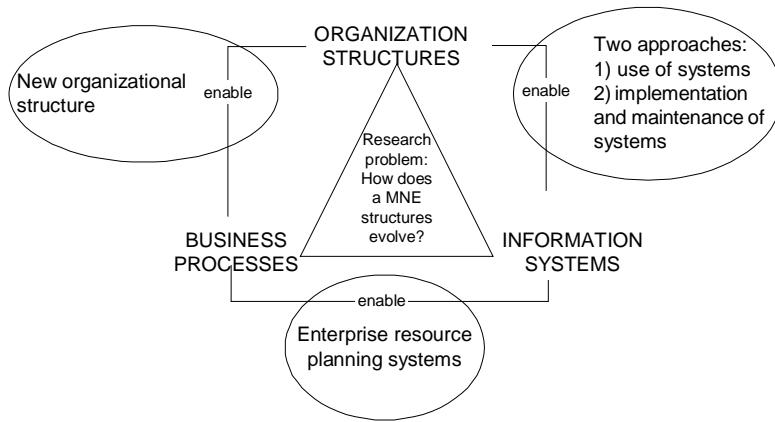


Figure 4. Research framework

The figure 4 above shows the linkages of the boundary elements for this research. Organizations select information systems to support their business activities. Business activities influence the way organizations are structured. This research is limited to the organizational structures of an MNE. The discussion is limited to the emerging process of a new organizational structure, why and how this process has taken place and identifying factors that have contributed to the organizational transformation. The research is also limited to ERP systems.

1.4.2 Research strategy: the inductive research approach

The classical distinction of research strategies includes the deductive and inductive strategies for research. It discusses the relationship between theory and data. Thietart (1999) states that this distinction is based on different research traditions originating in America and Europe. Most of the research relies on the deductive research strategy and

follows the approach on building from, testing or verifying existing theory with empirical data. Accordingly, a prior theory accurately describes the research object. Then a researcher uses the theory to explain the researched object, resulting in further extension of the applicability of the theory. If the relevant theory does not exist, the approach can be different. This research introduces phenomenon and emerging behavior on department and actor level. Because the phenomenon is the starting point, an inductive strategy is applied. Brinberg and McGrath (1985) call this an empirical path for conducting research. Based on the discussion of research problems, research questions, context and the aim of this research, three intertwined methodologies will be applied as the inductive research approach. These methods are grounded theory (Glaser & Strauss, 1967), inductive theory building (Eisenhardt, 1989), and processual analysis (Pettigrew, 1997).

The grounded theory approach has been widely supported for organizational research (Martin & Turner, 1986). Since its discovery grounded theory has been widely used, but seldom without a dispute over its definition. Glaser and Strauss originally defined the grounded theory as an inductive discovery methodology that allows a researcher to develop theory while being simultaneously grounded in empirical observations and data. Since the discovery of grounded theory, several variations have emerged during the use and evolution of grounded theory. (Glaser & Strauss, 1967, Glaser, 1992, Dey, 1999)

Strauss and Glaser (1967) emphasized in their discussion of grounded theory that theory cannot be disunited from the *“process by which it is generated”* as is in the case of deductive theory building. The characteristics of research applying a grounded theory approach include, for instance, the creation of an account of the object under investigation and a high degree of rigor in handling and interpreting the data from a variety of origins (Martin & Turner, 1986). In the grounded theory approach, the researcher aims to develop an account to facilitate general discussion on the study object. Thus, a rarely explored phenomenon and related case data can produce interesting insights (Glaser & Strauss, 1967, Martin & Turner, 1986, Eisenhardt, 1989, Brown & Eisenhardt, 1997, Dey, 1999). Dey (1999) phases activities to generate theory through research activities. These include discovery of interesting areas for inquiry, selection of sites, preliminary collection of data, generation of ideas, exploration through comparison, connection of emergent ideas and integration of them around a selected theme.

Central criteria for grounded theory by Glaser are fit, work, relevance and modifiability. He (1992:15) defined as follows:

" If a grounded theory is carefully induced from the substantive area its categories and their properties will fit the realities under study in the eyes of subjects, practitioners and researchers in the area. If a grounded theory works it will explain the major variations in behavior in the area with respect to the processing of the main concerns of the subjects. If it fits and works the grounded theory has achieved relevance. When these four criteria are met, then of course the theory provides a conceptual approach to action and changes and accesses into the substantive area."

Inductive theory building, being highly iterative and directly linked to the data, is suggested as the approach for research conducted in new topic areas (Eisenhardt, 1989). Eisenhardt (1989) argues that the linkage of research and empirical reality has often been weak, but could be strengthened with inductive approach. She (Eisenhardt, 1989) described the process of inductive theory building from case studies as a series of phases. These process phases are described as highly iterative, during which the researcher may return to previous steps. The process is depicted in figure 5. Although Eisenhardt focuses on the theory part emerging at the end in her development of the process, the final products of this inductive process can be 1) defined concepts 2) conceptual framework 3) propositions or 4) mid-range theory. A mid-range theory falls between the minor working hypotheses of everyday life and all inclusive grand theories and can be described as substantive or formal theory (Glaser & Strauss, 1967).

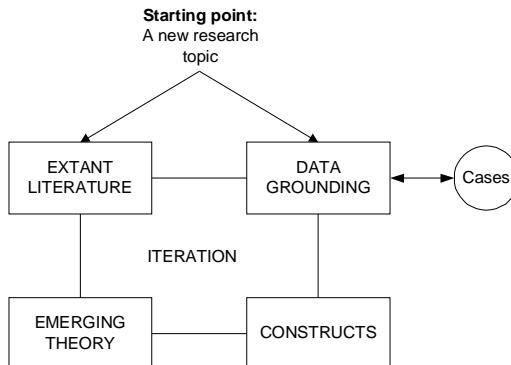


Figure 5. General process of building theory from case studies
(Constructed by author based on Eisenhardt, 1989)

Figure 5 shows the importance the starting point and cases in the research. The iterations of extant literature, data, constructs, and the emerging theory provide a rich analysis. Eisenhardt (1989) stated that the beginning of the research is often less clear about the scope and areas. Therefore, a wider approach to literature analysis can be taken. Hence, this approach has been applied in the present research.

This research follows the logic of **processual analysis** and research (Dawson, 1997, Pettigrew, 1997). Consequently, this research is not only interested in the results of the process, but the process itself, and why and how they shape the outcomes. Processual research is typically historical and linked to organizational context; it is multidisciplinary and both contemporary and retrospective (Dawson, 1997). The processual approach is applied for example to understand the adoption of inter-organizational systems (Kurnia & Johnston, 2000). Although this study is not directly categorized as longitudinal field study research, the methodology is supported (Van de Ven & Huber, 1990).

Organizations are social systems. Since social reality is not a steady state (Pettigrew, 1997), a processual analysis approach is well suited for the purpose. The guiding assumptions for conducting a processual analysis (Pettigrew, 1997) include the following: 1) Embeddedness: processes are studied across a number of levels of analysis. 2) Temporal interconnectedness: the past, present and future are included. 3) Duality: a role in the explanation for both context and action. 4) Holistic explanations. 5) The existence of has a link between processes and outcomes. These assumptions guide the research. The level of analysis was discussed earlier to include description of the corporate level, and examinations of the department and actor levels. The contemporary time frames are included. The duality and holistic assumptions are also met. The connections between transformation process and its outcomes will be established.

The inductive research approach applied

The grounded theory building, inductive theory building, and processual research follow the same underlying inductive logic of generating theory from data. Especially when applied in a case study, these new approaches increase the usefulness of case study strategies, and in turn increasingly support the case study methodology in the social sciences. Thus the term 'inductive research approach' is used to simplify the approach adapted in the present research. The characteristics of the guiding methodologies are summarized in figure 6 below:

AIM	TIME FRAME
Create understanding Focus on emerging topics Organization context strong Primary focus on analysing Catch a reality in flight Focus on behavior and less on future prediction	Longitudinal Real Present Retrospective
EVIDENCE	INTERPLAY
Associated with case studies Small number of cases (4-10) Multiple sources of evidence and methods Largely qualitative data Data driven induction and iteration	Concept and ideas from existing literature Themes and constructs from empiria Interplay with academic and empirical realities Preconceptualization and empirical description Multidisciplinary

Figure 6. Communalities framework for the inductive research approach
(Author's conceptualization)

The present study proposes an examination against the communalities framework of the inductive research approach presented in the figure above. The framework is a synthesis of the three approaches that were discussed previously. Likewise, Silverman (2000) supports the imaginative use of grounded theory. Assuming that aim, evidence, timeframe and interplay are key categories for conducting the present research, it is considered useful because it 1) allows a multi-faceted perspective on the phenomenon, 2) it suggests systematic instructions for carrying out the research, and 3) it offers a link for using new ideas as a background. It is also in line with Charreire and Durieux (1999), who call similar approach as hybrid exploration. In essence, the idea is to promote the interplay between empirical data and theoretical knowledge in the course of the research.

The research use complexity sciences as emerging theoretical topic in explaining and introducing a contemporary phenomenon. By analyzing a case, the study can highlight certain themes, which may not be found in a multiple case study, especially when strictly quantitative. Although the explanatory and descriptive nature has limitations, the study argues that the description and explanation are also needed to highlight an organizational transformation in a new emerging IT context (ERP). Providing a rich description and exploration of a case in which an organization transformation with ERP has occurred escalates the understanding. The present research is longitudinal. Here longitudinal refers to the period of analyzing the organizational transformation and the embedded actor behavior within the case company. This was discussed earlier. The time frame also suggests that the case is real. The phenomenon has been observed in reality. Furthermore, retrospective and

present perspectives are included. The research period in the case company is several years. This approach is also supported by Huberman and Miles (1994), who stated that inductively oriented research designs work well when an unfamiliar or complex single case is involved, and if explorative and descriptive are the intention. The case study strategy is found appropriate in research aiming to understand the dynamics of a single setting (Eisenhardt, 1989). A single case study as a methodology allows in-depth analysis of one organization and thus advances the possibility of a deeper understanding of a complex situation. This is achieved through the researcher's personal involvement with the activities analyzed. A similar approach has been adopted by other researchers (Sarkis & Sundarraj, 2003). Since organizations are complex entities operating in divergent and often conflicting ways, research producing a multifaceted picture and analysis of the dynamics occurring both within and across hierarchical levels should be valuable (Martin & Turner, 1986). The approach suggested here supports the variety of evidence used in research. Themes and constructs are assumed to arise from the evidence. Then they are examined with the theoretical concepts. The research is qualitative by nature. The quantitative approach increases the validity by providing wider information and by excluding potential threats of subjectivity. The theoretical framework for interplay is created through the literature review. Theoretical perspectives are discussed and the existing literature is analyzed to provide rich a background for analysis.

1.4.3 *Research design*

To increase the validity inherent in the research process, the research design adopts the logic of Validity Network Schema (Brinberg & McGrath, 1985). Accordingly, the selected research path is the empirical path. It is visible in the different stages of the research process. Since the research analyzes the organizational transformation on the department level in a MNE that has successfully implemented and used an enterprise resource planning system, it has an applied research orientation. Analyzing a real life phenomenon and searching for explanations of the real empirical situation is supported by grounded theory and inductive theory (Eisenhardt, 1989). Applying the research strategy, and following the research approach, a research design was developed. Iteration and flexible adjustments (see Eisenhardt, 1989 for further discussion) were made during the research process.

Following the empirical path (Brinberg & McGrath, 1985), the research process was divided into three stages (see the figure 7: pre-study stage, the actual execution of the study and the generalization stage. The first stage included participant observation of the phenomenon (organizational transformation), which was followed by a literature review. Some preliminary

patterns were observed and identified. They were compared with the existing literature. The second stage included the execution of the study. The data collection and evidence was acquired with different methods. The research evidence is provided through participant observations, secondary sources of data, interviews, and survey. The coverage of the dataset will be discussed in chapter 4.

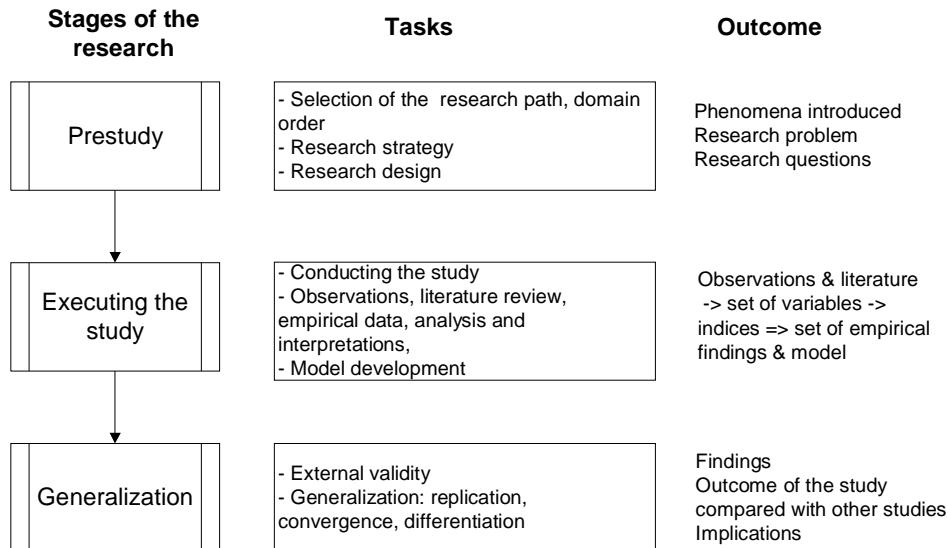


Figure 7. Research overview
(Adapted from Brinberg & McGrath, 1985)

The researcher was employed by the case company (NMP) and later the case corporation (Nokia) during the research timeframe and participated in the ERP related activities. Therefore, first hand experiences and truly participative observations are included. Participant observations that do not disturb the research have been included. These are known as unobtrusive measures (Alasuutari, 1991). Due to the employment, the discussions with colleagues about the phenomenon did not disturb the research. The researcher made notes during the employment. The theme subjectivity in selecting and interpreting the research evidence is present. Processual research, inductive theory building and grounded theory approaches emphasize the interplay between academia and the real context (Eisenhardt, 1989, Dawson, 1997). Hence, a typically hands-on approach and participative tacit knowledge creation are supported advantageous (Allard-Poesi & Maréchal, 1999), especially if combined with cross-validation methods of data (Dawson, 1997).

Secondary sources of data for this research comprise individual project related documentation. Due to the employment, the researcher has had access on project specific

documentation. Secondary sources also include other case-company-specific materials as well as documentation such as books, articles, annual and other reports, publications and memoranda. Confidential company intranet pages also provide company-specific data. The employment of the researcher has contributed by providing innumerable opportunities to discuss and reflect on the organizational arrangements with other employees. These discussions have provided background information for the research. Typically, this information includes data from particular memorable incidents suggested by the individuals.

1.4.4 Validity of the research

Validity is central to any research. Different perspectives on validity exist. One perspective focus more on the validation strategies and validation criteria (Eisenhardt, 1989, Yin, 1994) where as another (Brinberg & McGrath, 1985, Allard-Poesi & Maréchal, 1999) emphasizes the endogenous quality of the research process. Here, the meaning of the validity differs in each research stage. Thus, validity criteria for interpretativist can be credibility, trustworthiness, dependability, and confirmability (Girod-Séville & Perret, 1999).

The validation criteria suggested by Yin (1994) as areas in which the quality of a case study can be improved are termed as construct validity, internal validity, external validity, and reliability. Like Yin (1994), Eisenhardt (1989) emphasis the use of a wider range of literature, especially when unveiling emergent construct, theory and literature to improve the correctness of the result findings. To improve the quality of this case research, these suggestions were followed (see table below). Using the following tactics of multiple source of evidence, establishing a chain of the evidence and allowing the key informants to review the draft of the report were used to improve the construct validity. Both qualitative and quantitative methods are used in the present research. These included semi-structured in-depth interviews and survey data. Thus, a larger collection of empirical data was collected with a survey instrument.

The external validity was improved by focusing on in-depth descriptions. Reliability means that the operations of the research can be repeated with similar results. This is a result of the use of case study protocol, for example. Maintaining the chain of sources and the source evidence can also increase reliability. Reliability was improved by using a case study protocol and by developing a database for the case study. The repetition of the study with same results is thus possible and therefore the reliability was ensured. Furthermore, the research design described previously, aims to increase the validity of the present research. The selection of research method allows the researcher to acquire greater depth of

understanding on dynamic and complex interactions. At the same time the reduced ability to make generalizations is also acknowledged (Kurnia & Johnston, 2000). This inductive case study acknowledges these potential limitations.

Quality criterion	Guidelines from the literature (Eisenhardt, 1989, Yin, 1993, 1994, Girod-Séville & Perret, 1999)	How guidelines were applied or followed
Construct validity	Tactics suggested <ul style="list-style-type: none"> • multiple source of evidence, • establishing a chain of the evidence and • allowing the key informants to review the draft of the report • multiple data collection methods 	Evidence is collected in a variety of forms, including interviews, questionnaire, participant observation and documentation. Key informants review the draft of the report.
Internal validity	Tested by <ul style="list-style-type: none"> • perform pattern matching, explanation building and time series analysis. • use more qualitative data in data analysis to understand why dynamic relationships between constructs happen. 	Qualitative data and interpretation are used along the iteration of the evidence.
Reliability	<ul style="list-style-type: none"> • use a case study protocol • develop a database for the case study. 	The case study protocol is created. A semi-structured list of questions for the interviews constructed and separate database created for the empirical data.
External validity	<ul style="list-style-type: none"> • establish domain for the generalization • characteristics of data 	A narrative description of historical events is provided, the order and a sequence of events are preserved, and the results are discussed separately. Pattern formulation is examined and described.

Table 2. Summary table of tactics increasing the quality of the study

The research process aims to improve generalization of the findings. Generalization in qualitative research in the context of cultural research was discussed by Alasuutari (1991). He noted that the generalization should not be considered as a problem because if the audience recognizes the phenomenon based on the research, the interest is on the validity and qualifications of the explanations of the phenomenon. Hence, the research design and the analysis with interpretations are of importance. Lukka and Kasanen (1993) agree that eventually the audience will decide the success of the case study. They argue that the

inductive approach in case studies implicitly improves the generalizability. Therefore, case study poses a variety of methodological requirements to the researcher. The research design has followed the inductive research approach and included several parallel research phases. The evaluation of different methods were included and selected. The report structure discussed next.

1.5 THESIS STRUCTURE

Following the empirical path in the research, the report is structured as follows. The stage 1, pre-study, is described in chapter 1. Conduction of the study is presented in chapter 2-4. The third stage of generalization is presented in chapter 5. More specific descriptions are provided below.

The first chapter provides background for the research. It started with discussion of contemporary MNEs and introduces an interesting phenomenon of organizational transformation of the IT department under research. It also establishes the research problem and the research questions. The limitations of the study are discussed. Objectives for the present study were defined. The research strategy, approach and methodology decisions were described.

This applied research focuses on a real, substantive system. Thus, the case company description is presented in chapter two. The case company is introduced and historical development is provided. The strategies of the case company are discussed in order to understand the selection of the single instance ERP and its role in the management of the MNE. The phenomenon of organizational transformation in the context of the enterprise resource planning system utilization is discussed. Chapter two describes how the implementing organizational structures emerge during the implementation and evolve during the utilization in practice. Thus, the case company data are presented from the analytic-descriptive perspective.

Based on the research framework introduced in chapter 1, the related literature is examined next. The inductive research approach and the empirical research path do not rely on any specific theory. Chapter three intends to identify the relevant studies in management and organization literature, and in information systems research focusing respectively on transformation and enterprise resource planning systems. The literature review is based on the limitations discussed in chapter 1. The chapter develops the theoretical framework to be

used in the research. The conceptual model outlined reflects both the observations and literature analysis. It is proposed at the end of chapter three.

Chapter four presents the conducted study and results found. Empirical evidence is provided. Multiple sources and multiple methods are used to collect and analyze the evidence. The evidence is largely qualitative. Chapter four includes discussion of the sources of information. Especially, the role of observations is included. Interviews are analyzed. Interesting themes and results from univariate and bivariate analysis are reported. Similarly, the multivariate analysis (MVA) results reveal key themes. The findings are interpreted and then used in the model development.

The research report ends with chapter five, which includes a revisit to the proposed model, suggested modifications and discussion. Chapter five provides the research conclusions. The major results of the study are discussed. Theoretical and managerial implications are suggested. Chapter five also identifies future research topics complementing the present study.

2 ORGANIZATIONAL STRUCTURES OF THE CASE COMPANY AND THEIR TRANSFORMATION

Following the epistemological assumption, the nature of the research is to develop understanding of the organizational structure transformation. The purpose of this chapter is to examine the ERP implementation process in the case company. This examination is extended to cover the utilization of the implemented system. The period of analysis is several years. The chapter starts with an introduction of the case company: Nokia Mobile Phones. This includes a historical analysis of the organizational changes and strategies during the ERP implementation. The purpose is to elaborate the initial conditions in which the ERP system was implemented. Investigation of the co-evolution of dynamic phenomena requires examination of a broader setting (Lewin & Volberda, 1999). Then the chapter focuses on implementation of the ERP system in the case company. The organizational perspective in actor and department level is elaborated. Then the current utilization of the system is included. The chapter ends with a discussion of the organizational transformation trajectories. Additional information on the case company is provided in appendix 3.

2.1 INTRODUCTION OF NOKIA MOBILE PHONES

A short introduction of the case company, Nokia Mobile Phones (hereafter NMP), which is a major division of the Nokia Corporation (Hereafter Nokia), is included. Nokia headquarters are located in Espoo, Finland. Telecommunication became Nokia's focus in 1990s as a result of internal decisions and supported by the external circumstances of liberalization and deregulation of the telecommunication industry (Häikiö, 2002). Since the early 1990s, NMP has been a major contributor to the success of Nokia. Nokia is a large multinational enterprise. It can be categorized as a less hierarchical transnational network. The case company introduction is in a narrative and historical format. The content of this chapter is mostly based on secondary sources of information, including internal materials (presentations and documents) created by a variety of authors and therefore the references are not necessary detailed.

NMP is currently the world's largest manufacturer of cellular phones. It achieved the position as the industry leader in the late 1990s. Products are sold in 130 countries around the world. A full range of mobile phones products is offered for all major digital and analog technologies. This diverse product offering serves all regions in the world. NMP is a large international, complex, multi-unit organization with increasing needs to orchestrate,

coordinate and control synergy among business units while keeping the corporation continuously aligned with constantly evolving market opportunities. Particularly challenging is the balance between demands from business units worldwide and the advantages of capturing cross-business synergies, i.e. integration synergy. As suggested by Earl and Feeny (1996:97), "*the multidimensional thrusts of the transnational firm seem to involve high co-ordination and thus require intensive information processing*". Therefore, the role of information systems increases. Moreover, all NMP factories operate according to the same manufacturing processes and technologies. This contributes to the economies of scales. The manufacturing locations are in Brazil, China, Finland, Germany, Hungary, Mexico, South Korea, and the USA. The latest factory is being planned to locate in India. NMP also has sales offices in most of the national markets present. These offices are the first point of contact in conventional sales activities. Sales offices are mostly NMP owned facilities, which intake orders from customers and plan sales volumes to respective areas. Sales are also run through on-line services. (Nokia, 2002a)

NMP	1994	1995	1996	1997	1998	1999	2000	2001
Net sales EURm (M FIM)	10702 (M FIM)	2700	3629	4649	8070	13182	2188 7	2315 8
--BG % of Nokia Corporation		43%	54%	52%	61%	66%	72%	74%
Personnel: Average	5000	10616	10927	1263 1	1606 4	20975	2735 3	2732 0

Table 3. Case company figures

(Source: Nokia)

Table 3 shows a continuous and extensive increase in sales that directly influences management of operations in the case company. The steadily increasing operating profit between 1994 and 2000 is also significant. The growth of NMP has been rapid if measured in terms of net sales and personnel. NMP was already the second largest cellular mobile telephone manufacturer in 1991 with a 15 % share of the global markets (Ala-Pietilä, 1992). Respectively, it was the largest by the end of the decade. This research reports a case study of an ERP system that was implemented and is used successfully. Global implementation took from 1995 to 2002. The functional phenomenon studied within the case company is the renewal of the information system, which was based on a strategic choice by management. A single instance enterprise-wide SAP R/3 system was implemented (and used since) in NMP. During the end of the research period, the same SAP R/3 system was implemented in the second major division of the case corporation. The second division is excluded from this analysis. Likewise, modules installed after 2002 are excluded from the research.

2.1.1 *History of organizational changes in the case company*

The case company is noted for its positive view on change. The changes are often been large. Three corporate level change eras has been observed (Steinbock, 2001) during the 140 years of existence. Focusing on NMP, several large-scale organizational changes, i.e. engineered changes, have been conducted during the past two decades. Herewith is a short overview (based on Ala-Pietilä, 1992, Laaksonen, et al., 1998) of those organizational changes.. These structural organizational changes were closely linked to the technology strategies and technology changes.

The divisional organization phase from 1985-88 included three technology-standard-driven divisions (NMT, TACS and AMPS) respectively divided into three regions. Organizationally, a lot of duplication was present. The divisional organization was changed into a functional organization. **The functional organization phase** was from 1989 to 1991. During this phase, the transition towards a more functional and global organization took place and spin-off businesses were divested. Following the popular business trends, business process re-engineering (BPR) started in the early 1990s. **The process organization** phase was in the period 1992 to 1994 with cross-functional business processes. The four core processes defined were customer satisfaction, concurrent engineering, global logistics, and competence and systems development. The last process also included information technology management and total quality management. After this, the change from a functional to a process-oriented approach was taken. This represents the BPR initiatives discussed in chapter 3. The fourth phase of the organizational change was commenced in 1994, when these changes, especially the global logistics process changes, were already aiming to provide economies of scales yet local responsiveness (Ala-Pietilä, 1992). **NMP's area organizations** were established to improve customer orientation. The NMP areas were defined as the Americas, Asia Pacific (APAC) and Europe/ Africa. However, in the mid-1990s NMP was hit by a logistics crisis characterized by a huge growth in inventories and poor customer service. The logistics development phase began. The focus was on customer service and internal efficiency. **The renewed business process structure** was introduced in 1996 including three modified core business processes, namely the product creation process, the product delivery process and the management process. These business processes were cross-functional and thus cooperation increased. The product creation process is a process to create new products, e.g. it has a research and development focus. The product delivery process ensures selling, manufacturing and delivery of the products to customers, e.g. the supply chain focus. The sixth major change in organizational design was the development of a **new process structure**. The logistics were

reorganized by 1996, after which **the product line organizations** were added to the organization structure as a fourth dimension. Therefore, functions, business processes, regions, and product lines characterized the structural design. NMP continuously modifies its internal organizational structures. The latest major corporate-wide (Nokia) structural change was introduced in the end of 2003. Following the corporate-wide organizational changes, the NMP division was divided into two separate units.

The corporate level management style resulted an organization, which was described as flat and networked. The small cross-functional teams create flexibility and speed in operations. Whereas the strategies have been global (Steinbock, 2001). The orientation on heterarchical organizational structures within the Nokia corporation was noted already in the early 1990s (Kosonen, 1991). Hence, the Nokia can be described as less hierarchical and networked organization as suggested by the recent MNE literature.

Following the corporate level strategies, the transformation of the supply chain management in NMP in the mid-1990s (Häikiö, 2002), included several engineered change initiatives. This study focuses on one of the core processes of the case company: the delivery process (see the figure 8). The four sub-processes of the delivery process were product sales, global logistics, service support, and customer monitoring processes. These sub-processes were mostly put in place during 1996. Focusing more on the global logistics processes, they were to illustrate an end-to-end approach to logistics processes with cross-functional teams. The global logistics processes were further divided into three sub-processes: logistics planning, integrated order fulfillment, and channel logistics management. Again, all these processes were cross-functional and therefore participation from many functions was required to achieve the process targets. This cross-functionality created special needs for managing information. Before ERP, a wide variety of systems were in place. The design criteria for the global logistics processes were minimized lead-time, prevention of non-value adding activities, and avoidance of inventories. Metrics and measuring of the progress and performance was introduced as well.

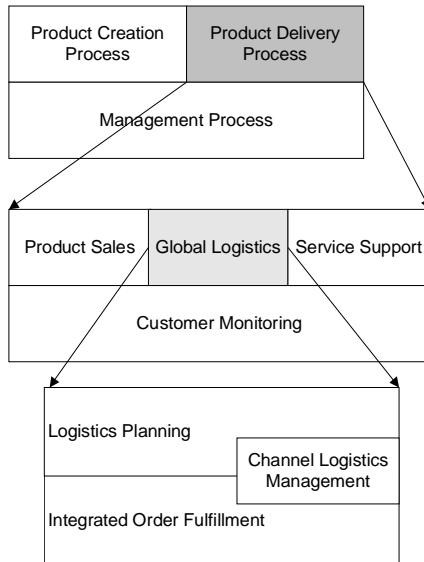


Figure 8. Core processes of the case company
(Adapted from Nokia internal document)

The general outline of the supply chain management change followed the business process reengineering. In short, the logistics planning process uses estimations for sales and supply plans, and through a balancing process produces agreed plans for sales, materials, and production capacity. Integrated order fulfillment delivers customer orders through an integrated manufacturing and distribution processes. Channel logistics management provides information on channel and markets. The core processes are in line with the collapsed value-added chain suggested by Rockart and Short (1991).

The global logistics department was established to oversee several activities. First, it was responsible for building a common logistics strategy, logistics processes, and related information management systems. Second, it had the ownership of the logistics strategy and global logistics processes. Third, it challenged, facilitated, advised, and supported line organization in logistics area. Fourth, it was responsible of benchmarking and best practice sharing. Fifth, it was responsible for the logistics information system concept development and implementation. The department could veto any decision having an impact on the total logistics performance of the case company. As a summary, the global logistics department was seen as a logistics competence and skills center within NMP and Nokia.

2.1.2 Logistics strategies for the period of analysis

Following the business process reengineering, the logistics strategies of NMP were streamlined. They are taken as granted and their contents were not challenged during this research. However, their significance is noted and thus described briefly here. The decision of ERP is based on these strategies. Similarly, they affect how the ERP was implemented. The logistics strategy implementation was divided into three overlapping phases. Internally, they were also called "shape-up", "internal integration", and "external integration" (see figure 9).

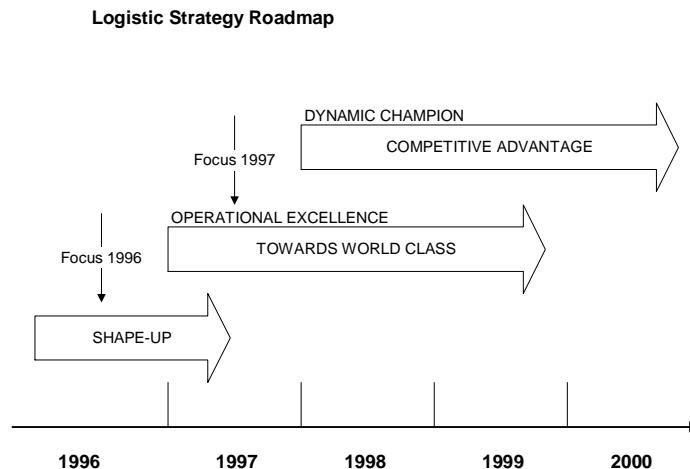


Figure 9. Logistics development roadmap
(Adapted from internal documentation)

The figure above depicts the focus areas for improvement. In short, the first "shape-up" step focused on inventory management and planning processes. This was triggered by the logistics crisis faced in the mid-1990s. Furthermore, re-engineering in the global logistics concept and processes were commenced. The second step "towards world class level" focused on building the foundation for competitive advantage, i.e. the logistics and supply chain management. Operational excellence was the target. Several actions were defined, including implementation of re-engineered processes and implementation of a new transparent IT system. This phase of operational excellence creation was planned to be accomplished by managing business processes instead of functions and by sharing information throughout the whole chain. The third step, "competitive advantage through logistics", focused on operating according to newly defined processes. The strategies, visions and the operative actions to achieve these were overlapping, and resulted in several different but somewhat integrated actions and improvement efforts. These strategic phases are now discussed in more detail in this chapter.

The strategy and related development initiatives were in line with the IT-enabled business transformation defined by Venkataram (1994)(see figure 14). The difference between the case company approach and the IT-enabled business transformation model is the slightly different order of activities. In NMP, the large-scale business process reengineering activities, often described as fundamental, were already conducted before implementation of the new information system. The functional organization was changed into a process organization and processes were redefined accordingly. However, smaller scale process re-engineering and enhancement did take place during the ERP projects. In the mid-1990s, process thinking was popular. At NMP, the mid-1990s the functions were fragmented and had separate processes. This led to disintegrated and sub-optimized business process and information system development. The development was also IT-driven. Generally speaking, the specific solutions were developed by local teams to solve local problems.

Pre-activities (1994-95)

From the operational perspective, in 1994, functional operations prevailed. The sales companies were responsible for business in their own region, focusing on sales, planning, and scheduling the deliveries to customers. The sales support department was responsible for coordinating the order handling process and deliveries from manufacturing/ distribution centers to customers. Procurement of bulk components and mobile phone related accessories was not yet regionally centralized. Customer service targets highlighted flexibility in product offering and communication, which would require stronger support from the information systems and better product delivery reliability. Late in 1994, the information required to support global logistics framework was not available. A current state analysis was made to develop global logistics processes including detailed process descriptions, lead-time analysis, material flows, bottleneck analysis, and data and financial analysis. Consequently, several business process-reengineering activities were launched.

The case company information system development activities resulted different fragmented information systems for different parts of the company (see the following figure): EMIS was selected as the manufacturing center's information system globally. Some distribution centers had an Oracle system and European sales companies' used SCALA system. Furthermore, customer-service-related functions used the in-house made order processing system 'PRIMAS' and production functions 'FIXMAN' (Finland) and 'BOXMAN' (Germany). Electronic data interchange (EDI) was used partly for data transfer between these various systems. The ERP system was later interfaced to some other existing stand-alone systems used in the case company. These systems provided functionalities outside of an ERP. For

example, human resources and payroll systems (Fenix), reporting system (Hyperion) and payment traffic system (Analyste). The product creation process systems included engineering systems (CAD), production support systems (PDMS) and product data system (EDMS). The product delivery process systems included the tracking and labeling system (MPWS) and the vendor agreement system (SAM). Generally, fragmented and sub-optimized information systems and management were used.

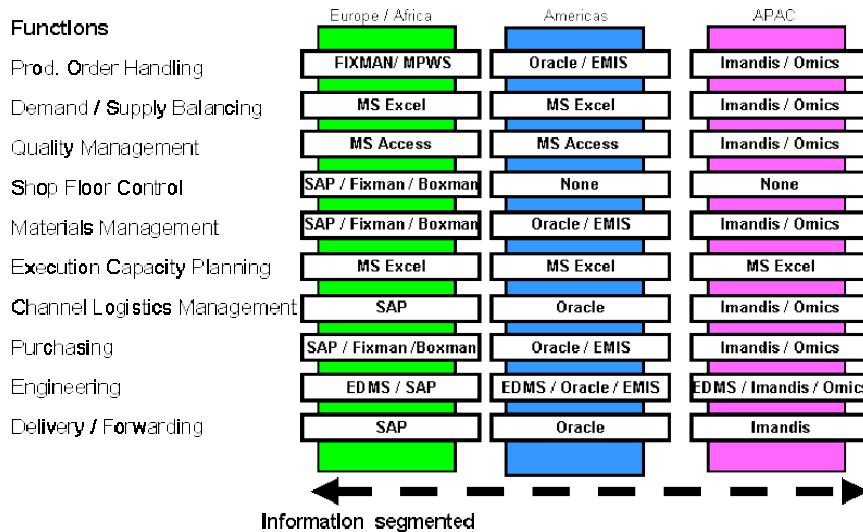


Figure 10. The replaced information systems

All of the ERP modules were introduced at a site at the same time (so called big bang strategy; see chapter 3.4.2 for further details), which meant that several information systems were replaced and thus disconnected during the go-live. The following figure indicates the extent of the technical replacement. The number of legacy and other stand-alone information systems replaced by the ERP was high. The figure above illustrates the major information systems replaced. Several sub-optimized systems were discarded and the fragmented information was integrated within the ERP system.

Shape-up (1995-96)

Prior to 1995, business was also set-up functionally. There was little integration between various functions in terms of operations, information and money flows. Therefore, each function was also sub-optimized having separate information systems to support each activity (see figure 11). The term "broken business processes" described the situation in 1995. In short, the several problems in logistics culminated in chaos behavior and loss of money. The logistics crisis was in hand.

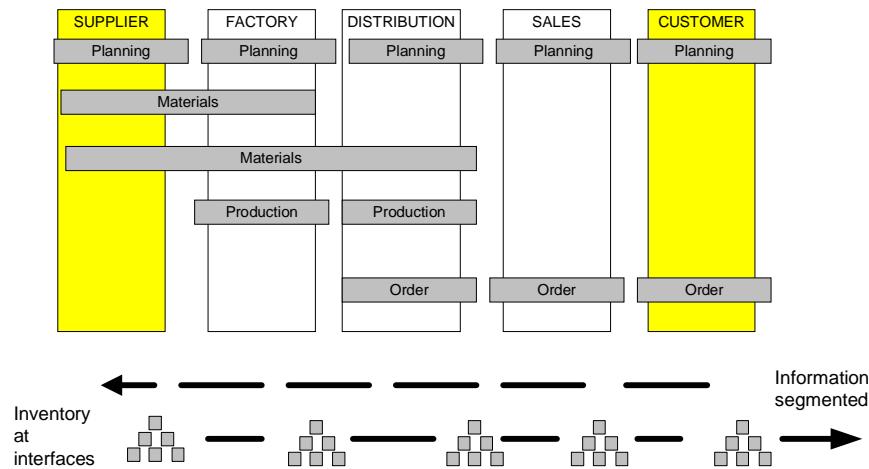


Figure 11. Status of the 1995 broken processes
(Nokia internal documentation)

Projected by a vision of growth in sales, the strategic decision in Europe/ Africa region was to start parallel development activities. Two major activities were conducted during the mid-1990s; the first was a change from a separate functional organization to a process organization. This was followed by a need to integrate these processes with relevant information and money flows. This led to the initiation of the first SAP R/3 implementation projects, which formed the baseline for the ERP system. Accordingly to the integrated approach would provide the basis for the new way of operating. The main processes would have an operational target: "plan for capacity, execute to order". Based on the strategies, there were a number of parallel projects to improve the situation, for example 'customer-driven logistics', 'direct distribution', 'lean and friendly', and later 'supply logistics' projects. Each of these projects focused on some core area, but they also aimed towards the same result.

Supply chain strategies included operational targets such as flexibility, minimization of inventory levels, and lead-time minimization. This would increase commitment to the whole supply chain instead of sub-optimizing each function separately. A customer orientation was driving strategy development. Information systems were to support the logistics strategy and provide visibility through out the chain. In practice, this would imply an integrated information system instead of several local information systems. The information management strategy for 1996 had the slogan *"For each person access to all needed information independent of location"*. Logistics was chosen as the key driver to increase profitability and the competitive advantage in NMP. The strategic intent included the creation of a market-driven logistic

chain in which the information and materials flow through integrated cross-functional processes that start from the customer and extended to suppliers. The defined strategies and global perspective required global implementation of an enterprise resource planning system in the case company. By 1996, the importance of logistics as the key competitive advantage was understood and accepted.

Years of internal integration (1996 - 98)

Shape-up activities started in 1996 and were described in internal documentation successful in 1997. The main achievements included an awareness of the importance of logistics as a key contributor to business success. Furthermore, the logistics strategy deployment continued through process re-engineering. The changes were significant: first, from functions to processes, second, from functional target setting to joint target setting and third moving from a push to a pull mode. In 1997, the strategic focus was to extend the new re-engineered processes into all regions. This would lead to a demand-driven, yet, integrated supply chain in the global perspective. This also included implementation of new IT, i.e. enterprise resource planning system for logistics. The centralized global logistics department oversaw the logistics strategy development and deployment.

"One set of numbers" became the key slogan among NMP professionals. Towards 1997, it was realized that certain key requirements had been established for the NMP division. The management message continued as "*plan for capacity, execute to order*". The slogan described the cornerstone of integrated order fulfillment process: integration and sharing of information, synchronization of the whole chain to actual end-user demand, visibility of demand and supply, end-to-end measures, electronic transactions, and improved information flow. The new information system was a crucial element in achieving all this. The key strategy implementation area included an integrated transaction processing system, i.e. enterprise resource planning system (SAP R/3). Since the logistics business processes were piloted and first introduced in Europe, it was logical to start in the Europe/ Africa region. The decision to use one system or one instance globally was not realized at once. Firstly, it was decided that the Europe/ Africa region would use the same instance. Later, the APAC region rollout would follow using solutions piloted in the Europe/ Africa region. However, in the Americas region, the decision to introduce the competing, Oracle system, had already been decided.

The global strategies and global drivers demanded unified logistics processes. Moreover, the network approach was incorporated. The supply chain was seen as a network. Regional

markets would receive materials from several factories and distribution centers, not only from their own region. There would be global customers, who were served by more than one factory. Rapid market changes would require flexibility to redirect resources. The aim was to integrate company processes with customers and suppliers. This end-to-end (e2e) integration was possible with sufficient IT projects ongoing. Similar alignment with global strategies, information technology, and a networked approach were suggested by Ives, Järvenpää, and Mason (1993).

Years of external integration (1998-2001)

The logistics strategy 1998-2000 included a detailed logistics information management strategy. Increased information sharing included product availability information, advance information of deliveries, and joint planning to increase delivery reliability and responsiveness. The globally applied information system was the means to increase coordination and integration in the matrix organization. To achieve targets, the new logistics processes and selected IT tools would play a significant role. The strategy development clarified the role of information and followed the trend in society to highlight the contemporary notion of information age.

By implementing the common information system platform, SAP R/3, for logistics and related finance transactions (and other information systems like Manugistics, which was later replaced by i2 for planning purposes) operations would globally be supported. The management of the NMP had defined a strategy, which was rather unique: the single instance ERP. Dependence of other geographically distanced units suggests a networked type of organization. According to the strategy, this IT platform would, support rapid changes in logistics structure (organization, product, or other changes), processes and systems and create the basis for electronic commerce with customers and suppliers and other service providers. As one of the interviewees pointed out

“One system (instance) supports this logistics model the best, and that is probably true even today (2002)”³

The strategies in the late 1990s focused on improvements of logistics capabilities. Relatively little was described about the management or organizational development requirements concerning the implementation of these strategies.

³ Author's translation

2.2 ORGANIZING ENTERPRISE RESOURCE PLANNING SYSTEM UTILIZATION IN NOKIA MOBILE PHONES

NMP began to implement the selected ERP system (SAP R/3) in one region, later extending it to other regions. ERP implementation was a collection of multi-site projects. In NMP, two streams of projects were ongoing simultaneously: the enhancement of e.g. development release projects and deployment e.g. rollout projects. The former referred to supply logistics projects (here after SuLo) and the latter to deployment SAP R/3 in a specific location (site). Furthermore, on a need basis, system upgrade projects were launched. The financial services rollouts, which are excluded from this research scope, would have their own schedules and contents. The implementation took place on a rolling basis. While one unit is implementing the information system with the redefined business processes, the previously implemented unit has already moved to daily use of the system. Moreover, the next unit to implement the ERP is still using the old systems and processes. This chapter first introduces the ERP projects as activities and then focuses on the organizational perspective. The organizational development is discussed. Several new organization structures and positions (roles) were established. The role descriptions can be found in appendix 6.

2.2.1 *The baseline implementation of enterprise resource planning system*

The selection of an ERP application took place in late 1994 and the first implementation project (pre-SuLo) was established to implement SAP R/3 in Finland in 1995 and then in Germany in 1996. These first two implementation projects were smaller in scope. They included a partial implementation of the system at distribution centers and accessory procurement. They were, however, the initial implementation of the SAP R/3 in NMP and thus provided a baseline and experience. This approach has been supported (Skok & Legge, 2001). A steering group for the SAP R/3 implementation project was established and project manager was appointed. The project team included sub-teams with team leaders. The sub-teams included the finance and control team, sales, production planning team, and the material management team. Basically, each of these teams included IT experts from the existing IT department, a few end-users from the business units, and a few external SAP R/3 consultants from SAP Headquarters in Walldorf, Germany. The organization structure was conventional as defined in chapter 1 (see figure 1).

The project organization structure was technology-driven, which is a conventional way of populating an information management project. Beginning directly after the first project, the second project (Germany) was scheduled to have go-live in September 1996. The project organization in these projects was similar with local support. These projects were

technology-led instead of business-led. The baseline for one region and for the whole implementation and long-term use was established. However, the majority of NMP operations were still executed without the ERP system.

2.2.2 Introducing the enhancement and the deployment dimensions

The name 'Supply Logistics' (SuLo) was applied first to the ERP initiatives. The activities were operationally and managerially grouped under a program of several projects. At first, SuLo was Europe/ Africa region focused, since there had not yet been a global company-wide decision. SuLo projects generally described the content of the functionalities implemented in the SAP R/3. Those functionalities were also deployed in the rollout projects. The SuLo program comprised several projects producing process and system capabilities to achieve seamless end-to-end integration from customers to suppliers in the demand-supply network. The rollouts projects were given different individual project identification such as the Americas region rollout "R3: Connecting Americas", or "Anaconda" for the Brazil rollout or "Huffa" for the Hungarian rollout.

Figure 12 shows that by 2001 all the major regional rollout projects and several enhancement projects (SuLo) had been accomplished. They are illustrated with the strategy roadmap described earlier to depict the big picture. The rollout projects are different in length and schedules. The logic was that the changes in strategies would also demand creation of new business processes or changes in existing ones. Consequently, these changes need to be applied in the ERP system. This figure shows the global geographical perspective.

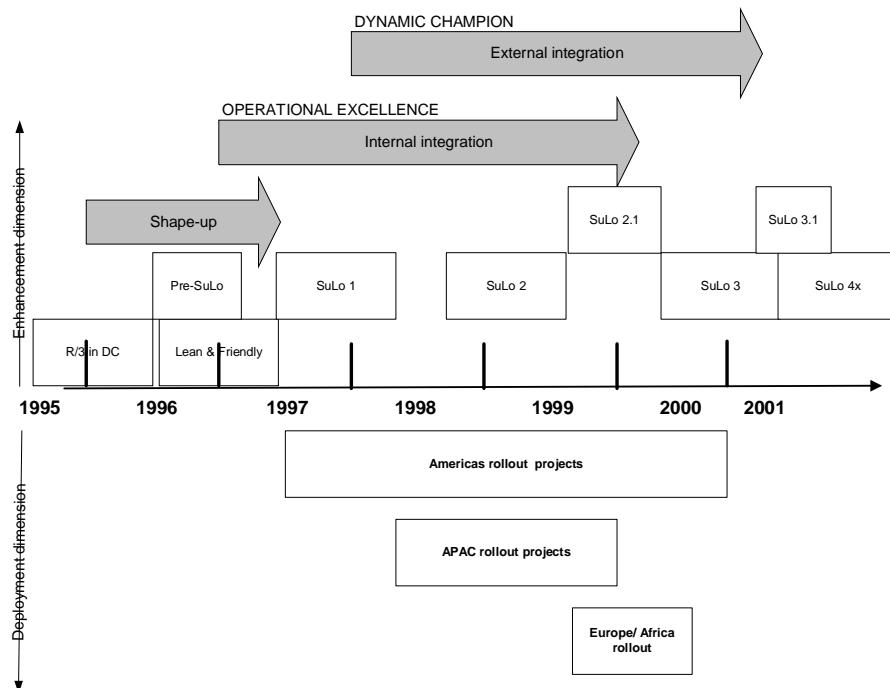


Figure 12. SAP R/3 implementation, enhancement and deployment project schedules
(Combined from Nokia internal documents)

Supply Logistics project activities

SuLo projects would create an end-to-end SAP R3 platform. The first project aimed at process improvement and extended R/3 implementation in Europe and integration of NMP manufacturing units into a common system within the NMP Europe/Africa region. The project used almost a year to first understand the re-engineered processes and to further reengineer them. Time was spent on defining and describing the business processes to a very detailed level. This work was very time consuming and much of it seemed as unnecessarily long. However, the definition of processes to a detailed level created competencies to the concept owners, brought understanding from business representatives, and their business requirements as well as helped to formulate networks between concept owners, process owners, and business experts in line organizations. Criticisms came especially from the configuration side, as their approach was to minimize the changes in the ERP system. After the first project the focus became global. Each project scope was also distinctive from the previous project. Each SuLo project release would always include process development, since the case company environment was volatile and turbulent times were constantly

changing requirements for the business. The SuLo programs continue with varying focus areas.

Based on the global logistics process descriptions, the process owner and the concept owner led teams analyzed and clarified all activities in the processes and the interfaces to other processes, the inputs and outputs, possible threats, and improvements. All of the business processes were derived from the main map (see figure 13). The map illustrates the complex interrelationships between the sub-processes. The high level BPR theories do not consider these sub-level processes. However, they need to be defined and agreed before reflecting to the ERP system. This work was done without considering the potential of the ERP system. Slowly, the participants learned the basics of the ERP system. However, the guiding principle was to define the functionality requirements for the ERP system from a business perspective in order to configure the ERP system to support the case company's way of operating, and not the other way around. This was a novel approach.

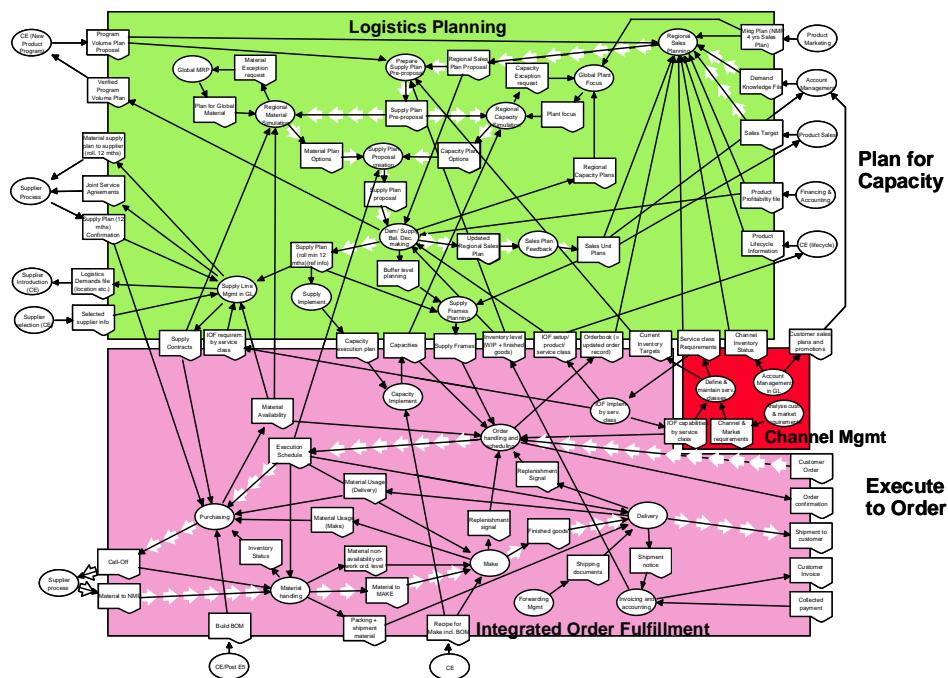


Figure 13. Global logistics processes and major interfaces between sub-processes (Nokia internal documents; “Mother of all slides”)

Following the business process re-engineering activities and minimizing the main processes to three, each main process required definition of sub processes. The figure above describes all delivery process area processes defined in the case company. This was NMP's business

process map. It indicates standardized business processes with very little divergence locally. Its demands in a global perspective guided the configuration of the ERP system. It was noted that the ERP providers generally encourage their customers to implement the software application as they have created it. The best practices may not, however, satisfactorily describe how the focal firm operates (Bingi & Sharma & Godla, 1999). Here, NMP took the approach that the ERP system should be defined in such a way that it supports the company processes satisfactorily. These processes created functionality requirements for the information system. These requirements were defined in detail in the concept documentation. Configuration owners were involved in the concept creation phase; they contributed their expertise about what is possible in the ERP system currently, what could be possible in the future, what needs to be modified and what add-on systems were needed. Although there were differentiated tasks, the members learned from each other in teamwork. Especially concept owners and configuration owners worked closely together. There was a very little discussion directly between end-users and configuration specialists at this point.

The concept phase was followed by the system development phase, when the needed configuration, programs and modifications were done and tested to support the operation in question. After interface testing the configurations were transported to the quality test system. After satisfactory results from tests in the quality system, these configurations were transported to the productive system. This is according to the implementation process models discussed in chapter 3.

Changes made in SuLo projects were applied at all sites in NMP; a harmonized ERP environment was built to support the standardized business processes. The Pareto rule (80 – 20) applied here well. Due to local requirements such as market, customer, product, financial or legal regulations, some adjustments were needed. There was need for systematic information system development and systematic deployment of the system in a rollout project. This two-fold approach required changes in organizing the overall work to that the results are not contradictory. All ERP modules at one site were implemented at once. Implementation at all factories, distribution centers, and sales organizations, would be done geographically parallel and rolling basis. Overall, a global organization was created to support all logistics system projects (SuLo and ERP rollouts) in 1998.

Rollout project activity in Americas and Asia regions

Regional resources were responsible for deployment of the functionalities developed in rollout projects. The global resources (SuLo organization) would support rollout projects on a needs basis: concept validation and especially configuration.

In the Americas' rollout, the Americas program was responsible for identifying gaps in the global concepts. Americas chose to take a different approach on documenting the work in the implementation rollout. Process design and SAP scope were defined in work packages. Work packages included definition, outcomes, business rules, changes, controls, roles and skill requirements, screen shots, function keys, special messages and approval/ review history. The business design approach also differed slightly by starting with mapping SAP R/3 processes to applicable case company business processes. Checking of the business process flow followed this. Then case-company-specific activities were added. This was followed by a definition of what was done in the ERP system and what was done outside of it. The final work package document was created for the defined SAP process. This approach was clearly the opposite of the original approach chosen by the global team and what was done in the previous implementations. This approach was more SAP R/3-driven instead of business driven. Colliding interests caused some difficulties. Global coordination partly replaced local autonomy. Furthermore, the level of documentation and the amount of documentation was increased compared to with previous implementation projects. Instructions were created to guide and design document structures to eventually manage the program. The technical writers were available to create documentation. Despite the work done in the Americas projects, the implementation was a year late. This delay postponed the ERP deployment planning. Because partially same resources are used, delay in one region reflects to other regional projects. They were postponed accordingly.

APAC region SAP R/3 implementation was planned for 1998. The implementation strategy included the financial service platform and SuLo platform to replace current logistics systems in China, including accessory manufacturing and transceiver manufacturing. SAP R/3 was introduced to Japan and Hong Kong before to China. Sales of products were mainly domestic. The project followed project management methodology and provided a project plan with major activities scheduled in it. The regional teams accomplished the tasks. The go-live was in March 1999. The project had only two types of documents: the project management documents that describe the project content and documents that describe the results of the project. Weekly meetings were scheduled for the project teams.

To summarize the ERP initiatives, the simplified schedule for ERP is presented in the following table. The table shows the emphasis of the activities, with culmination near the beginning of the year 2000. The year 2000 challenge with date digits created pressures because the old systems were to be replaced. The duration of ERP implementation in the case company was over 6 years. This implementation included also some implementation activities outside the NMP. The objective was to have the ERP system in use in all of NMP sites by 2000. The European currency (EURO) conversion in 1999 tied up some of the implementation resources. It is noteworthy that the plans (budget and schedules) made for the ERP system implementation in 1996 were achieved. Only two site implementations were delayed; the USA due to a dispute of selection of the system and the differences with the methods, and Brazil due to underestimation of the implications of the legal requirements of local authorities. As such, these are only small delays in an extensive exercise. After implementing ERP in NMP, Nokia Corporation has moved to implement the same ERP system in another major division. Within the forthcoming years, the ERP system will be in use throughout the Nokia Corporation. As can be seen, the schedule of the projects is stretched over several years. The reviewed literature suggested much shorter timeframes. The overall implementation of the ERP system was stretched over the years due to the extent of the work and the availability of resources. The enhancement and rollout projects were activated from 1997 onwards (projects⁴ see the list of projects from 1998 to 2000 in appendix 5. The following table summarizes the various individual projects with the strategic directions.

⁴ Few of the original time schedules are available.

Dimension	Project/ Program	1995	1996	1997	1998	1999	2000	2001	2002
Initial implementation	Project #1 (Finland)	1995 - 1996							
	Project #2 (Germany)		1996						
	Pre-SuLo projects	1995							
Start implementing transaction processing platform									
SuLo 1				January 1997	1998 - 1999				
SuLo 2					June 1999 - January 2000				
SuLo 2.1						2001			
SuLo 3							2002		
SuLo 4									
Start 1997									
Alliance DC (R3: Connecting Americas)		1997 - Spring 1999							
Alliance MC		1997 - Summer 1999							
Mexico MC		1998 - Summer 1999							
Mexico DC		Summer 1999 - Winter 1999							
Canada DC		Spring 1999 - Autumn 1999							
Brazil MC/DC (Anaconda)						Summer 2000 - Spring 2001			
Brazil sales						1999 - Spring 2000			
Start 1999									
Japan DC						Summer 1999			
China DNMP MC						1999			
China DNMP MC phase I						1999			
China DNMP phase II						2000			
BNMT MC						Summer 1999			
China hub						1999 - 2000			
DNMP2 MC						Spring 2000			
Korea, TMC MC						Winter 1999			
BNMT (XingWang)						2000 - 2001			
Hungary MC (HUFFA)						Summer 1999 - Summer 2000			
EURO conversion									
Africa						Spring 1999 - end 1999			
Europe									
All regions									
Baseline 3.0		1995							
3.0 to 3.1			1997						
3.1 to 4.5B				Autumn 1999					

Table 4. ERP activities according to the dimension of utilization

2.2.3 Evolution of organizational architectures

The adoption of the enterprise resource planning system created changes in NMP management and operations. Autonomy in defining business processes and related ERP was decreased by central coordination. The global logistics department was the central point. The central coordination and local responsiveness needed to be balanced as suggested by Doz and Prahalad (1984). This was achieved by creating centers of excellence in regions. ERP was installed to improve operations and integrate separate business units. It became the coordination mechanism (Martinez & Jarillo, 1989) for the focal firm.

To demonstrate the multitask environment, the following figure shows the different layers of activities and organizations identified in 1999. The main dimensions are process and concept, feedback, development, and deployments.

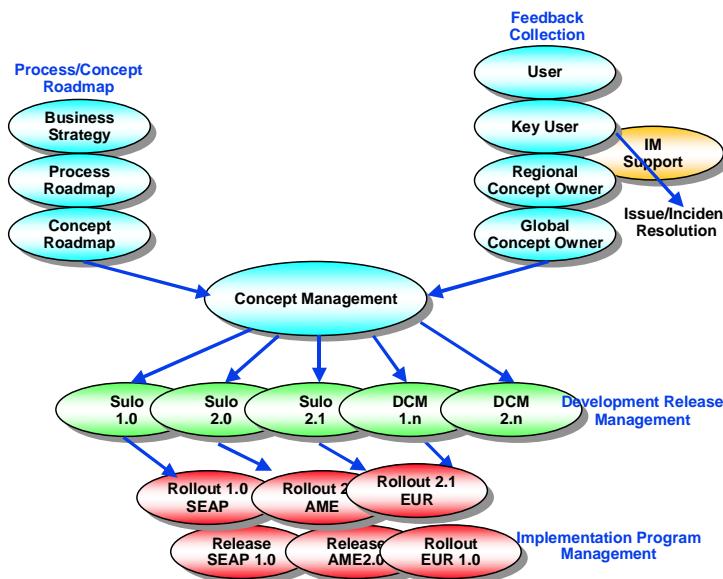


Figure 14. Dimensional layers of the principles defined in 1999
(Nokia internal documentation)

Figure 14 highlights various efforts from a global perspective. This figure provides the holistic picture of all activities related to the ERP. Geographical, organizational, and hierarchical perspectives are illustrated. All of the activities were highly intertwined. Enhancement activities were combined into releases to improve the communication of system development. The release would also include facilitate both line management and

information management. Resources would focus on each release. Experiences would be shared globally when new functionalities were implemented. Therefore, duplicate functionalities would be minimized.

Project structure in the role perspective

The difference in roles and responsibilities pre-SuLo compared with SuLo projects is significant. The approach was no longer technically oriented, but business-driven. This was clear by the definition of the roles, responsibilities and population of those roles. Recall the basic project setting from the first projects described earlier. In this project, the project organization approach, which not only includes IT department but also, process owners, concept owners, business experts, future system end-users, and key-users in the joint projects. This structure was established based on the experience of the earliest ERP projects, and pre-SuLo activities, which were the predecessor of SuLo. The structuring started with a definition of each role, its responsibilities and interfaces to other roles, finally ending in appointments. Various roles were combined into teams (project teams), which solved existing issues.

Concept areas

The BPR literature does not discuss the organizing in relation to the business processes. In NMP what was different was that the main logistics processes were divided into "concept areas" (see figure 30). Concept areas were based on business processes rather than divided according to the module structure of SAP R/3. This was due to the process orientation applied in NMP. Some of the concept areas included only one or two system application modules, but other concept areas would be more horizontal, including several modules in the system. However, the respective configuration areas were divided strictly according to the SAP module division. The concept areas divided the work activities. This change was distinct from the IT department role, which was functional. The IT department would not be able to solve multi-dimensional business problems because they specialized in solving technical problems.

Dividing the work task areas into concept areas was an important organizational development. It followed the logic of process thinking and business process re-engineering, in which the functional organizations are converted into process-oriented organizations. Hence, the operational activities were no longer based on function or task itself, but on a problem to be solved. This would be in line with the trend towards the

solution-centered work typically conducted organizationally in projects. Much of the ERP related literature in the past has dealt with the technical issues, mostly from the information system perspective. Business issues were to be overcome by setting up a project organization. The multi-dimensional problem solving requires business knowledge and expertise alike the technical expertise.

The concept owner would then be the link between the business and the IT domains, thereby constituting a new role within the ERP implementation in NMP. The strategy relationship would be strengthened through cooperation with process owners. The language and cultural barriers between IT professionals and business professional have been noted (Lohmeyer, et al., 2002). Combining two separate domains demands more than the vision of a common approach. The results reveal that by creating a specific role of concept owner, the language and cultural gap could be minimized. Furthermore, the role of concept owners was to transform business requirements and functional requirements into functional requirements and further system requirements.

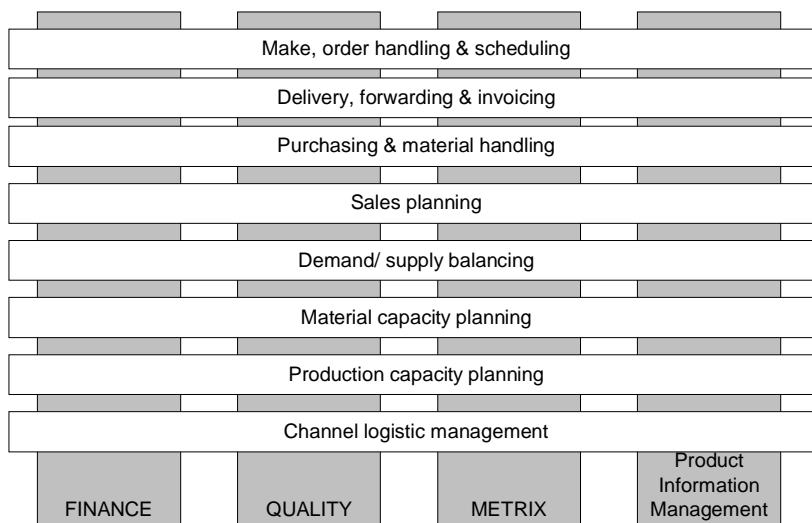


Figure 15. Concept areas and respecting project team structure set 1997
(Nokia internal documentation)

In figure 15, the business processes are divided into eight separate but integrated concept areas. In addition, the overlapping supporting processes are divided into four concepts, which intersect all established eight concept areas. Commitment from the business domain was required.

When the ERP was extended ... it was clear that IT department could not possibly lead and manage...talking about production control, for example...nobody in IM department has any

knowledge about that – it requires a lot of knowledge and experience of production to reflect it into system correctly.⁵

A concept owner led the concept areas: a person responsible for the concept, its development and functioning. Since ERP systems embed business processes, the team composition with the typical technical approach seems less applicable. Lockett (1996) in his study of IT projects in large multinationals distinguished a successful project; the development team is important to bridge the gap between business and information systems. Furthermore, he specifies (Lockett, 1996:128) “*the most critical area was converting business needs into functional specifications of information systems requirements*”. Concept owners were selected from the business units with operative business experience. Thus, they would also have existing relationships with the business domain. Since the business entities continued their own activities, end-users could not be directly involved full time in the ERP project. However, information and requirements from business entities were needed to configure the system satisfactorily. A close relationship between the future end-user entities was needed. The concept owner role was designed to bridge the gap between business experts in line organizations and information management team.

Furthermore, to strengthen the progress, more new roles were designed. The following roles were in place and populated by the end of spring 1997. These include R/3 implementation manager, project leaders, concept owners, configuration owners, and R/3 key-users (more detailed role descriptions are in appendix 6). The R/3 implementation manager oversaw the implementation project. He was in charge of the project timelines, schedules, budgets and resources as in any other project. Project leaders saw a need to cooperate with sub-areas to ensure success. The concept owners’ main task was to create concepts. Concepts include systems requirements, and they were based on strategies, business requirements, analysis, and future demands. Concepts were verified and approved by line organizations before they were handed over to the configuration owners, who applied them in the SAP R/3 system. If SAP R/3 did not support a functionality defined in the concept, it was subjected to further discussion. Although the system specialists’ view was to implement the most standardized SAP possible, several hundreds changes were needed over the years. Some of them were crucial to the case company’s business. In 1997-1998, new business environment and strategies discussed demanded functionalities that were not supported by the selected system. Some of these

⁵ Author’s translation

functionalities were configured in cooperation with the ERP vendor, but mostly by NMP's own resources. This was due to the business strategies and business model, which created a competitive advantage for the case company and was thus highly classified. Key-users were embedded in each business unit and each team. They represented the end-user community and provided first hand support to the adopting organization. The role of key-users in both support and enhancement cannot be underestimated. Key-users provided not only system support to other end-users, but also brought practical operative experience to the enhancement activities. Therefore, the key-users formed a crucial point of contact during the knowledge transfer.

In the beginning, the role of SAP R/3 consultants was to provide ERP system and implementation expertise. With the development of organizational architectures and new roles, the consultant role changed. The organizational approach emphasized the role of consultants to be supportive. Their use was more focused and concentrated on solving sporadic issues and problems. The new organization with growing experiences and learning would provide the most of the resources. This approach was useful, because of two simultaneous tasks of the ERP implementation were combined: first process development and second system development. It was considered important not to do one without the other. Only employees would have the information required and access to the necessary resources. By providing a key contact in the geographical proximity, e.g. the concept owner, the practical information was included in the system solution. The early establishment of the permanent nature of these new roles was significant. Although the work activities were done in projects, all of the positions were permanent, thereby developing a consistent approach towards adoption of ERP. This contradicts to the conventional approach discussed earlier. A new organization structure was established.

From regional exercise to global focus

The scope of ERP was expanded from regional to global. The decision was based on the good experience from the previous implementations. This significantly affected the implementing organization. More layers were needed to ensure cooperation. More challenges were faced. The management style of the case company had provided reasonable authority to the regional units. The pressure of the logistics crisis triggered business process development activities. Another edge of chaos situation occurred. It was seen from the regional perspective that information systems were also incorporated with those many decisions that were centralized in the headquarters (Finland), thereby reducing the autonomy of subsidiaries. Especially the USA subsidiary was against a

centralized and integrated system with a single instance, due to the fear of diminishing control. This was because it forced the already ongoing process development to standardize the logistics processes even more closely. Soon the Americas region began to act differently as discussed earlier in this chapter. They did not want to give up their autonomy. This can be defined as an edge of chaos situation. To overcome the challenges faced by the ERP functionality and the various market demands on global bases, the implementing organization was changed. The principle of roles and responsibilities was applied as defined previously, but more layers were included. The global concept owners coordinated globally, ensuring the required standardization levels from the holistic perspective. The regional concept owners brought up the local requirements and played an important role in securing the local responsiveness of the system. After each rollout, the end-users would require support. The support functions were established. The role of key-users became important to support and link end-users with the others in the implementing organization. The global configuration owners ensured the functioning of the system by controlling the configuration done at local and regional levels.

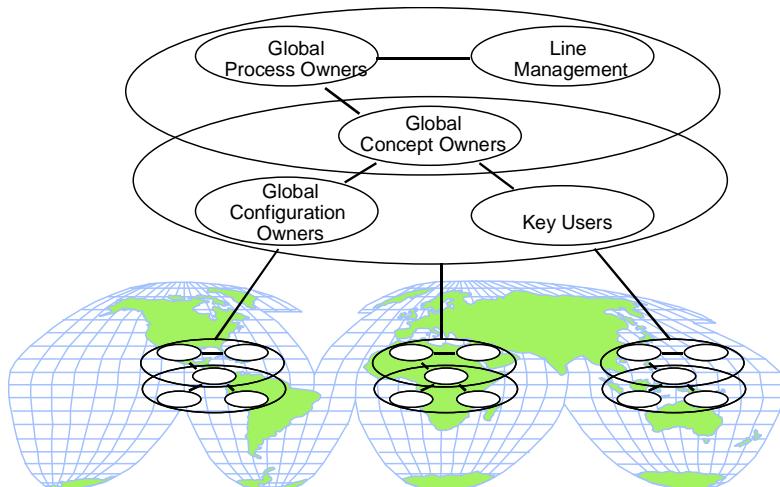


Figure 16. Roles after the scope change of ERP implementation became global (Nokia internal documents)

Figure 16 presents the new layered geographical approach of the organization: global, regional and local layers. The figure also implies two layers of enhancement and deployment: first concept development and second system development. From the local perspective, each individual in the business domain had a locally appointed key-user. The key-users had close relationships with the regional concept owners, who would combine

and prioritize requirements arising within the focal adopting organization. Regional concept owners also provided expertise about the local and regional legal or financial restrictions. The business representation in the roles of process owners and line management who created strategies was also linked to the structures. The latter phase was more application development led by the configuration owners. In this work, the same three-layered teams were applied: local, regional, and global levels, to capture the essential knowledge and information. The liaison role between business domain and information system development was assigned to concept owners both globally and regionally. The layers of global – regional - local did not illustrate hierarchies in terms of direct reporting. Networking and self-organizing was used for cooperation. The local actor did not report to regional owner. Neither did the regional owner report to the global owner. They were strictly geographical mandates, with the exception that a global owner would be approving suggestions. This increased networking among the actors. Without the formal hierarchical mechanisms for coordination, the global owners would need more informal and subtle means of coordination (Martinez & Jarillo, 1989). The lateral relationships were established. Communication flows were both formal and informal.

Several new roles were established due to the geographical mandates. Most of the participants would work simultaneously, for example participating in the rollout project and an enhancement project. Each of these activities could be in different countries and regions. The novelty of the organization structure created difficulties, as one of the interviewees pointed out:

“Understanding the new roles had some problems...Also building a network for transferring learning basically from person to person is not easy either. We had congruent processes and plans for common information system for different parts of the world, which required very harmonized organizations, especially on the concept side, so that each global position would have a counterpart in each region. To understand that has been a great challenge.”⁶

The role of global owners (process, concept and configuration) evolved and became significant towards the integrative role. Similarly, as Ashkenas and Francis (2000) noted in the context of mergers and acquisitions, the demand for integration manager, the ERP implementation called for integration roles. Creating organizational structures, making social connections, engineering success, and injection of speed are included in the integration manager's activities. The roles were set to overcome the challenge of how to develop functionality in the ERP system to best support the business processes in global perspective. The selection of the information system itself and the scope of

⁶ Author's translation

implementation had both temporary and permanent impacts on the implementing organization. The role of the ERP was significant.

The enhancement work is an ongoing process with continuous projects. NMP is a leader in the telecommunication industry. To get that position, NMP has to developed strategies and business operations. The industry leading companies need to stay ahead of the game and therefore an in-house development of both business solutions and technical system is a pre-requisite. The NMP competitive advantages included state of the art logistics processes. Since an ERP is built on best practices commonly known in the industry, the industry leader may value those best practices less. In fact, NMP developed several novel business processes. They varied from sales and production planning to warehousing and customs operations that were to become industry best practices. Therefore, they were not to supported by the selected ERP system. This forced NMP to focus on concept creation and configuration. The configuration owners were to invent functionalities in to the ERP and this increased the number of NMP modifications in the ERP. The amount of enhancement has decreased, but still continues. Therefore, the expertise needed can be located in the established permanent organization. With the periodical upgrades, organizational changes and ERP implementation projects to other divisions, the organizational approach to increased internal learning and knowledge of the ERP system has provided a competitive advantage to the case company.

Enterprise resource planning system use in Nokia Mobile Phones

The study demonstrates how an enterprise resource planning system emerged as a key component of an enterprise wide IT infrastructure (Weill, et al., 2002). It focused only on the ERP although the other elements of the IT infrastructure are acknowledged. The implementation of the ERP system provided a base for the IT infrastructure within NMP (Nokia).

The scope of ERP system in NMP was most of the modules in the manufacturing and logistics segment provided by SAP. These included sales and distribution, production planning, materials management including the inventory management and warehouse management, quality management, and the financial accounting modules. During the utilization, the module portfolio has increased with the export control and transportation modules for instance. After the implementation in the last site in Brazil, the human resource management module has been implemented. The scope of the implementation was extensive, covering the whole supply chain management and related financial flows.

Although Nokia has only one instance in use the actual productive system (P10), Nokia has several SAP R/3 systems (instances) for different use such as for development purposes (2), for testing (7), and for training (5). During the busiest phase in September 1999, the total number of different R/3 systems was 38 due to several parallel initiatives. This required significant coordination of resources. In SAP R/3, the Nokia organizational and business structure is defined in the enterprise model. This data describes how the focal firm is represented in the ERP system. Authorization is managed separately in on SAP R/3 environment. It is also used to direct the functionality of the ERP system and to provide the means to restrict the access rights of users to the organizational units that users are responsible for. End-users can have access to single organization, or multiple e.g. regional or global accesses. Employees have a user authorization for the productive system of the case company. The majority of the users are from the NMP division (78.3%). The number of users changes on a daily basis while the ERP system is introduced into other business divisions. The movement to utilization is visible in the number of users of the ERP system. Figure below illustrates the estimated trend in ERP system users. This estimation was made in 1997. In May 2002, the SAP R/3 productive system (P10) had over 9400 users according to Nokia internal user count report (Nokia, 2002b).

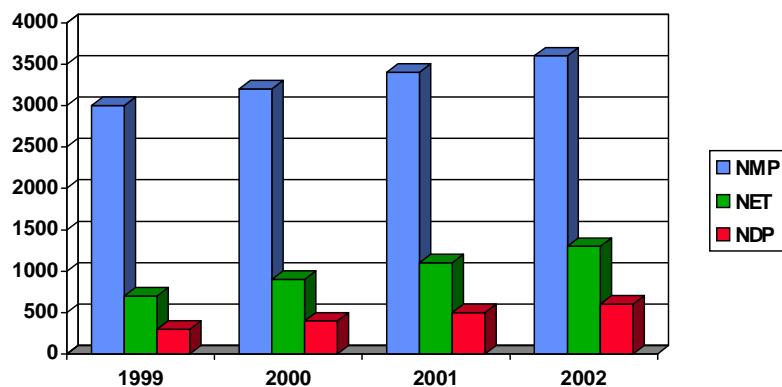


Figure 17. Number of ERP users in the case company (estimated in 1997)

The deployment of the ERP system into sites as rolling basis was executed with success. There were no unplanned breaks or disturbances in the major activities such as production and customer deliveries. Throughout the utilization of the system, the ERP system has been closed for only during the planned maintenance breaks. The ERP

system provides an infrastructure for the firm. The continuity of the enterprise resource planning system is still crucial within Nokia Mobile Phones.

2.3 SUMMARY OF THE CASE COMPANY ERP EXPERIENCE

The illustration of the case company has shown the changes over time. The changes can be described on department, actor, and activity levels. As the case corporation and the case company were used for platform thinking in its production strategies as discussed briefly earlier, it was less of a surprise to extend the platform thinking into other areas of business. The selection of an enterprise resource planning system to support NMP's logistics operations was clearly a distinct move towards platform thinking in the use of information technology. The underlying thought of "platformization" lies in the efficiency improvement potential, and has proven to be successful in the case company. Hence applying the idea into organizations is not so far fetched. The case study describes the structural development of a platform organization inside the case corporation. In the first years, the emerging corporate level platform organization mainly focused on the NMP division, but extended the focus to other divisions, thereby becoming a corporate-wide organization. Hence, it later became a corporate-wide function. The trigger for the development towards the new, platform, type of organization originated in the logistics crisis, the information technology strategy, and the selection of an ERP. The information technology strategy has extended to other information technologies and a variety of information system applications have been introduced in the case company. This adoption of new information technologies have been advanced partly due to the established platform organization, which itself continues to shift in structures to better support the strategies chosen. The significant role of the ERP system in the organizational transformation was noted.

A holistic view on organizing the activities was built on the layer model of ERP implementation and usage: dimensions of work, parallel activities in regions deployments (rollouts), and globally driven enhancements (SuLo). The enhancements could originate from any of the regions but were prioritized and piloted by the global team coordinating the efforts. The longitudinal approach was embedded in the model. Movement from temporality towards permanent roles in activities was accomplished in the project mode. Documentation improved with experience. The status in 2002: all NMP units utilize the same instance of an ERP system. Individual projects and parallel activities had been transformed into a platform organization.

The longitudinal analysis of the ERP implementation and use in the case company revealed several differences compared with existing research (review in chapter 3):

- 1) Re-engineering took place prior to the ERP decision and implementation contrary with the suggestions of Venkataram (1994).
- 2) ERP implementation was divided into two separate sets of projects, while the scope (from regional to global) changed. These were functionality enhancement projects and rollout projects. This has been covered less in the existent literature.
- 3) ERP implementation organization transformed during the period of analysis. Although permanent by nature, the roles became manifold and more fragmented due to specialization. This has not been noted by existent literature.
- 4) Re-engineering streamlining and new process development took place during all four dimensions and not just with implementation.
- 5) The case company installed only one productive instance (for some legal reasons there were two other partial installations to support the national financial regulations within those countries) compared with other large companies which typically have more than one instance linked together (Sarkis & Sundarraj, 2003). Davenport (2000) gives an example of a European conglomerate which had more than 400 different versions of the same system.
- 6) The implementation approach was "big bang" with all logistics processes and selected ERP modules. This approach is suggested less by the current research.

Several structural development incidents were in the development of the platform organization. From the micro level, e.g. department level, several organizational structural events could be identified. First, the conventional ERP implementation project structure was used in smaller scope initial implementation of sites in Finland and Germany. The implementing organization was a stereotype of an ERP implementation project organization, which was established from the IT perspective. Competent IT resources were transferred to learn new technology and simultaneously to implement smaller scope ERP. A large number of SAP consultants and some key informants from the business entities supported them. Although both of the projects were successful, the analysis revealed that this could not work with a wider scope of the implementation.

Second, SuLo 1 was a new regional implementing organization structure. It was revolutionary with the clear aim of integrating and forcing closer cooperation between business and IT domains. New roles were established and piloted. Business-driven IT implementation required some new ways of working, but proved functional.

Third, in SuLo 2, the organization structure became global. The SuLo 2 organization provided not only a global perspective, but also regional and local perspectives. This approach divided the workload and endorsed semi-controlled decentralization. The discussion of standardization and localization continues. This organization structure was a result of SuLo 1 structuring.

Fourth, temporary roles became permanent. The process thinking resulted that the function- and task-oriented IT department was seen as less capable of managing the region-wide ERP implementation alone. Therefore, changes were introduced in the organizational setting: concept areas were introduced allowing resources to be more efficiently focused and solving the holistic business problems and challenges faced due to the information system selected. The expertise of information systems possessed by actors in the IT department was complemented by expertise on business operations. The configuration owners would have clear contacts on the concept owner side and vice versa to solve arising problems. The key-users provided the daily operational expertise and line management level expertise. Business process owners would provide special expertise on each process areas especially concerning the strategies and their future development. The integrative role of concept owners would complement the setting by providing a holistic perspective not only on the ERP system but also on business operations. The change in ERP implementation would therefore be from technology-driven to business-driven. The focus was on shifted from 'lets make the system work maximally' to 'lets make the business operations be supported by the system maximally'.

Fifth, the new platform organization included business process and solution competencies as well as more traditional IT competencies. This was based on the approach that since the business and IT strategies can be and should be incorporated, the traditional IT organization would not be able to assist businesses. Different competencies needed to be incorporated in the unit. Cooperation between actors, departments and units was achieved in common projects.

The observed organizational transformation from several fragmented departments to a centralized platform organization is supported by Hodgkinson (1996) who pointed out the constant restructuring of IT function. The movement between centralized and decentralized IT organization was suggested. However, the difference here is that the emerged platform organization cannot solely be categorized as an IT function due to the several business related activities and roles included within the organization. In brief, the implementing organizational structures motivated by the ERP system implementation (and later utilization of it including other information systems) could not be predicted in 1994/1995. Neither was these structures planned. Looking back in 2003, the transformation was visible and can even be described as evolutionary. A chain of evolutionary incidents can be traced.

The direct integration between business domain and IT domain is difficult in complex multinational organizations in which the tasks of the users are very fragmented and geographically bound. A global view could not be achieved, yet it was required due to the high level of standardization. An end-user in one specific department, function or geographic location cannot make decisions concerning the entire corporation while his/her current position may not provide expertise or information for fact-based decisions. Furthermore, it may be impractical to tie the end-users directly in the system implementation while they should be concentrating the line organizational tasks.

The role of concept owners created during the ERP implementation represent the role of the “hybrid manager” (Skyrme, 1996:436): “ *A hybrid manager is someone who blends the skills of information management and business management.*“ The concept owner role is clearly a hybrid manager role during the ERP utilization. In order to capture the business requirements in centralized manner, a cadre of concept owners was appointed. The fact that most of them came from the line organizations ensured the closer relationships with the end-users. The participant observations resulted in the notion of another hybrid manager group. These were the configuration owners while to some extent their role developed to be that of hybrid manager. The configuration owners came from the IT functions, but during utilization were required to learn the business domain activities, strategies and reasoning. Their interest beyond the technical side of the implementation was observed.

Before the notion of hybrid managers and hybrid teams, the information system literature was based on the assumption to integrate the future end-users and IT specialists directly (DeSanctis & Courtney, 1983, Feeny & Earl & Edwards, 1996). In the case company similar efforts were made. Through service level agreement (SLA), Nokia IT organization agreed with NMP (business organizations) on services and their management. SLA standardized and formalized the dialog between IT and NMP management. It described cooperation in different levels in organizations. However, this formal agreement did not directly bind the concept owners who worked at that time for different department. The SLA was most visible in the global support model (see appendix 7). The concept owner role was defined in it. This implies that the hybrid manager role, such as concept owner role, is not organizationally bounded. The supportive role given to them was without a mutually agreed mandate.

3 EXPLORATION OF THE RESEARCH FOR THE MODEL DEVELOPMENT

This study is related to the disciplines of organization and management, international business, and information management science. This poses a challenge. Literature from different streams is considered, but it clearly concentrates on organization and management in the international business perspective. Information management literature is included. However, this review is by no means exhaustive because it distinctly focuses on research identifying ERP as the information system. Although the following was not in the central focus in Maula's (1999) research, she noted that the nature of the multidisciplinary studies can cause several problems. First, the researcher's single-dominant background may have a limiting effect. Second, understanding the concepts and terminology may cause difficulties. Third, the disciplines lack shared concepts. Fourth, different interpretations of concepts between disciplines may cause problems. And fifth, the methodological approaches supported in different disciplines can collide. The phenomenon under study demands a wide understanding of different models applied simultaneously in an MNE context. To avoid the possible problems stated by Maula (1999), this research has tended to focus on the perspective of international business discipline rather than on information systems or information management disciplines. To avoid the second difficulty, the present study defined the key terms used in this research. This research will provide a common approach to overcome the third and fourth difficulties by defining the concepts.

This chapter reviews the recent literature suggested in the research framework. The research assumes a longitudinal continuum of theory development in relation to organizations, management, and change. The chapter is divided into five interrelated sections (see figure below). The review starts with the focus on the recent theoretical developments. The present study divides this continuum into scientific management, systems theories, and complexity science(s). The introduction of the recent development in the MNE research is discussed especially the structures and coordination mechanisms, because the organizational focus is a MNE. After this, the discussion proceeds to the complexity science(s). It is followed with discussion of transformation especially bringing up the business process reengineering literature. From the IT specific literature, the enterprise resource planning research is reviewed. After the overview of the recent research, the chapter continues with development of the theoretical model.

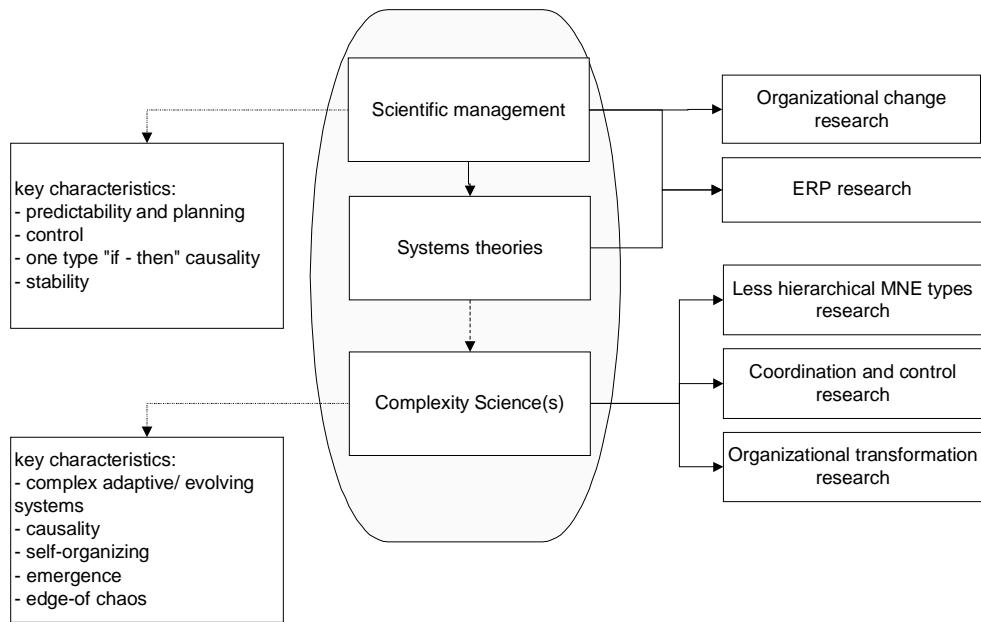


Figure 18. Theoretical background

The figure above depicts the theoretical background related to the research interesting for the present research. In this research, the theoretical alternatives are not seen as contradictory but as supporting each other. The present study explores the complexity perspectives. It looks into complexity sciences as an emerging school of thought. For the purpose of introduction and discussion, the theories are introduced next.

3.1 FROM COMPLEXITY THEORIES TO COMPLEXITY SCIENCES

International business research usually focuses on firms that cross national boundaries. Dynamics in the business world create new challenges to firms. Hence, international business is characterized by increased uncertainty. The general methods to cope with uncertainty may include prediction, insurance, avoidance, control and flexibility (Mascarenhas, 1982). The explanatory power of scientific management has been evolved towards the theory of complexity sciences. The complexity sciences are characterized as under development. Several theoretical research streams are identified and introduced, for example, chaos theory explains how a seemingly small change somewhere can potentially produce a large and unpredictable change elsewhere. More practically, it concerns complexity theory, which focuses on the system capabilities (Eisenhardt &

Brown, 1999). Autopoiesis theory can explain cognition and language in social systems (Maula, 1999). Therefore, complexity sciences are discussed next in more detail level.

The theoretical orientation

The chapter develops the theoretical framework for the present study. The figure below highlights some of the central differentiators among the theory choices. The theoretical background for scientific management is relatively well known and incorporated in the current mainstream theories in management. Scientific management is based on the work of Taylor and Fayol (Stacey, et al., 2000). However, Dooley, Johnson and Bush (1995) consider the Newtonian paradigm as the origin. Stacey, Griffin and Shaw (2000) go as far as claiming that much of the current research and discussion around management is based on the scientific management that date back to Taylor and Newtonian mechanics. Figure 21 depicts some of the main differences between the theories. The premise of this thesis is the applicability of the complexity sciences in research on organizations and management.

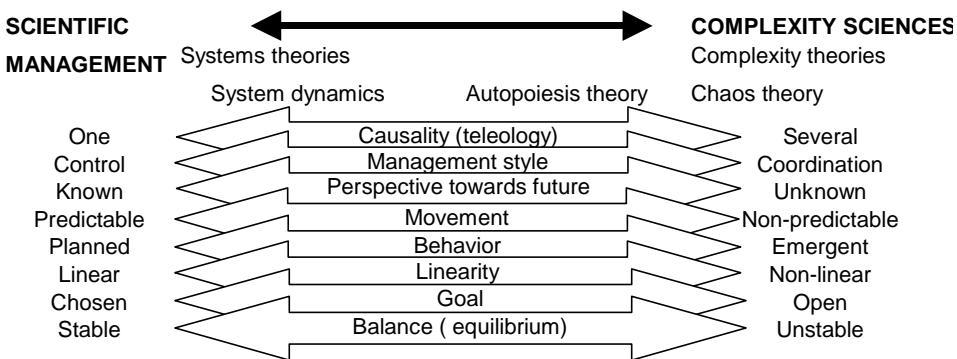


Figure 19. Characteristics compared with systems theories and complexity sciences

Comparison between the Newtonian mechanics, scientific or systems theory and complexity sciences have been common in the literature while this juxtaposition easily demonstrates the differences between the theories (see Dooley & Johnson & Bush, 1995, Stacey & Griffin & Shaw, 2000). For scientific management the observer is seen as external and objective. This reductionist thinking and thinking in linear fashion are embedded in the western cultures (Parker, 1994, Wood & Caldas, 2001). Accordingly, complex relationships can be reduced to simple forms and analyzed separately. Thus Parker (1994:3) stated "*the whole is merely the sum of parts*". Moreover, linear reasoning emphasizes the specific effect of a cause. Therefore, they are not typically challenged.

The mechanism is considered as a whole and thus it has to be analyzed in parts. Necessary rules or laws are created to govern the behavior. These laws then produce movement to optimal patterns of behavior.

Scientific management contributions

The main contribution of the scientific management (Stacey & Griffin & Shaw, 2000, Hedman & Kalling, 2002) was the efficiency approach and introduction of scientific methods in management such as forecasting, planning, organizing, coordinating, and controlling. They create stability, which is commonly sought and respected. Scientific management influenced the development of general system theory, cybernetics and systems theory (Stacey & Griffin & Shaw, 2000). Furthermore, cybernetic ideas are also embedded in management science, in control theory, systems engineering, and information theory (Flood, 2001). Forrester developed the applied systems theory emphasizing industrial dynamics. This has subsequently become known as systems dynamics. Information feedback systems, decision-making processes, experiments, and computer systems form the foundations of systems dynamics. Modeling systems allow study of the dynamics and correction of any problematic behavior. Mathematical models and model simulations are used to construct a system and non linear equations specify how the system changes state over time. Lately systems dynamics has been applied in organizational learning and the study of its dynamics (Forrester, 1961, Senge, 1990, Stacey & Griffin & Shaw, 2000, Flood, 2001). To summarize the discussion of scientific management, they are applicable in a stable situation, especially when the world is viewed as regular and predictable (Parker, 1994). Several models and suggestions originated from it are still valid in managing organizations.

In contrast to this conventional scientific management perspective, complexity science assumes that equilibrium and stability in an organization diminish the creativity and flexibility required in turbulent times. The future is unknown and therefore specific predictions cannot be made. Researchers working from the complexity science perspective argue that the limits of Newtonian rationality have been reached and that other theories and explanations are needed (see for example Prigogine & Stengers, 1984, Johnson & Burton, 1994, Stacey & Griffin & Shaw, 2000).

Application of complexity sciences

Complexity sciences can be applied through many lenses and unified view is not yet available (Johnson & Burton, 1994, Maquire & McKelvey, 1999, Stacey & Griffin & Shaw, 2000, Fuller & Moran, 2001, Richardson & Cilliers, 2001, Mitleton-Kelly, 2003). Wide interest in complexity sciences has emerged in the past decade. This is shown by a variety of books - both academic and popular - (Maquire & McKelvey, 1999), articles and research programs (Complexity, 2004). Numerous management of organization publications (for example Stacey, 1991, 1995, Brown & Eisenhardt, 1998, Eisenhardt & Brown, 1999, Wheatley, 1999, Stacey & Griffin & Shaw, 2000) have shown increasing interest in recent decades in applying this perspective in studies of organizations. Articles are often conceptual or theoretical (see for example Johnson & Burton, 1994, Thiertart & Forgues, 1995, Anderson, 1999, Fuller & Moran, 2001). Considering the impossibility of including all of the exhaustive literature on the subject, a selection for the review has been made. Complexity sciences has been applied in the study of management and organization, and applied in organizational research. Dooley, Johnson and Bush (1995) have rather controversially applied the complexity science paradigm in research on total quality management practices. Furthermore, MacIntosh and MacLean (1999) have proposed a three-stage model of organizational transformation from the complexity science perspective. Volberda (1998) contributed to the discussion of complexity science application to management science. He stated that in contrast to classical or modern management principles, which encourage people in organizations to obey orders and keep their place, the new management perspective values participants in organizations based on their ability to *"take an interest in, challenge and question what they are doing"*. Fuller and Moran (2001) applied complexity sciences in the context of SMEs. Thiertart & Forgues (1995) applied chaos theory in the study of organization and management focusing on organizations as nonlinear dynamic systems. Within the field of organization and management, the complexity science perspective has been applied in the study of the role of chaos in management (Brown & Eisenhardt, 1998, Wheatley, 1999). The interest in applying complexity science is growing. It suggests that different explanations are required to explain organizational behavior today. However, discussion of whether complexity sciences are applicable to management and organization has also emerged (see Johnson & Burton, 1994, Lissack, 1999, McKelvey, 1999). This applicability is questioned for several reasons: first, due to the development state of the theories included in sciences of complexity in general, second, because the original findings of complexity sciences are mostly found in molecules, particles, and systems comprised of them. Therefore, direct application to human systems, i.e. organizations are questioned.

The applicability of the complexity sciences into the study of organizations is supported (Stacey, 1995) because organizations are nonlinear feedback systems, which is the domain of complexity science. Organizational success is explained (McDaniel & Walls, 1997) as dependent on understanding that complex relationships are more important than hierarchical positions in an organization. Interestingly, recent research shows that applying complexity sciences in organizational settings would require a shift from role definitions towards relationship management (Anderson & McDaniel, 2000). This relationship management approach would support development of information-driven networks.

Classification of the complexity sciences

According to Stacey, Griffin and Shaw (2000) there seems to be a number of different strands of thought that form complexity science. In contrast to researchers (Johnson & Burton, 1994) who link chaos theory and complexity theory together, Stacey, Griffin and Shaw make a clear distinction between 1) chaos theory, 2) complex adaptive system theory, and 3) dissipative structure theory that together formulate the complexity science (see figure 20). This distinction is explained by underlying causality and novelty. The differentiating reason might also be the level of analysis: macro and micro level or the perspective of future (Stacey & Griffin & Shaw, 2000). The future is generally characterized as either known or unknown. Richardson and Cilliers (2001) in their review of complexity literature found three different schools of thought: first, reductionist complexity science, which intends to develop a grand theory of organization; second soft complexity science, which provides metaphorical lenses and concepts to create common language and meaning; third, complexity thinking, which aims to change basic assumptions. Another categorization in application of the complexity science in management studies is to divide this body of work into two groups: edge of chaos research and dissipative structure research (MacIntosh & MacLean 1999). They are distinguished by their view on the concept of deep structure. Deep structure is understood as a set of rules governing the organization and business logic. Thus, the deep structure is the basis of the organizational archetype. Also scientific chaos theory, chaos theory and complexity theory have been used almost as synonyms (Johnson & Burton, 1994).

According to Stacey (1995:491)

“The science of complexity suggests to focus on how random connections between people and the simple decision rules they use can lead to complex global patterns of behavior taking the form of new strategic direction and organizational renewal.”

The present research relates the autopoiesis theory to sciences of complexity (see figure below). It is on the same continuum with scientific management and systems theories, and complexity science. Hence, it is part of the larger group of sciences of complexity. This interpretation stems from the focus of the theory, e.g. complex systems. According to autopoiesis theory (Maturana & Varela, 1980), systems are autonomous, self-referring, self-constructing, and closed. They do tend to be homeostatic, which implies systems theory characteristics. However, the characteristic of self-production and system complexity ties it then to science of complexity. Autopoietic systems create their own boundaries and therefore can decide what information enters the system. They produce themselves and their components, which imply that they have potential for self-organizing. The following figure depicts a synthesis of the main theories included in the sciences of complexity. The development of each theory is continuing. These theories use concepts from the same complexity pool (see table 5). Due to the developmental phase of the theories, the discussion, concepts, paradigms and theories have been quite mixed.

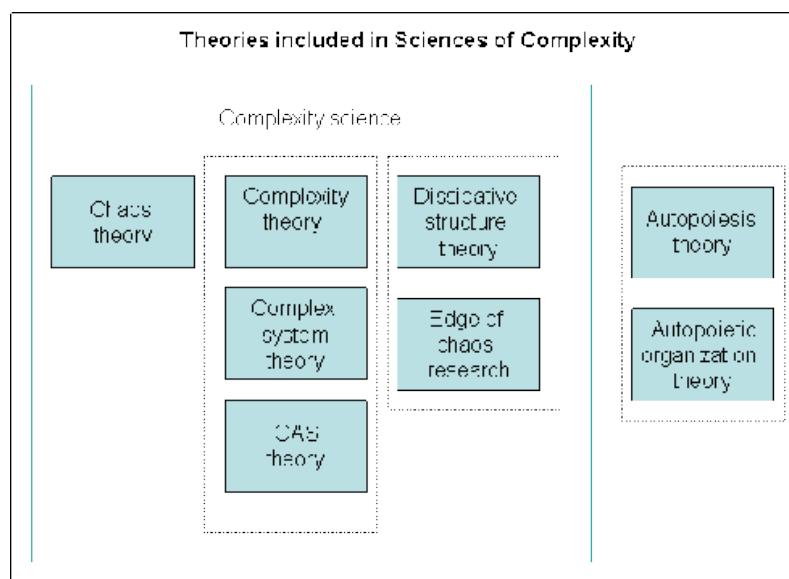


Figure 20. Theories comprising the sciences of complexity
(Synthesis of MacIntosh & MacLean 1999, Maula, 1999, Stacey & Griffin & Shaw, 2000, Bakken & Hernes, 2003)

Some researchers (see Dent, 1999) have listed descriptors for comparison of the new thought on complexity science with the more traditional approach. Other researchers (see Lissack, 1999) have listed the metaphors used in complexity science. There are also publications comparing the Newtonian paradigm and the complexity paradigm in terms of values, beliefs, symbolic generalizations, and shared examples (Dooley & Johnson &

Bush, 1995). The above discussion illustrated the theoretical variety within the complexity sciences. This chapter continues to introduce some key concepts. Then the central theories included in complexity sciences framework are discussed.

3.1.1 *Key concepts in complexity sciences*

The complexity sciences incorporate a number of concepts and theories. This implies controversy and confusion in interpreting and applying them. Several key concepts are selected from literature for further analysis. The synthesis of the concepts is presented in table 5. It illustrates some of the key concepts and provides a short general explanation from the complexity sciences perspective. The research views organizations as complex adaptive and evolving systems. Mitleton-Kelly (1998:3) suggested that "*Complexity arises from the inter-relationships, inter-action and inter-connectivity of elements within a system and between a system and its environment.*" Hence their characteristics are analyzed next. The concepts of causality, self-organization, emergence, and edge of chaos are then elaborated in more detail because they are intertwined with the CAS/ CES. Fuller and Moran (2001) stated that the study of complexity relates to changing patterns, self-organization, and constrained diversity. Furthermore, the case study examines their presence.

Concept	Closely related to	Meaning
Attractors	Fractals	Demonstrate the pattern of system behavior. The behavior observed is controlled by control parameter, which is the rate and value of energy inserted to the system (entropy).
Bifurcation point		A critical point in which the movement/ behavior of the system is unpredictable.
Causality		In scientific management and systems theories, one type of "if - then" -rules of causality is defined. In sciences of complexity, there are variety of causality.
Complex Adaptive Systems (CAS)	Complex Evolving Systems (CES)	(Complex) Systems that are formed out of many components, which have emergent behavior. The system are subject to unexpected change and thus adapt through a process of self-organization.
Complexity		Associated inter-relationships and inter-actions that connect system constituent elements.
Dissipative structures		open systems which exchange energy, matter or information with their environment. New level of order in system disintegrated by far-from-equilibrium condition.
Edge of Chaos	Far-from-equilibrium	The elaborate nature between order and disorder, or regular and irregular behavior. The space between stability and instability. Energy and stimulation leading to creativity. Systems that survive often when they are pushed away from equilibrium (cf. economic models) while they die if they remain at equilibrium.
Emergent phenomenon	Emergence	Dynamical construct of structures.
Entropy		Control parameter external to the system, which triggers the behavior that is enfolded in the system. The rate and value of energy inserted in the system.
Initial conditions	Sensitivity to initial conditions ; Sensitive dependence on initial conditions (SDIC)	Dependence on the initial condition is noted when a small factor or event produces unexpected outcome. Thus a small change in the initial conditions can produce major and unpredictable (qualitative) changes.
Irreversibility		Nature that there is no possibility to reverse changes back to the initial conditions.
Nonlinearity		Nonlinear systems have embedded synergy which makes " the whole greater than the sum of parts", cf. linear systems produce a single, predictable outcome.
Predictability	Unpredictability	Perspective towards future, behavior etc. in which the predictability is insignificant.
Self-organizing	Self-organization	Spontaneous creation of (complex) structures arise out of disorder as a result of system dynamics, i.e. process of self-organization.

Table 5. Concepts constituting the complexity sciences

Five frameworks of causality

In comparison with the systems theories, complexity science has a different perspective on causality. In their criticism towards most writers, Stacey, Griffin and Shaw (2000) point out that one of the most important characteristics is the perspective on causality. They agree with systems thinkers that causality exists, but not just the homogenic "if – then" - causality rules suggested by a rather mechanistic view of management. They suggested five distinctive causality (final causes) concepts. The conceptualization includes the following causalities termed as teleologies⁷: 1) secular natural law teleology, 2) rationalist teleology, 3) formative teleology, 4) transformative teleology and 5) adaptionist teleology. (Stacey & Griffin & Shaw, 2000)

⁷ **teleology** (Gk., *telos*, end) The study of the ends or purposes of things. Blackburn, Simon. 1996. *The Oxford Dictionary of Philosophy*.: Oxford University Press.

	The Natural Law Teleology	Rationalist Teleology	Formative Teleology	Transformative Teleology	Adaptionist Teleology
Movement toward a future that is	Repetition of the past; known state	A goal chosen by reasoning autonomous humans; known state.	A mature form implied at the start of movement or in the movement. Implies a final state that can be known in advance; known state	Under perpetual construction by the movement itself. No mature or final state, only perpetual iteration of identity and difference, continuity and transformation, the future is unknowable but recognizable: the known and unknown at the same time.	A stable state adapted to an environment that may change in unknowable ways; unknown state
Reason for the movement into the future (sake of/ in order to)	Reveal or discover hidden order, realize or sustain an optimal state. Change is only movement to the perfect.	Realise chosen goals. Change is a consequence of human choice.	Reveal, realize or sustain a mature or final form of identity of self. This actualization of form or self that is already there in some sense, reproduction of forms without any significant transformation.	Express continuity and transformation of individual and collective identity and difference at the same time. This is the creation of novel variations that have never been there before. Imply potential to radical transformation.	Survive as an individual entity. Change is movement to a stable state of adaption to environment.
The process of movement or construction; the cause is	Universal, timeless laws or rules of an "if - then" kind. The cause is efficiency.	Rational process of human reason with ethical universals, reflected as human values. The cause is human motivation.	Process of unfolding a whole already enfolded in the nature, principles or rules of interaction. The cause is formative.	Processes of micro interactions in present forming and being formed by themselves. The iterative process sustains continuity with potential transfromation at the same time.	A process of random variation in individual entities, shifted out for survival by natural selection. The cause is formative.
Kind of self-organization	none	none	Repetitive unfolding of macro pattern already enfolded in micro interaction.	Diverse micro interaction of paradoxical kind that sustains identity and potentially transfroms it.	Competitive struggle.
Nature and origin of variation/ change	Corrective, "getting it right", aligning, and fitting.	Designed change through rational exercise of human choice	Shift from one given form to another due to context. Stages of development	Gradual or abrupt changes in identity, or no change, depending spontaneity and diversity of variations of micro connections.	Gradual change due to small change variations at the individual levels.

Table 6. The five causalities framework
(adapted from Stacey & Griffin & Shaw, 2000)

Capability to predict and control is dependent on capability to identify causal links. The causalities presented in table 6 show fundamental differences in understanding the change in organizations. The second distinctive characteristic is the nature of the control in organizations. Stacey, Griffin and Shaw (2000) claim that in systems theories and thus the domain of the management school of thought, the manager's role in organizations is to design and control what happens in the organization. Staying in control is a virtue and assumed to lead towards success. Controversially, they argue that individuals comprising the organization cannot control all activities that are happening. They (2000:15) argue

"that an understanding of creativity and novel change in organization requires this perspective of Transformative Teleology."

The organization's intrinsic change and transformation leads to truly novel structures. Therefore, by controlling individuals, managers aim to prohibit the internal dynamics that are intrinsic in every organization. This may in turn decrease innovation, experimentation, and individual initiative (Thierry & Forges, 1995). According to the understanding of the present research, the one type "if – then" causal rule exists but the understanding that other causalities may be present is underlying the study.

Complex adaptive systems (CAS) and complex evolving systems (CES)

Similarly to a definition of organization, complex systems are easy to recognize but difficult to define (Morel & Ramanujam, 1999,). A complex system is illustrated in figure 20. Bar-Yam (1997) stated that systems that are formed out of many components that have an emergent behavior are called complex systems. When including the space dimension, e.g. the environment, the complex systems are generally characterized as adaptive. Thus, the term complex adaptive system is used to describe these systems. A complex system captures its history, which in turn affects its evolution (Richardson, et al., 2001). Maquire and McKelvey (1999:26) define a complex systems as

“a system (whole) comprised of numerous interacting entities (parts), each of which is behaving in its logical context according to some rule(s), law(s) or force(s). In responding to their own particular local context, these individual parts can, despite acting in parallel without explicit inter-part coordination or communication, cause the system as whole to display emergent patterns – orderly phenomena and properties – at the global or collective level”.

The researchers view CAS and CES from different perspectives. When the CAS model is used, the managers are said to focus on designing the future (strategy, vision) instead of on forecasting the future, on keeping the structure of the organization flexible instead of trying to find or design the right structure, and releasing the potential dynamics embedded within the organization (Anderson & McDaniel, 2000). Information and energy from the environment can freely flow into a CAS (see Anderson & McDaniel, 2000) and without energy a CAS does not function (Pascale, 1999). Furthermore, a CAS is characterized by a large number of agents, which interact locally in dynamic and non-linear fashion (Anderson, 1999, Pascale, 1999, Morel & Ramanujam, 1999,, Anderson & McDaniel, 2000). When organizations are seen as complex adaptive systems, they are moving from the thought of mechanistic hierarchical system of control towards flexible rules or structure settings (Pascale, 1999, Anderson & McDaniel, 2000). In effect, the CAS is self-organizing (Brown & Eisenhardt, 1998, Pascale, 1999, Anderson & McDaniel, 2000). Independently observable and empirically verifiable patterns appearing due to the collective behavior of agents are called an emergent property of the complex system (Morel & Ramanujam, 1999).

Anderson and McDaniel (2000) argue that the history of the system matters when organizations are seen as complex adaptive systems, while the multiple feedback loops in the interactions of agents exists (Thiart & Forques, 1995, Morel & Ramanujam, 1999,).

The concept of time (edge of time and pace of time) has been suggested as a characteristic of CAS (Brown & Eisenhardt, 1998). It has also been argued (MacIntosh & MacLean 1999, Anderson & McDaniel, 2000) that agents interact under changeable sets of rules. These rules change due to interaction between the agents themselves as well as due to the encounters with the environment that lead to the emergence of orderly patterns of behavior. The agents may not be aware of the behavior of the entity as whole (Anderson & McDaniel, 2000). Diversity in the group of interacting agents as well as with the relationships is seen as a positive strategy for CAS (Anderson & McDaniel, 2000). As a consequence of the characteristics discussed above, complex adaptive systems are described as learning systems (Dooley & Johnson & Bush, 1995, Anderson & McDaniel, 2000) and anticipating systems (Pascale, 1999, Anderson & McDaniel, 2000). To distinguish human systems i.e. organizations from other systems, the term **complex evolving system** (CES) was recently introduced (Mitleton-Kelly, 1998). This conceptualization is supported by Brown and Eisenhardt (1998). Systems capable of learning through the learning of agents of the system are complex evolving systems (Complexity, 2004). Both CAS and CES can also be seen as dissipative structures.

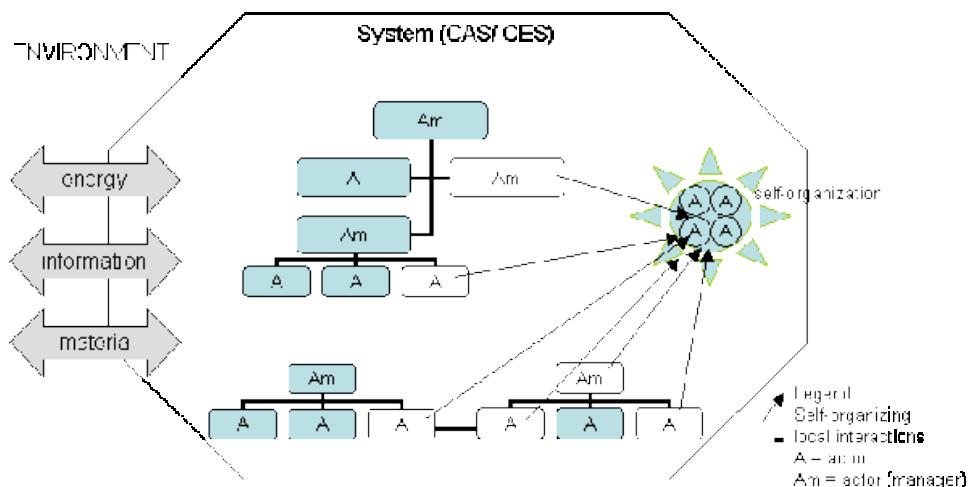


Figure 21. Illustration of complex adaptive system/ complex evolving system
(Author's illustration; synthesis of the literature)

Figure 21 illustrates the self-organizing process embedded in CAS/ CES. The actors (A) in a system, here organizational system, began to self-organize when system receives energy, information or material from the external environment. Moreover, self-organizing agents build intra-organizational relationships. They create emergent behavior, which then creates novelty and transformation in organizations to respond to future changes.

The self-organizing is not planned by manager (Am), but spontaneous. The actors may belong to different units within a system (organization). They group together to solve an issue. After self-organizing and solving the issue, the structure dissipates. As a result of applying CASs in professional organizations, Anderson and McDaniel (2000) found that the managers should focus on relationships between the agents of organizations more than on role determination. This shift of attention focus is needed because the agents interact with each other and are thus interdependent. Similarly, Anderson (1999) suggests that application of CAS would produce rapidly evolving and adaptive solutions. This increases the information creation in an MNE. CAS theory states that a CAS has a large number of agents (actors in organizations) having local interactions, which allow self-organizing to emerge, thus leading to structural development.

The process of self-organizing and self-organization

Through the process of self-organizing, order and organization can emerge from disorder and chaos (Prigogine & Stengers, 1984). In his studies on self-organizing and emergent order, Stacey (1995) observed that the richer patterns of inter-connection between individuals lead to more a changeable system until everybody is connected with each other and then system becomes random. According to Stacey, when the interconnections between organizational agents are few, the order will be unchangeable in form, but when these linkages emerge and become too rich, the system will be hyperactive and difficult to make sense of. Therefore, random interconnections at local level can produce an emergent global order. Self-organization is defined as a spontaneous creation of structure as a result of the dynamics of the system, and during this dynamic transformation system gets increasingly organized under own dynamics. Furthermore, self-organization requires certain condition in a system. This condition is called being out-of-the-equilibrium or on the edge of chaos. Patterns of self-organization may be emergence, adaptation and evolution.(Stacey, 1995, Morel & Ramanujam, 1999, Wheatley, 1999, Fuller & Moran, 2001)

In contrast to general view on self-organizing, MacIntosh and MacLean (1999) argue that the self-organizing process does not need to be spontaneous, random, and unpredictable. Organizations consisting of humans have capability to consciously construct conditions under which a successful transformation process can take place.

Wheatley and Kellner-Rogers (1996) identified identity, information and relationships as the conditions of self-organizing organizations. Similarly, Knowles (2001) suggested

identity (focus), relationships (interdependent), and communication (open) as the domains of self-organization. Self-organizing systems are characterized by equal distribution of power and self-management (Ludema, et al., 2001). A self-organizing system is simultaneously a dissipative system (Jenner, 1998). Moreover, they have a change capability to create structures that work in the situation in hand (Wheatley, 1999). The capability of self-organization indicates that self-organizing human systems can be described as a learning organization (Dooley & Johnson & Bush, 1995). Nonaka (1990) defined self-renewing process through four phases; generation of new visions, activation of organizational information creation, generation of dynamic cooperation, and restructure of organizational knowledge. He proposed that chaos is created and amplified to increase new information intake. As such, the trigger for self-renewal can come from inside or outside the firm. A central feature of self-organization is that local interactions aggregate individual behavior and novel, unpredictable patterns emerge. In consequence, they may change the structure of an organization. Informal structures emerging in organizations, especially command-and-control type of organizations, are another sign of self-organizing capability that can explain resistance towards formal changes (Anderson, 1999, Knowles, 2001). Therefore, participation rather than the imposed or designed actions of an agent (especially managers) brings emergent behavior and the dynamics of self-organizing (Stacey & Griffin & Shaw, 2000, Fuller & Moran, 2001). Likewise, Stacey, Griffin and Shaw (2000) suggest that in an organizational setting, managers try to prevent self-organizing from happening. The idea of spontaneous change is neglected, while the managers are eager to control and guide the change. Managers aim to change organizations by keeping them the same. This cannot lead to novel solutions in organizations structures or activities. The different management logic founded in self-organizing changes the management identity because it stresses trust in bottom-up processes (Lewin & Volberda, 1999). However, in knowledge-intensive organizations this trust should be inherent, since the actors are specialist/ professionals in their areas. Intrinsic motivation produces self-regulation or self-control that cannot be achieved by control. A close term to self-organizing is *autopoiesis*, which according to Wheatley (1999) refers to a system's capability to create and renewing itself. Autopoiesis in action means that the system focuses on preserving itself, which may lead to something new. Autopoiesis theory is discussed separately.

Emergence and emergent phenomenon

The emergence according to Coldstein (1999:49) "refers to the arising of novel and coherent structures, patterns, and properties during the process of self-organization in

complex systems". Standish (2001) agrees that emergency is a key feature of a complex system. The emergent phenomenon therefore has the following identifying properties: radical novelty, coherence (identity), macro level or global existence, dynamic construct, and visibility. Applied to organizations Stacey, Griffin and Shaw (2000) consider a situation emergent in which the individual actors in the organization emerge without control or decision from the managers. Therefore, self-organization happens without any pre-definitions. If managers decide first on the organizational structure for the future and then how to get there, it is not a sign of an emergent property of the organization, i.e. the self-organizing process.

Edge of chaos

The term chaos is paradoxical. Its everyday sense and the scientific sense collide. The everyday meaning refers to muddle, mayhem and randomness in behavior. However, the scientific meaning emphasizes the elaborate nature between order and disorder or regular and irregular behavior. (Parker, 1994) Chaos refers to system behavior which looks random, but is driven by deterministic rules (Thiart & Forques, 1995).

"The edge of chaos" or "far-from equilibrium" is defined as a state leading to creativity, which on the other hand, is required to be able to cope with the turbulent environment (McDaniel & Walls, 1997). Stacey, Griffin and Shaw (2000) argue that many researchers such as Brown and Eisenhardt, Pascale, MacIntosh and MacLean use the concept at the 'edge of chaos' as a situation of crisis that can be used to push organizations into creativity or change. The space between stability and instability is also called bounded instability (Parker, 1994). In this state, the formal systems are used in organizations in day-to-day operations to secure their function effectively. However, the informal system operates simultaneously in a destabilizing manner to create change in the organization (Stacey, 1995). The balance between the organizational structure and flexibility can create improvisation that is temporary by nature. It is not an "out-of control" situation, but rather an edge-of-chaos situation (Anderson & McDaniel, 2000). Furthermore, the state of chaos is understood as a cause of an emergent pattern of behavior in the organization. The essence of edge of chaos conditions is captured (Prigogine & Stengers, 1984:13) as follows:

"The remarkable feature is that when we move from equilibrium to far-from-equilibrium conditions, we move away from the repetitive and universal to specific and the unique."

The behavior at the edge has potential importance for application in management sciences (Parker, 1994). Applied in management science, the balance in an organization or fit can be described as an equilibrium condition. Thus complexity science suggests that behavior on the edge of chaos is more critical to firms than being in the equilibrium state because too much or too little structure do not create positive change (Brown & Eisenhardt, 1998). Furthermore, Prigogine and Stengers (1984) state that "communication" can arise far-from-equilibrium conditions bringing up a new coherence among participants. Respectively, the edge-of chaos condition may be present in CAS/CES when self-organizing begins. Hence, it can be directly linked to the organizational transformation.

3.1.2 *Theories incorporated into complexity sciences*

Complexity sciences incorporate several theories. A short overview is provided of (scientific) chaos theory, dissipative structure theory, complexity theory, and autopoiesis theory. The developing self-organizing theory is also included. These theories are in a developmental state in application to organizations. They have originated in natural sciences, especially biology and physics. A characteristic of the theories is their paradoxical concepts such as (scientific) chaos and dissipative structures. They use the same concepts such as stability/ instability, order/ disorder and self-organizing.

The introduction and historical reviews of the evolution of **chaos theory** are manifold (see for example Dubinskas, 1994, Johnson & Burton, 1994). Scientific chaos theory can explain observed phenomena, which have characteristics of order and stability, and also disorder and irregularity. Thierart & Forges (1995) suggested sensitivity to initial conditions (impossibility to measure and thus predict), strange attractors (attraction towards organizational configurations), organizational scale invariance (fractal forms), time irreversibility (non-repeatability of past situations) and bifurcation processes (phased change processes) as the qualitative properties of chaos theory. As a positive consequence, disorder (chaotic behavior) provided an opportunity to explore new ways of doing and acting. Stacey, Griffin and Shaw (2000) contend that the main difference between complexity theory and chaos theory is the perspective towards the future and novelty in change. The change or movement in the future is already enfolded within. Therefore, there is no true novelty in this change. It has been argued (Mitleton-Kelly, 1998, Stacey & Griffin & Shaw, 2000) that chaos theory cannot be applied directly to the study of human systems such as organizations, because humans have freedom to make conscious actions, change the rules of interaction, learn, and adapt. Chaos theory may

increase the understanding of the role of stability and instability, and order and disorder within firms.

As with the concept of chaos, the dissipative structure concept is also paradoxical. The term dissipation refers to loss and structure refers to embodied order (Wheatley, 1999). In other words, the constructive role of dissipative processing (destruction) during the formation of a new structure. Triggered by edge of chaos/ far from equilibrium condition, the dissipative structures demonstrate self-organizing into a new form of order (see Dooley & Johnson & Bush, 1995). This self-organizing is triggered by anything disturbing the system and leading its transformation. Prigogine and Stengers (1984) have developed **dissipative structure theory**. New types of structures may emerge through sequences of disorder into order. In other words, the dissipative structures are understood as a dynamical pattern of change that has the characteristics of external factor, bifurcation point, self-organization, and emergence. The system begins to self-organize, during which a new coherent pattern emerges. This new coherent pattern cannot be predicted from the former system. A system dissipates imported energy or information from the environment by continuously renewing itself. Central to this pattern of dissipative structures are the small movement variations, or fluctuations, either in the entities that comprise the system or in the environment in which the system operates. If organizations are viewed as dissipative structures, these organizations tend to have cycles of evolution and revolution (MacIntosh & MacLean 1999). The shift from a formative towards transformative teleology is noted (Stacey & Griffin & Shaw, 2000).

Transformation of an organization is seen by MacIntosh and MacLean (1999) as a process in which the organization, seen as a dissipative structure, keeps the organization structures changing until a new archetype prevails eventually. The process could start in a crisis such as a bad performance. MacIntosh and MacLean continue that sensitivity to initial conditions underlies the transformation. According to Maquire and McKelvey (1999) organizations can generate emergent dissipative structures such as self-directed teams, emergent networks and cross-functional liaison teams. They can be supported by providing agents (employees) with a variety of information including performance levels compared with competitive firms. Consequent to information flows is knowledge accumulation and learning.

MacIntosh and MacLean (1999) see **complexity theory** applications in the social science domain. Especially organization and management are closely linked with the concepts of self-organizing, interacting, and co-evolving systems and sub-systems. Complex system

theory and complex adaptive system theory form complexity theory. There is a link between organization theory and complexity theory; dynamic change, adaptation and evolution of complex systems are a common field of research in both disciplines (Morel & Ramanujam, 1999,). Pascale (1999) links the complexity theories with organizational research by noting that the more homogenous the organization is the more vulnerable it becomes since the existing social order inside the organization works to neutralize, isolate, and destroy foreign agents. This notion of diversity is supported by other scholars (McDaniel & Walls, 1997). Flood (2001) maintains that in the organizational context the traditional prediction and control practices could never explain everything. This is because social dynamics remain beyond control.

Scientific chaos theory and complexity theories have been developed in the natural science and recently shown emergency in the social sciences. Similarly, autopoiesis theory has been developed in biology (Maula, 1999, Bakken & Hernes, 2003) by Maturana and Varela (1980), who used the nervous system as an example of an autopoietic system. Maturana invented the word "autopoiesis" to describe the autonomy in living organizations. Accordingly, autopoietic systems are autonomous, self-producing and closed systems. (Maturana & Varela, 1980)

Maula (1999) has successfully applied **autopoiesis theory** in her research on MNEs as learning and evolving systems investigated in three perspectives: the knowledge management, communication, and enabling information systems perspectives. Maula in her in-depth analysis of autopoiesis theory and its applicability to multinational enterprises noted that autopoietic theory can be used as an interpretation in learning and evolution in an MNE. She also discussed differences between general systems theory that emphasizes order and control, and modern systems theory, which reflects autopoietic theory. Similarly, Flood (2001) discusses systems perspectives and systemic perspectives. Autopoiesis represent the self-referential systems theory stream and is closely linked to the organization theory field of study (Hatch, 1997). The concept of autopoiesis is used to emphasize that both structure and structure elements are constantly constructed and reproduced (Jönhill, 2003). Maula's (1999) interpretation is in line with other researchers (Maturana & Varela, 1980, Luhmann, 2003) that an autopoietic system is a living and autonomous system that produces itself. Moreover, she calls autopoiesis theory the theory of self-production (Maula, 1999).

Luhmann's **Autopoietic organization theory** (Bakken & Hernes, 2003, Luhmann, 2003) is closer to organization theory. It is autopoietic theory applied in social systems.

Luhmann defines organizations through decisions and communication. His theory has been influenced both by biology and systems theory. Since communication is both horizontal and vertical within organizations, Thyssen (2003) places less emphasis on the random and competent character of the horizontal communication, i.e. communication among colleagues. Other application than communication exists. For example, Morner (2003) uses Luhmann's autopoietic organizational theory to find factors stabilizing emergent and self-organizing systems.

The research of the self-organizing systems has been increasing (Contractor, 1999) including the historical development of the self-organizing systems theory (Houston, 1999). According to Stacey (1991), the frequency of unintended outcomes of management demonstrate challenges to management in turbulent times. **Self-organizing theory** shows that innovation arises in conditions of instability and from chaos through process of self-organization. Thus, success depends on spontaneity and individual initiative in an organization.

3.2 MANAGING MULTINATIONAL ENTERPRISES

Management science tries to discover how social groups exists and can produce together more than a simple sum of their individual expertise (Thietart, 1999). Hence, this chapter positions the present study in the contemporary international business management research domain. Moreover, it can be categorized under organization science research. The present study focuses on multinational enterprise only. The key MNE theories closely related to the international business domain include the characteristics of MNEs (Ghoshal & Bartlett, 1990, Sundaram & Black, 1992, Ghoshal & Westney, 1993), the ideal types of MNEs (Bartlett, 1986, Hedlund, 1986, Bartlett & Ghoshal, 1989, Ghoshal & Bartlett, 1990, Marschan, et al., 1993, Volberda, 1996), strategy and structure models of the MNEs (Chandler, 1962, Stopford & Wells, 1972, Egelhoff, 1982, 1988), subsidiary – headquarters relationships including coordination and control within the MNE (Doz & Prahalad, 1981, Baliga & Jaeger, 1984, Cray, 1984, Doz & Prahalad, 1984, Mascarenhas, 1984, Martinez & Jarillo, 1989, Andersson & Forsgren, 1996), and operationalizing theories such as internationalization process (Johanson & Wiedersheim-Paul, 1975, Johanson & Vahlne, 1977). A slightly different approach is found in the theory of information processing (Egelhoff, 1991) and its application focusing on the design of the organization. Moreover, different typologies exist for international business research (Hedlund & Ridderstråle, 1997). Accordingly, international business research on MNEs

has focused on four traditions: 1) transaction cost approach 2) the imperfect competition approach 3) internationalization process approach and 4) the information processing approach.

Like MNCs, multinational enterprises can be defined from different perspectives (Sundaram & Black, 1992). MNEs generally share a common pool of resources and a strategic vision. The strategic orientations that affect for instance the governance, strategy and structure of an MNE, can be categorized as ethnocentric, polycentric, regiocentric, and geocentric (Rugman & Hodgetts, 2003). The definition of an MNE includes both environmental and internal variables (see extensive discussion in Sundaram and Black 1992). The structure of a multinational is defined by Malnight (2001:1188) as

“organizational mechanisms used to control and coordinate worldwide operations.”

Another useful definition of an MNE is provided by Sundaram and Black (1992: 733)

“...any enterprise that carries out transactions in or between two sovereign entities, operating under a system of decision making that permits influence over resources and capabilities, where the transactions are subject to influence by factors exogenous to the home country environment of the enterprise”.

These definitions on MNE show the embedded complexities. Therefore, Kim et al. (2003) propose that the real challenge for managers is the design of an organization that can achieve global integration of business operations. Respectively, Jones (1996) highlights the function of an MNE. Accordingly, MNEs control resources that they can move across borders and control their use. He continues that of these resources, the most important are ideas, technology, and organization. The view of the present research on MNEs follows the logic of Jones (1996) and stresses the role of organizational mechanisms as defined by Malnight (2001). The research discusses these organizational mechanisms more extensively later in the chapter.

Examinations of the internal structural patterns of MNEs have been on a single dimension of operations: structural variations across geographic units, functions or products. Malnight suggested three reasons for the importance of examining the emerging structural patterns of an MNE: 1) International management research has a goal to understand how MNEs function globally. Especially, the growth of the internal organizational complexity is noted. 2) Emerging structural patterns may lead to efforts to develop a theory of the MNE. 3) MNE level research may lead to general analysis of

diversified organizations. Thus, research on emerging patterns of internal structural differentiation within MNEs is considered important. (Malnight, 2001)

3.2.1 *Organizational archetypes of the contemporary MNEs*

Holistic structural change research aims at an ideal type of MNE and research on emerging internal structural patterns (Hedlund, 1986, Bartlett & Ghoshal, 1989, Martinez & Jarillo, 1989, Westney, 1993, Malnight, 2001). Research on the movement towards less-hierarchical structures emerged from the 1980s onwards because the subtle and more informal coordination mechanisms became more efficient than the hierarchical model leading towards new idealized models of MNCs (Birkinshaw & Morrison, 1995).

Where earlier model of the MNCs were hierarchy and control based, and bounded by the scientific management assumptions, the evolution of the ideal types of multinational enterprises is influenced by a shift in the theoretical assumptions. These new theories and models generally have a common denominator; they are first based on complexity sciences and second non-equilibrium focused. The evolution of the organizational structures is also visible in the development of coordination mechanisms. Scientific management and complexity science were discussed to explain contemporary management of an MNE. Within the field of organization and management research and international business, the research based on scientific management and systems theory has been dominant (for discussion see for example Volberda, 1998, Stacey & Griffin & Shaw, 2000). As Lissack (1999) notes, understanding this change suggests that the underlying assumptions of organization sciences are closer to complexity sciences. In discussing the nature of MNEs, internal organization structures and management are central with innovation and change.

The move away from the central – periphery model of the MNC has resulted in concepts such as heterarchy, transnational, the multi-focal MNC, and the horizontal MNC. Respectively, an MNC must meet different requirements of overall organization instead of mere exploiting the resources. First, creation-oriented firms will be organized in projects that represent temporary networks of diverse competencies. Second, coordination methods change from hierarchical and formal control-based management to informal processes supported by flat structures. Third, criteria used for actions are from economic rationality for exploiting MNC to multi-rational creativity that relies on experimentation. And fourth, relationships to environments: A creative MNC views environment as a source of knowledge instead of constraints. (Hedlund & Ridderstråle, 1997) This will change the

way MNEs need to be managed and organized in the future. That in turn requires new capabilities and competencies.

The idea of adaptability and flexibility is not new but the (co) evolutionary perspective (Malnight, 1996, Lewin & Volberda, 1999) as embedded in the complexity sciences may bring a useful explanation. Recently, several other characterizations of innovative forms have been made. Researchers such as Drucker (1988), Miles et al. (1997), and Pettigrew et al. (2000) have noted the evolution of the information-based organization, the N-form, the cellular form, the boundaryless form, and the individualized form. These types differ significantly from the premises of the earlier structure-strategy type of organizations.

Pettigrew, Massini and Numagami (2000) found in their research on new forms of organizing that organizations are no longer focused only in form and structures, but in dynamic adjustments between the structure, process, and boundaries. Their findings indicate that the organization structures are developed with more holistic perspective on internal operations.

This chapter continues with a brief introduction of the contemporary organizational architectures of MNEs. It includes the transnational corporation (Bartlett, 1986, Bartlett & Ghoshal, 1987, 1989, 1991, 1993, Egelhoff, 1999), hierarchy (Hedlund, 1986, 1993), networked organization (Thorelli, 1986, Ghoshal & Bartlett, 1990), and flexible forms of organization (White & Poynter, 1990, Volberda, 1996, Evgeniou, 2002). Common with these archetypes is 1) the less hierarchical 2) networked, and 3) multi-centered organizational structures that require new means for coordination (Hedlund & Rolander, 1990). Because of the intensive information processing, need for sophisticated administrative, operational and strategic systems, the contemporary archetypes rely heavily on IT and information systems to achieve the coordination (Bartlett, 1986, Porter, 1986, Earl & Feeny, 1996). Furthermore, these centers have more active role in formulating and implementing corporate strategy. The simultaneous global standardization and integration, and local responsiveness by national differentiation require coordination. The management of the transnational corporation requires different means to ensure the cooperative manner. This directly suggests that coordination mechanisms such as information systems should not inhibit the functioning of the MNE. Likewise, IT development appears to be one pre-requisite for the organizational structure development. Handy (1993) suggested that these forms of may be described being on the path to federalism. Since the corporations are mini-societies of complex organizations, the

concepts may be borrowed from political principles. The organizational archetypes influence how the firms are coordinated. Therefore, after the introduction of the contemporary MNE forms, the coordination mechanisms are discussed.

Characteristics of a **transnational corporation** (TNC) are multidimensional perspectives on complex demands and opportunities, distributed but interdependent capabilities and flexible integrative management and organization processes. TNCs are regarded as integrated network of distributed and interdependent resources and capabilities where various “centers of excellences” flourish. A TNC is neither centralized nor decentralized. In a multinational enterprise decisions of what could and should be globally coordinated and nationally different is of major challenge. The integrated network has complex interactions between physically remote, diverse and interdependent organizational units. The most important characteristics of a TNC are systematically differentiated tasks and responsibilities instead of uniformity and symmetry, management of interdependency among different units in the firm instead of patterns of dependence or independence and finally, mechanisms for more flexible coordination and cooption against control mechanisms. (Bartlett, 1986, Bartlett & Ghoshal, 1987, 1989, 1991, 1993, Egelhoff, 1999)

Networks have always existed in some way, but emergence as a true **networked-organization** design is rather new. As in inter-firm networks, the concepts of specialization, positioning, power and other interdependence-related attributes (Thorelli, 1986) prevail in the networked organization. A high degree of differentiation resulting a high degree of specialization (Rockart & Short, 1991), which poses challenges for example in communication and coordination between fragmented and specialized teams. Venkataram (1998) suggested that the conventional command-and-control type of hierarchical organizations be replaced by networked organizations, which are characterized by knowledge work. Therefore, organizational structures and processes will change to process-based and also incorporate information technology within the organizations. Three types of intra-organizational flows have been suggested: capital flows, product flows, and knowledge flows. This multidimensional network perspective is linked with the coordination and control mechanisms (Gupta & Govindarajan, 1991, Gupta & Govindarajan, 1994). The networked organization is an organizational innovation that has emerged from and is enabled by information technology. In the networked organization, IT is a major design factor that allows organizational design to be more complex and responsive. The role of IT in the networked organization includes (Rockart & Short, 1991) structures, roles, processes, teams, markets, hierarchies, and systems

integration. This approach is in line with the thoughts of Hagström (1991) and his model of the “wired” organization.

Ghoshal and Westney (1993) described **heterarchy** as a firm which has "a mechanism for constantly selecting and adapting structure and governance mode". On corporate level, the difference between a hierarchical MNC and a heterarchy can be found in 1) resource disparity in the organization, 2) in relationships between subsidiaries, and 3) in coordination of activities (Birkinshaw & Morrison, 1995). Marschan (1992) described heterarchical structure as complex due to the variety of the interdependencies between units. The centers form the heterarchy in which there is a variety of organizing principles and coupling between the organizational units. They also form coalitions with other firms. Heterarchical organizations focus on practical coherence. They use a wide variety of different governance models because the relationships between units are not necessarily governed in the same way. Heterarchy achieves integration rather through normative control such as corporate culture and management style than bureaucratic control. The primary components in heterarchy are knowledge, action and position of authority. Furthermore, in heterarchy, the units, which have multidimensional characteristics of the heterarchy, are summarized (Hedlund, 1993) as multidimensional (knowledge, action and position dimensions), asymmetric order along these dimensions, temporary subordination and simultaneous sub- and super-ordination, non-transitivity and circular, horizontal, normative and goal-directed integration.

The typology of **flexible forms of organizations** constituted by Volberda (1996) describes organizational forms and their capability to cope with hypercompetitive environment (see figure 20). These forms are not permanent solutions. He argued that flexibility originates from the managerial capabilities, which produces the management challenge and the responsiveness of the organization. To be successful in a hypercompetitive environment, organizational form may play a critical role.

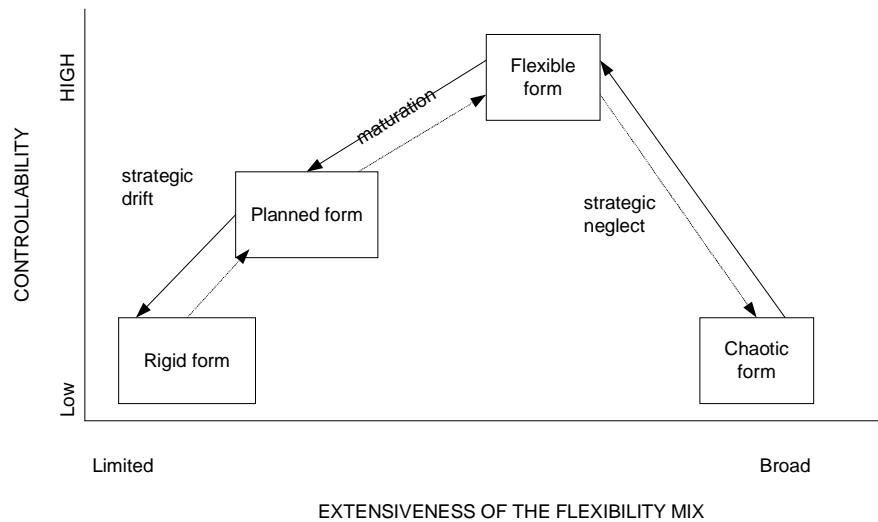


Figure 22. A Typology of Alternative Flexible Forms for Coping with Hyper competition (Volberda, 1996:367)

According to Volberda (1996), the trajectories of transformation presented in the figure above include the natural trajectory of routinization. This is the trajectory from chaotic form to flexible, planned and rigid forms. The maturation trajectory moves from flexible form towards planned form. The reverse trajectory of revitalization is actually the reverse of the natural trajectory. Some of the trajectories seem emergent, whereas the others are rather deterministic. The natural trajectory of routinization in a hypercompetition seem surprisingly similar as notion of stabilization by Cyert and March (1963) dated back to 1960s. They noted that organizational precedents exhibit greater stability. An increase in standard operating procedures was noted. However, Cyert and March specified organizations as stable and equilibrium-based, which avoid uncertainty. Based on these findings, the processes of maturity of the organization seem to be similar. The routinization is also called institutionalization. Here, the complexity science assumptions prevail most in the chaotic form and least in the rigid form, which is the result of scientific management dominance. The success in the changeable world is considered to be associated more with constantly enabling forms that respond to chaotic business (Sauer & Willcocks, 2003). Similarly to flexible forms, adaptive enterprise is suggested (Evgeniou, 2002) as an organizational structure to manage information strategy, and processes, and technology to achieve visibility and flexibility. Also, different characterizations exist for the firm that is seeking to be flexible.

Common for all of these contemporary MNE archetypes is the increased complexity among interdependent teams, which requires a different way of management. A question arises, how will they survive in the future. As the organizational forms have developed, the controlling mechanisms in MNEs have evolved. Those contemporary corporate archetypes discussed could not be managed in conventional ways. Information is a key element in coordination and controlling. In future, global complexity of activities and connections will most likely increase among international firms, and successful firms will require new means for this global coordination. Thus coordination devices remains essential in the international management of MNEs (Martinez & Jarillo, 1989).

3.2.2 *Coordination and integration of an MNE*

The previous chapter introduced the contemporary corporate archetypes. They reflect the complexity science characteristics, and tend to be less hierarchical and less control-focused. This chapter moves to discuss the coordination and integration challenges of MNEs.

Like control in MNEs (Doz & Prahalad, 1981, Baliga & Jaeger, 1984, Andersson & Forsgren, 1996), coordination has received wide interest among international business researchers. How to coordinate and manage effectively the diversity inherent in multinational enterprises has been and still is a major problem in conducting international business operations (Davidson & Haspeslagh, 1982, Björkman, 1994). Managing a multinational corporation has usually focused on how to balance priorities, which are often conflicting, between central coordination and local responsiveness (Doz & Prahalad, 1984). International integration include barriers such as host-country interests, host country laws, host country – home country relationships, geographical distances, differences in cultures, differences in time frames, differences in local market conditions and particular subsidiary -related occurrences not found in other subsidiaries. Thus, to coordinate MNE's interdependencies among subsidiaries four modes have been suggested: impersonal methods, system-sensitive organization members and the process of socialization, compensations and personal communication patterns (Cray, 1984, Doz & Prahalad, 1984, Mascarenhas, 1984).

Martinez and Jarillo (1989:490) define coordination mechanism as

"a mechanism of coordination is any administrative tool for achieving integration among different units within an organization."

The coordination mechanisms used by MNEs are results of evolution (for extensive review, see Martinez & Jarillo, 1989). This evolution has been from more formal tools towards subtler forms of coordination. Respectively, the coordination mechanisms are divided (Martinez & Jarillo, 1989) into two groups: structural and formal mechanisms, and informal and subtle mechanisms (see table below).

STRUCTURAL AND FORMAL MECHANISMS OF COORDINATION	INFORMAL AND SUBTLE MECHANISMS OF COORDINATION
<ol style="list-style-type: none"> 1. Departmentalization 2. Centralization/ and decentralization 3. Formalization and standardization 4. Planning for systems and processes 5. Output and behavior control 	<ol style="list-style-type: none"> 1. Lateral relationships 2. Informal communication (networks) 3. Organizational culture (institutionalization)

Table 7. Coordination mechanisms
(Martinez & Jarillo, 1989)

According to the suggested division, simple strategies rely on structural and formal coordination mechanisms whereas complex strategies have increased coordination needs relying on coordination mechanisms from both categories. Of particular interest have lately been the lateral relationships, which compromised direct contacts, temporary or permanent task forces, integration roles, integrative departments, teams, and committees.

Hierarchy alone does not solve multidimensional problems of MNEs. Similarly to Martinez and Jarillo (1989), Doz and Prahalad (1981, 1984) suggested that the multidimensional problems should be solved with multidimensional solutions (see table 8). Therefore, three sets of coordination devices or administrative mechanisms could be employed (Doz & Prahalad, 1981): 1) Data management mechanisms (information systems, strategic planning, budgeting). 2) Manager's management mechanisms (choice of managers, career paths, patterns of socialization). 3) Conflict resolution mechanisms (decision responsibility assignments, integrators, and coordination committees). Surprisingly, information systems were perceived to have low importance in categories of continuity and the need for top management ongoing support. This can be explained by the technology available at the time of the research (1980s). The role of information technology and information systems has increased since in multinational enterprises. The technological developments ensure the closer interaction and use of technology in novel

way. For example, enterprise resource planning system can integrate the fragmented information in MNEs (Davenport, 1998).

Period	Label	Structural configuration or organizational pattern of MNCs	Coordination mechanisms	Pattern of international competition	Strategic response of MNCs
Before 1920	local or regional			scale of economies	homogenous product needs in different countries; low trade barriers
1920 - 1950	multinational or multidomestic	decentralized federation	<u>Structural and formal</u> : internal divisions, direct personal reporting	multinational or multidomestic (or country-by-country)	country-centered strategies, direct investments, decentralized organizations, differentiated and nationally responsive strategies, autonomous branches (loose federation); competitive advantage in downstream value activities
1950 - 1980	Global or pure global	centralized hub	<u>Structural and formal</u> : international division, product - geographic - regional divisions, higher centralization (HQ), standardization	global (or worldwide basis)	global strategies, economies of scales, few manufacturing plants, centralized control, standardization of product designs; competitive advantage in upstream value activities
1980 -	transnational; complex global	integrated network	<u>Structural and formal mechanisms</u> : former structures and global matrix organizations, centralized but upgrading the role of subsidiaries, high formalization, strategic planning. <u>Subtle mechanisms</u> : lateral relationships; temporary and permanent teams, informal channels of communication, strong focus of organization cultures	global (or worldwide basis)	globalization of industries: global with increasing foreign investments; specialized decentralized manufacturing plants with strong interdependence among them, interorganizational transfer of technology; national interests and local needs addressed; competitive advantage on both directions of value activities.

Table 8. Period of evolutionary patterns
(Adapted from Martinez & Jarillo, 1989)

Since MNEs have become less hierarchical, control is based more on coordination. Global information technologies have been noted to increase opportunities for both control and coordination (Hagström, 1990, Ives & Järvenpää, 1991, King & Sethi, 1999). According to the above definition, the ERPs are also coordination mechanisms for multinational enterprises. Therefore, they should be included in the analysis of international management. Three visions for controlling MNEs have merged in relation to enterprise resource planning systems. These are 1) the economic vision, 2) the logistics vision and 3) the information vision. Respectively, an enterprise is seen as a financial entity with economic flows, as material flows, or as an information system with information flows. (Clausen & Koch, 1999)

In the recent organizational development within MNCs, the means for steering and controlling foreign operations include information systems, and less stress the role of the formal organizational structure (Marschan, 1992). The present study assumes that information systems such as ERPs can be used as coordination mechanisms in MNEs. The online information provided from each business units create unparalleled visibility to management. Therefore, the use of such a coordination mechanism requires successful implementation of the ERP. Combined with the other forms of coordination, the ERP

system complements and provides information necessary to operate and manage international business operations of the firm.

In short, scientific management views organizations as mechanistic systems in which the predictability and adaptation to external changes is important. Furthermore, managers increase control within the organization and design organizations explicitly to fit forecasted changes. This means movement towards to equilibrium state. In the state of equilibrium (fit), order prevails. (see Lissack, 1999, Stacey & Griffin & Shaw, 2000) When conditions change, and organization can be characterized as being in a far-from-equilibrium state or on the edge of chaos. Prigogine and Stengers (1984) argue that the conventional paradigm assumes that the world is very simple. Moreover, the organization is managed to behave determinately. The recent decades have shown that the environments no longer have a predictable character. On the contrary, in many industries the environments are hardly predictable. Deterministic and planned behavior of an organization is assumed to lead towards optimal efficient performance and hierarchy as a controlling structure guarantees the required coordination. In organizations, the rules and interactions between different parts are set and thus the system can perform the designed activities only. (Stacey & Griffin & Shaw, 2000)

3.3 TRANSFORMATION LITERATURE

Organizational theories assume that the desired state of an organization is stability (homeostasis) according to the scientific management principles. Nevertheless, change is a vital but an elusive part of organizations. Therefore, in contrast, flux should be considered a normal condition in organizations. (Dubinskas, 1994) The present study sees organizations as open, adaptive and evolving systems. Change is therefore accepted as part of the normal conditions. Research on organizational change has mainly concentrated on debate on environmental or contextual change with firm structural change suggesting a fit between firm's structure and its environment (Van De Ven, 1976, Malnight, 2001). This contingency theory discussion follows the scientific management approach. Although the contingency theory states that there is no one optimal organization structure effective for all organizations, it emphasizes to role of the fit between the environment and the firm (Donaldson, 2000). Therefore, the changes required in the organizational structures are forced by the contingency factors such as firm's size or technology. Similarly discussion of the punctuated equilibrium model has

dominated the change literature, neglecting continuous types of change (Brown & Eisenhardt, 1997).

The processual tradition perspective in organizational change research, including the modernistic perspective, has been widely studied. Several models have been created. For example, stability is the focus of Lewin's model of organizational change, which includes three separate activities of unfreezing, change (moving) and (re) freezing (Hatch, 1997). This approach has not been selected because the model focuses on change in a stable environment. It does not explain change in a turbulent environment. The eight steps model (Kotter, 1996) for implementing fundamental changes in organizations has been defined. A more evolutionary model is the Big Three model, which incorporates the key concept of organizational change in the organization theory perspective. Coordination changes, for example through business process reengineering, may involve restructuring the organization or technology flows. (Hatch, 1997)

Logistics theories for improving operations – business process reengineering

The business process reengineering (BPR) practices are discussed to elaborate the different approaches taken in organizations. BPR is used especially within the context of information systems as engineered change. It has been argued that by using information technologies, organizations can change their way of operating (MacIntosh & MacLean 1999). Again, the focused organization is the adopting organization. There are two early articles discussing the phenomenon of BPR from the early 1990s (Davenport & Short, 1990, Hammer, 1990). The early promotion was largely due to information system research and explicitly suggested that BPR was very much an information system endeavor. BPR is about fundamental, radical, and dramatic engineered change. In reengineering, the existing processes are disregarded and replaced by new ones (Hammer & Champy, 1993.). Therefore, it was not originally about enhancing the existing business processes. However, today BPR may be about enhancement i.e. improvement of internal efficiency and focused on streamlining the existing business processes (Kallio, et al., 1999). This distinction is important.

MacIntosh and MacLean (1999) point out that the core of the BPR was in converting functionally operating firms into process-oriented firms by breaking the historical working practices through in radical change efforts, therefore aiming to enhance the operational effectiveness of a focal firm. Earl (1996) lists the six fundamentals of BPR. First, business changes: jobs and roles changed, thereby enhancing teamwork and collaboration.

Second, it is IT-enabled. Third, business processes are the focus. Fourth, the key challenge is change management. Fifth, transformation is a comprehensive one-time revolutionary turnaround in organizational design. Holmström and Drejer (1996) suggested that in creating and implementing a flexible and integrated organization, business process reengineering may be useful. According to Rockart and Short (1991), BPR activities have been recently studied in the supply chain management context. This is illustrated in the following figure. The value added chain has been reduced from several separate functions to three main or core processes such as product development, product delivery, and customer service and management processes. Likewise, Bancroft (1996) suggests that each company has a few (8-12) core business processes, which are divided into a number of smaller sub-processes. These processes are complex by nature and interdependent.

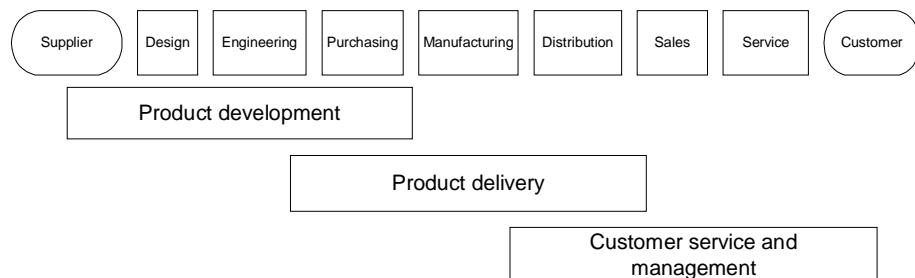


Figure 23. Collapsing the value-added chain
(Rockart & Short, 1991)

In the figure above, the functional departments are converted to process organizations and their number is minimized. Bancroft (1996) positions ERP as a technology that enables BPR, while the application itself includes best practices and thus areas of interest for firms in their BPR design. Furthermore, she stated that ERPs are not only enablers of BPR but also drivers, while they force firms to change their processes according to those included in an integrated manner in ERP. She also discussed the timing of the BPR: should the reengineering take place before, after or during the ERP implementation? She does not support reengineering that takes place after ERP implementation. Likewise, Davenport (2000) sees BPR as a preamble to the enterprise system implementation now taking place in firms of various size.

Organizational transformation and change

The phenomenon of organizational change and transformation has several strongholds in literature such as focus on the process, learning, or cultural issues. The co-evolution of organizations and environment research has resulted in the suggestion that organizational change is co-evolution with a joint outcome of managerial intent and environmental and institutional influence changes (Lewin, et al., 1999, Lewin & Volberda, 1999). Organizational change research can be focused on different levels such as control or coordination, but also different perspectives, for example cultural change. According to Hatch (1997), in the modernistic perspective, change in the environment and the firm's survival trigger organizational change. In the postmodern perspective of organizational change, the influence of knowledge on change rather than control of change is emphasized. Four research themes have been found in the review of organizational change in the 1990s. These themes are content issues, contextual issues, process issues, and criterion issues (Armenakis & Bedeian, 1999). On the other hand, the fact (Old, 1995) that not all three fundamental levels are included in the analysis, but namely transactional, systemic and deep structures, is criticized. This research takes the post-modernistic perspective on change.

In addition to the generic term organization change, the term transformation has recently arisen and is used widely in organization literature. There is not a common definition for the transformation and the variation is significant (Tosey & Robinson, 2002). Therefore, researchers define the transformation from their own perspective. In the definition of transformation, scope and behavioral change have been included (Blumenthal & Haspeslagh, 1994). Typically, the goal of transformation is to improve a firm's performance (Blumenthal & Haspeslagh, 1994). In his analysis of the logic of three organizational transformation theories, Lichtenstein (1997) found few similarities in the content, but more in the process: Theories explain up to a certain point, but something more magical conveys the transformation. This magical shift from rationality can be explained by the complexity sciences and the emergence of chaotic logic. Furthermore, the unexpected events and experiments seem to be the catalyst for transformation. Blumenthal and Haspeslagh (1994) found three types of transformation. This categorizing is focusing on the behavioral perspective in the change and perceives the firm and the transformation from the holistic perspective. Tosey and Robinson (2002) identified four themes towards transformation:

- The degree of personal engagement in the transformation process: organizational transformation may trigger personal transformation

- The extent to which transformation is seen as a process rather than a product: transformation can be understood as deliverable or as a journey without an end-state
- The extent to which transformation can be “engineered” in contrast to a leap-of-faith; rational thinking dominated the 20th century
- Whether transformation is seen as necessarily desirable, compared with acknowledgement of its dark side: whether transformation is seen as negative or positive

Ackerman (1986) has identified three types of change in organizations: developmental change, transitional change, and transformative change. She combined both scientific management and complexity science perspectives into organization change to emphasize the nature of the change. Scientific management is present in both developmental change and transitional change. The transformational change is based on the complexity sciences perspective. Similarly, Brown and Eisenhardt (1998) combine both evolutionary and adaptive characteristics in their perspective of change. Stacey (1991) highlighted the role of control in changes and introduced a dynamic management model. It included three aspects of change: closed change, contained change, and open-ended change. Accordingly, each of these change types had different characteristics and roles, and they happen in organizations simultaneously. This categorization was found interesting. When considering the time horizon, the closed change type has the shortest timeframe. This type also creates fewer long-term consequences. Change events and consequences may be relatively predictable. Hence, scientific management characteristics are present. The contained change type has more variety considering the timeframe linked to the change event as well as the magnitude of the consequences. With these change situations, forecasting is to some degree possible. The third type, open-ended change, has a long-time horizon. Some events happened in the past, have consequences in the present, and may have consequences in the future. One cannot forecast the end-state of an open-ended change situation. Here complexity science characteristics are present. All these change situations are, however, interconnected. Stacey (1991:35) continues by defining the differences with the change situations

“...in closed and contained situations, change impacts on an organization from outside that organization, and it adapts... in open-ended situations, organizations have to develop new approaches to control and develop as they handle the change. This is because that change is unique and has never been confronted in that form before”.

Sometimes the terms ‘change’ and ‘transformation’ are used as synonyms. The richness of the research related organizational change and transformation is acknowledged. The results have often produced models or process descriptions (see for example Limerick, et al., 1994, Lichtenstein, 1997, Neal, et al., 1999, Shields, 1999, Kotnour, 2001, Chapman,

2002, Sawyer & Southwick, 2002, Tosey & Robinson, 2002). Similarly, the term transformational change is used (Limerick & Passfield & Cunningham, 1994). The open-ended change as defined by Stacey is close to the assumptions of organizational transformation discussed in this study. It also has similarities with the transformative perspective of Ackerman (1986) discussed earlier. Therefore, the term transformation is used for the open-ended transformative type of change, in other words organizational transformation.

Strategic transformation

Strategic transformation also defined as business transformation should meet the following characterization: first, strategies and management processes are invented in transformation, second, the whole organization is in focus, third, deeply embedded and often tacit values and beliefs are touched by transformation, fourth, new skills and capabilities are required and, fifth, transformation is strengthened with a new management processes. (Blumenthal & Haspeslagh, 1994, Venkataram, 1994, McKeown & Philip, 2002).

Venkataram argued that the benefits of information technology deployments come into effect only if corresponding organizational characteristics such as strategy, structures, processes and cultures accompany them. Since the discussion does not specify the structures, this study assumes that the structure refers to the adopting organization. The role of IT has changed, and it focuses instead on efficiency on enabling flexible business networks external to the focal firm (see figure below). The two approaches of “Improve Efficiency” and “Enhance Capabilities” are highlighted. The *efficiency improvement* type of redesign is limited by fixed boundaries of current strategy and thus the main objective is to achieve operational excellence within the given and fixed boundaries. The “*enhance capabilities*” approach is fundamentally different, while the focal company has to first specify its position in the value chain in the future, and then decide which business processes to redesign and with which guidelines. (Venkataram, 1994)

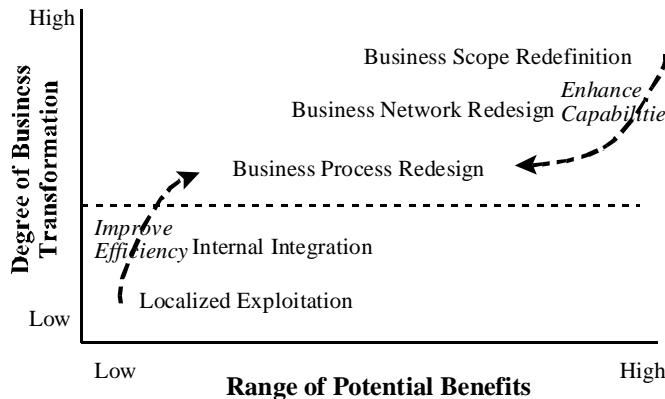


Figure 24. Five levels of IT-enabled business transformation
(adopted from Venkataram, 1994)

Similar to Venkataram's approach is the multi-stage business transformation model (McKeown & Philip, 2002) with three stages of restructuring, revitalization, and renewal, which includes the enablers of the business transformation of those identified by Scott-Morton in 1995. Hsiao and Ormerod (1998) used the MIT90s framework as a starting point for strategic change. Hence, the technology can be seen as a trigger for transformation. The strategic transformation and business transformation are only partly intra-firm activities. The efficiency improvement phase is closely related to the case study analysis of the present study. Although Venkataram (1994) did not place BPR in the center of operational efficiency, the improvements in operations are achieved by reengineering business processes (Blumenthal & Haspeslagh, 1994).

The previous discussion of the research in transformation revealed that the organizational transformation and organizational development discourses are mostly based on the assumption that transformation is logical that can be planned and thus managed. Therefore, the underlying logic is the same as with change, which was discussed separately earlier. The third type of transformation categorized (Blumenthal & Haspeslagh, 1994) is called self-renewal. It occurs in the firms, units and organizations that already exist. It has been studied in the contexts such as the technological change (Hedlund & Ridderstråle, 1997) and globalization of Japanese MNCs (Nonaka, 1990). One can debate whether novel organization type or structure is a renewal of the existing one or whether it is truly original. Self-renewal type of transformation emphasizes creativity instead of exploitation (Hedlund & Ridderstråle, 1997).

3.4 IMPACTS OF ENTERPRISE RESOURCE PLANNING SYSTEMS ON MNEs

This chapter reviews the enterprise resource planning system literature. First, the information technology and information system literature are briefly included in order to capture development towards the ERPs.

Information technology and MNE

At present, information technology and information systems (IS) are increasing their role in organizations. IT has a profound impact on business (Hagström, 1991, Scott Morton, 1991, Venkataram, 1994, Carlson, 1999). There is a notion that IT reduces the distance between geographical locations towards zero, shrinks the time between actions, increases flexibility and on-line functionalities, and act as an organization memory (Scott Morton, 1991). Roche (2000) argues that MNEs are the major users of information technology. They will continue to increase the use of information and communication technology (ICT) to improve worldwide operations. Since the first computers in the 1950s, a new technological feature has influenced organizational developments. The rapid developments in computer technologies have influenced organizations in numerous ways. This will continue in the future. **Four eras of IT** have been identified (Hedman & Kalling, 2002). They are 1) mainframe technology focusing on cost reduction (1950s-1970s), 2) decentralized computing for better decision making (1970s-1980s), 3) client/ server and PC technologies for industrial transformation (1980s-1990s), and 4) Internet technology (2000 onwards). These eras are overlapping. Growing investments in IT have been reported in public and academic literature since the mid-1900s (Brynjolfsson & Hitt, 1998).

Although growing information needs in MNEs have led to a large extent to new information technologies and information system strategies, little is yet known about the effects that implementation of these strategies has on the organizational structures and management. One of the earliest typology including the firm structure, strategy and IT configuration is presented in the following table 9. Jarvenpaa and Ives (1991, 1993) used Ghoshal and Bartlett's MNE typology of a firm (international, multinational, global, transnational) when they mapped the different configurations of IT. The configuration suggested (Broadbent & Butler, 2000) differ greatly according to the globalization strategy.

Globalization category	Strategic focus	Firm configuration	IT configuration
Global	Cost advantages	Centralized assets	Centralized, HQ-driven IT operations
Transnational	Global efficiency and flexibility, learning	Complex balance, interdependent and dispersed	Integrated and synergistic IT operations
International	World-wide diffusion and parent company adaptation	Mix of centralized and decentralized based on core competencies	Selective synergy in IT operations
Multinational	Strong national bases, local autonomy	Decentralized assets, nationally self-sufficient	Decentralized and independent IT operations

Table 9. International business orientations and configurations
(Adapted from Broadbent & Butler, 2000)

The table 9 depicts the IT configuration possibilities, which an MNE has based on its globalization orientation. However, it is noted that the IT configuration may be inconsistent with strategic orientation in terms of business structure (Jarvenpaa & Ives, 1993). As suggested, the IT infrastructure research has approached the questions of capabilities on a technical perspective, but the research on how MNEs develop and manage their IT capabilities is still less developed (Broadbent & Butler, 2000).

Hagström (1991) studied the role of information systems in structural changes in an MNC context. This conceptual research included international data communications and attendant computer-based systems. Hagström found that in a continuously structurally changing “wired” MNC, information systems are key elements in organization structures. He also found that in less stable and dispersed MNCs, information systems played an integrating role and hold the organization together. This is in line with the research on MNE coordination discussed earlier. Hagström argued that the information system infrastructure is actually the most salient stable element in the “wired” MNC. This conceptualization brought up several interesting themes, but it did not explain the process towards the “wired” MNC or how to maintain the wired nature.

The organizational design for IT function in large firms to ensure the fit between the corporate strategic management, organizational styles, and IT organization has been noted (Earl, et al., 1996, Hodgkinson, 1996). McKersie and Walton (1991) looked into behavioral conditions that would influence the implementation of IT. These conditions are motivation, competence, and coordination. The motivation condition continuum is from reluctant compliance to high-level spontaneous commitment of those persons, who can

influence IT implementation. The competence refers to the skills of the persons managing and operating the IT. Moreover, the coordination was defined from individual action to strict teamwork. Those conditions are also discussed within this research.

Technology may be used to change organizational structures in a firm. When organizations focus more on projects and processes, centralized and decentralized control is merged. According to Lucas and Baroudi (1994), the transformational effect of IT can be seen in the coordination of a firm: grouping tasks, functions and people no longer requires physical proximity. They contend that organizational design is an emergent process. Interaction of both the technological and the social environments, which are complex and not predictable, contribute to the outcome of the new structure. This finding supports the focus of the present research. Caglio and Newman (1999) claim that IT's influence on organizational structures is still inconclusive and sometimes contradictory. In this study, the influence on unit level structures is analyzed.

The role of the IT organization

The role of information technology organizations has changed dramatically over the past decades. Traditionally, IT department was seen as a support function and had an administrative role in firms (Marchand & Horton, 1986, Lohmeyer & Pogreb & Robinson, 2002). This information management evolution has been noted to (see Marchand & Horton, 1986, Venkataram, 1991, Lohmeyer & Pogreb & Robinson, 2002). First, a there has been movement from a support function to a business-management function, and second, a shift from organizational effectiveness towards overall business performance.

There is a perceived gap between the IT professionals and the other organization members concerning the working relationships (Feeny & Earl & Edwards, 1996, Gefen & Ridings, 2003). Four inhibitions can be found in bringing IT functions closer to business units (Lohmeyer & Pogreb & Robinson, 2002): two separate cultures, too much bureaucracy especially from the IT side, too many concealed informal channels, and too many junior managers. The cultural divergence needs to be overcome to pursue more collaborative introduction of IT (McDonagh & Coghlan, 2001). Furthermore, successful partnerships have evolved by making business leaders accountable for IT investments or in charge of the IT agenda, and by integrating IT organizations more closely into other business organizations. A recently reported study of business managers (Bassellier, et al., 2001) suggests that IT competent (explicit and tacit knowledge) business managers

increasingly partner with IT people and participate increasingly in IT projects. Hence, new organizational capabilities should be developed.

Peppard and Ward (1999) have created a framework to analyze the gap between IT organizations and other business organizations. In western companies, the liaison roles between IT specialists and IT users end up as middlemen between these two different sides (Bensaou & Earl, 1998). Consequently, these intermediaries, the hybrid managers, do not have positive career expectations, but can rather expect a dead-end career-wise. However, contrary opinions exists (Scott Morton, 1991, Skyrme, 1996). Ferguson and Khandelwal (2000) in their review on IT and international operations pointed out that little is reported on the structure of the IT organization in MNEs or as what form the IT function would take in an MNE. They defined the structure of the IT function as federated, autonomous, or hierarchical. This research clearly separates the IT function from the rest of the MNE organization and functions. Earlier Ives and Vitale (1996) recommended that firms combine effective organizational structure with appropriate management systems and technology in development and implementation of information systems, and would focus on maintaining competitive use of IT with a long-term perspective. Kangas (2000) points out that even though the alignment of information systems to business strategies in the 1990s was widely supported, to streamline the organization structure accordingly, would pose difficulties.

Despite the increased research, IT research has approached the questions of capabilities from a technical perspective, but the research on how MNEs develop and manage their IT capabilities is still less developed (Broadbent & Butler, 2000). Managing new systems may demand different organizational capabilities from what most IT departments currently have (Prahalad & Krishnan, 1999.). Likewise, Marchand and Horton (1986) stated that more emphasis is needed on the organizational structures and management, because business management will direct the use of those IT resources. The present study agrees on this approach, but little information is given on what triggers this transformation of bringing the IT function and business closer and how the transformation is accomplished. The future role of the information technology/ management departments in MNEs is changing. The present study examines how this takes place in an MNE.

Lately, the IT research has showed interest in organizational capabilities and their development. Yet, the focus continues to question the functional role of the IT organization. Four structural trends of 1) process-based working, 2) outsourcing, 3) centers of excellence and 4) increasing application development embedded in business

units are reported (Gartner, 2003) to cause a "slimmed down IT organization". Corporate structuring was reported to mirror the IT organization structuring. A federal line organization was the major holistic structure noted. Focusing on the IT organization perspective, the report foresees that IT organizations will lose traditional function, and therefore their role will change. On individual level, traditionally technical and cost-focused professionals are required to become business-focused and valued-based. This will require a different set of competencies. Five key roles for IT organization are suggested: IT leadership, architecture development, business enhancement, technology advancement, and vendor management. The change from conventional IT organization to the new IT organization model is promising. However, even with the increased business focus, the suggested model will remain focused on the functional IT organization. It does not necessarily introduce the incorporation of the IS organization into the MNE structures. Therefore, the role of the IT organization seems to remain separated and functional.

The literature on information technology–organization has been criticized by Sampler (1996) for lacking description of 1) the unit of analysis, 2) the task, 3) the nature of IT, 4) conceptualization of organization, 5) the period of data collection and 6) alignment between IT and the organization. Accordingly, researchers have studied the impact of IT on only one part of the organization and then made statements concerning entire organizations. Only information systems that affect the whole organization should be studied if the whole organization is the unit of analysis. Sampler (1996:14) suggests that

“The nature of the task that IT is impacting must be consistent across the various studies if comparative findings are to have any meaning... In interpreting research on IT and organizational structure one must be clear exactly what type of IT is under consideration”.

Sampler's criticism may be harsh. However, it became visible when reviewing the IT research for this literature review. The main argument of Sampler (1996) is that IT and organizational structure are not separate entities, but interconnected; they affect each other. Furthermore, he argued that there is not a well-defined relationship between organizational structure and information technology. Likewise, Venkataram (1994) pointed out that the role of IT has changed from being focused on efficiency towards being an enabler of flexible inter-organizational arrangements. This research acknowledges these shortcomings of the existent research. Therefore, the present research focuses on enterprise resource planning systems. The characteristics of the ERP system and the ERP industry will be discussed next. This is followed by the

introduction of ERP implementation strategies and the research on organizing the ERP implementation.

3.4.1 *Overview of enterprise resource planning systems*

This part of the literature review concentrates only on research that has identified enterprise resource planning system as the IT context. ERP systems are the most complex and comprehensive form of information technology currently in organizational use (Hedman & Kalling, 2002). An ERP system is a company-wide transaction system that integrates almost all aspects of business operations (Davenport, 1998). ERPs are relatively flexible information systems in relation to the selection of modules and configuration choices during customization (Clausen & Koch, 1999). Therefore, the fit between business model and information system can be found. From the strategic viewpoint, enterprise resource planning systems represent information technology that can move organizations from an efficiency focus to an overall business-performance focus. In addition, ERPs can be used to build the strategic management and business transformation capabilities. This review looks into reasons for selecting ERPs, overview on the ERP industry, the ERP implementation strategies, implementation models and organizing, critical factors, and failure reasons. The aim is to capture the essence of the rich ERP research.

Reasons for selecting an ERP system

The promise of an ERP includes the benefits of an integrated information system. The general assumption is that an integrated information system may provide several potential benefits to a firm. They are categorized in three groups: business, technical and strategic benefits. **The business benefits** (Davenport, 2000, Hedman & Kalling, 2002, Koch, 2002a) include cycle time reduction, time and cost reduction in key business process lead-times. Furthermore, they promote smaller inventories, greater productivity, and have efficiency. Optimization of the supply chain can be achieved as can integration of business units. Faster information transactions integrate all information about customer orders and overall financial management improves. They also support making tacit process knowledge explicit. Business process improvement and standardization of processes are necessities. **The technical reasons** include the upgrading needs at formerly popular legacy systems (see Dickson & DeSanctis, 2001) and laying the groundwork for electronic commerce and Internet use. Basically all Internet transactions have to be connected to basic transaction systems and databases in order to provide

information (Davenport, 2000). Maintenance resources (time, money, people) are lower than in non-integrated multiple stand alone systems/ distributed information systems (see Davenport, 2000, Koch, 2002a). Finally the operating costs decrease although the system capacity increases (Hedman & Kalling, 2002). **Strategy-based key drivers** (see Davenport, 2000, Dickson & DeSanctis, 2001, Skok & Legge, 2001) included 1) Year 2000 compliance challenge, which required two-digit dates to be changed to four-digit dates in all information systems. 2) The expansion of the national and international regulatory environment (European monetary union) and a new currency across organizations in Europe (euro). 3) Fewer IT jobs and middle management positions, and significant change in existing positions.

ERP industry

Despite declining sales of new ERP systems, ERPs are seen as key tool to cost reduction and efficiency improvement, and increasingly vehicles for organizational consolidation and business process improvement. Although the ERP market is fragmented with more than 40 vendors, 61% of the total ERP markets in 2001 were shared by four ERP vendors: (in order) SAP, Oracle, PeopleSoft and J.D. Edwards. Revenues of these four application providers in 2001 were respectively (\$M) 6600, 2843, 2069 and 883. Interestingly, the European-based ERP companies outgrew the North American ERP firms. (Kraus & Shepard, 2002)

To illustrate the size of the ERP industry, the ERP revenues (in 2001) are categorized by the revenue type in table 10. It indicates clearly the growth path for the ERP firms, but also the expenditures for the focal firms implemented ERP systems.

Revenue type	Revenue 2000 (\$M)	Revenue 2001 (\$M)	Revenue share 2000	Revenue share 2001	Growth rate 2000-2001
Application software license	6906	7098	37%	36%	3%
Application hosting/subscription	189	129	1%	1%	-32%
Application software maintenance	4578	5612	25%	28%	23%
Implementation/ service/ training/ consulting/ custom development	6431	6647	35%	33%	3%
Hardware and other revenue	477	393	3%	2%	-18%
Total	18581	19878	100%	100%	7%

Table 10. ERP total revenue and share by revenue type, 2000-2001
(Kraus & Shepard, 2002)

Despite having the highest growth rates in the late 1990s, the \$20B ERP market in 2001 was expected to decrease slightly in core ERP growth, but to increase in other application and service types. However, the European market for enterprise applications looks still promising: in 2001 was \$12B and was expected to rise (estimated in 2002) to \$21B by 2006. (Barling, et al., 2002, Kraus & Shepard, 2002)

The increased markets have attracted a large number of ERP system providers (Bingi & Sharma & Godla, 1999, Davenport, 2000, Kraus & Shepard, 2002). Yet, only a few bigger vendors dominate the markets (see the following figure). A list of the 30 biggest ERP vendors ranked by company revenue (2001 status) is provided in the appendix 1.

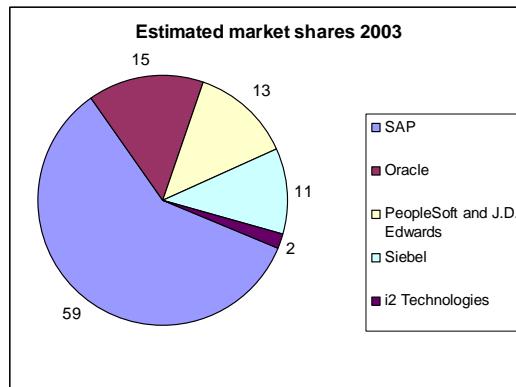


Figure 25. The enterprise resource planning system industry market shares (SAP, 2003)

The estimated markets shares in 2003 are presented in the figure above. SAP AG is clearly the market leader with the 42% of the total market (Barling, Davis, Lucas, Montgomery, O' Brien, & Pollard, 2002). SAP has increased the total market share in 2003. A short introduction of an ERP application supplier SAP AG is provided in the appendix 2. The SAP R/3 is the ERP system implemented in the case company. Hence, the SAP R/3 is illustrated next.

Enterprise resource planning system SAP R/3

A short description of the ERP application package R/3 is given below. SAP AG continuously develops their product offering. The expenses spend in research and development has been over 12% of the total revenue (1999-2003). The information in this chapter is not an in-depth description of the application package because the core of this research is not technical. The description here is rather an overview providing some basic

information for understanding the technicalities and the complexity of the ERP system itself. The technical complexity and integration influences the implementation. The description given is based on three sources of information: Nancy Bancroft's book *Implementing SAP R/3* ((Bancroft, 1996), Thomas Davenport's book *Mission Critical* (Davenport, 2000), and information provided by SAP AG on their web site (www.sap.com).

The R/3 application package is available for different industries such as pharmaceutical and telecommunications. Each industry specific ERP system includes industry specific functionalities. R/3 application package has a number of different application software **modules**, which have been integrated together. These modules cover most of the business activities, each having access to more than 1000 business processes. Each business process included in the modules is based on known industry best practice and updated on a regular basis. Thus, they reflect what the application vendor (SAP AG) considers the way companies typically work (Davenport, 1998).

The accounting-related modules are providing functionality needed to run financial accounts in a firm. The modules available are the **Financial Accounting** module, which includes accounts payable, accounts receivable, general ledger, and capital investments. Controlling includes activities such as cost center, and profit center structures, enterprise accounting, and profitability analysis with the necessary reporting functionalities. Asset Management is designed to manage all kinds of corporate assets. Necessary reporting functionalities are available including financial statements, closing of the books for periods, and balance sheet. All information in the ERP system is current and integrated. The **Human Resource** module has functionalities to manage employee-related activities within a firm. The **Manufacturing and Logistics** segment is the largest and most complex combinations of functionalities and it includes the Materials Management module, Plant Maintenance module, Quality Management module, Production Planning and Control module and Project Management System. Each of these modules provides basic functionalities and includes several sub-components as well. The last introduced segment is **Sales and Distribution**, which includes the Sales and Distribution module for customer and sales management, pricing and distribution-related activities. This module can handle export control (foreign trade module), shipping, transportation (transportation module) and billing activities. All paperwork related to the deliveries can be produced from the system directly.

Each module has several technical structures. The data structure in R/3 is built on various tables. These include tables such as system configuration tables, control tables, master data tables, transaction tables, and application tables. The system configuration tables, control tables and application tables define the structure of the system and are programmed in ABAP/4 language. Only SAP AG configures these core tables. The customer, i.e. the implementing organization, may customize the system's control and application tables. Davenport explains that (2000:301) "*A configuration table enables a firm to tailor the functionality of the system the way it chooses to do the business* ". The ERP is configurable with over 8000 configuration tables. It is suggested that they are first implemented in a test environment and then transported to a productive system. Further development efforts and enhancements to the productive system follow the same logic; first in the development or test environment and then transported to the productive environment.

Evaluation of empirical ERP implementation research

An analysis of recent empirical studies in ERP implementation research (see table 11) in which a case study method was applied was conducted. The small number of cases and small number of samples in those cases are notable. The small number of cases can be defended with the explanatory or descriptive in-depth analysis, but then more samples (persons) should be included in the analysis. Furthermore, these case examples seem to highlight the perspective of senior management as the only source of information. However, the ERP utilization is a very operation related activity. Therefore, the sample should include actors from the operational level. Different levels of participants bring information from variety of perspectives providing a more holistic starting point for the analysis.

For example, an exploratory field survey of 28 ERP implementation cases representing different industries was conducted (Wood & Caldas, 2001). Only two respondents from each case company participated in the survey, making the total number of responses 56. Woods and Caldas found three types of factors: substantive, institutional, and political with ERP implementation. Furthermore, they used terms "techno-reductionism" to describe IT focus and "systemic-reductionism" to describe the IT and reengineering focus during ERP implementation. The results showed significant negative results and implications. Again, the number of the respondents from each case company was small and thus potentially provided somewhat biased information.

A comparative study of 13 industrial firms (Robey, et al., 2002) examined the dialectics of change from a learning perspective. The method was a non-recorded structured telephone interview of senior managers in each company. A total of 30 interviews were conducted. The researchers themselves noted that since they interviewed only senior managers, they did not have access to situated learning. The case study methodology with the discussed sample characteristics raised several questions and yielded ambiguous results. The results indicated two types of knowledge barriers: those associated with configuration of the ERP and those associated with assimilation of new work processes. The first knowledge barrier identified is closely related to the technical constraint of the system. The second barrier refers to organizational challenges. This research does not indicate the integration level of the ERP system. It briefly listed the ERP modules taken into use. However, several interesting themes were noted. For example, one case company noted that most of the knowledge acquired during the implementation was lost when 16 (of 20) project team members left or returned to prior positions after the project was finished. The international site implementation failed due to the lack of international representation. Larger core teams were reported to be less effective when turnover increased. This was a quite surprising finding as only 5 of 13 cases pursued a fuller implementation (concerted) including the business process reengineering approach. The study clearly shows that, first, even smaller case ERP implementation is not without difficulties and, second, that the short term project organizations do not enable successful implementation.

Researcher(s)	Case study type	Focus	Number of cases	Sample size	Type of sample	Case study methodology
Robey, Ross & Bourdreau (2002)	comparative case study	dialectic of learning in ERP implementation	13	30	senior managers (Sponsor, PM and line mgr)	telephone interviews
Stirling, Petty & Travis (2002)	single case study	methodology for developing ERP further by solving system requirements	1	20	experienced professionals in system analysis/ERP experience and Smaller number of potential user	structured interviews (approx. 90min)
Lee and Lee 2000	longitudinal and exploratory case study	knowledge transfer	1	10	University of Nebraska: 5 purchasing employees and 2 financial employees	in-depth analysis; semi-structured in-depth interviews, process analysis and documentation analysis
Baskerville; Pawlowski & McLean (2000)	exploratory	impacts of adoption of an ERP on organizational knowledge	1	7	senior managers only; 3/7 from IT	semi-structured interviews; grounded theory and cognitive mapping used
Sarkis & Sundarraj (2003)	case study	management of ERP implementation from process-oriented perspective + lessons learned	1	not specified	not specified	structured interviews, telephone and email communication, "snowballing" sessions and archival information
Kawalek & Wood- case study Harper (2002)	case study	user participation in ERP implementation	1	1	senior project manager and users at one site	interviews, documentation positivist tradition
Sarker & Lee (2000)	longitudinal positivist case study		1	16 (formal interviews)/ 20		
Parr & Shanks (2000)	case study	to investigate the relationship between PPM phases and necessary CSFs	2	min. 5/ company = min. 10	variety of professions	semi-structured interviews, documentation, cross-case comparison
Wood & Caldas (2001)	exploratory field survey	reasons for implementation of ERP, substantive factors, institutional factors, political factors, implementation approach and outcomes	28	2/ each case = 56	agent and key user interviewed	interviews with structured survey
Krumholz et. al. (2000)	empirical study	corporate and national culture impacts on ERP implementation	1 (2 subsidiaries)	21 questionnaires were returned, number of interviews not	IT development managers, module developers, key-users	2 day visits to UK and Scandinavian subsidiaries; interviews and questionnaire used, observations
Brown & Vessey (1999)	case study	descriptive data	6	not revealed	IS and non-IS stakeholders, other participants	semi-structured interviews, cross-organizational analysis

Table 11. Examination of the empirical case studies of the ERP implementation
(Brown & Vessey, 1999, Baskerville & Pawlowski & McLean, 2000, Krumbholz, et al., 2000, Lee & Lee, 2000, Parr & Shanks, 2000, Sarker & Lee, 2000, Wood & Caldas, 2001, Kawalek & Wood-Harper, 2002, Robey & Ross & Boudreau, 2002, Stirling, et al., 2002, Sarkis & Sundarraj, 2003)

3.4.2 Enterprise resource planning system implementation strategies

Although shortened production cycles, accuracy enhancements in demand forecasting, improved customer service, reduced operating expenses and reduction of overall IT costs are suggested (Umbler & Umbler, 2002) as results of successful ERP implementation, empirical research on successful ERP implementations is scarce. Moreover, the utilization aspect has not been dealt while the focus has been on the implementation. Therefore, successful ERP utilization in an MNE context is an emerging topic of interest.

As an IT objective, implementation of an ERP system across multi-functional and multi-national organization is different compared with conventional software implementation that fulfills a certain functional role. This is due not only to technical specifications, but also due to the number and variety of stakeholders, the high cost of implementation and related consultancy, integration of business functions, consequent configuration of software, management of change and political issues, and the need for training and familiarization. (Skok & Legge, 2001)

Business driven implementation rather than technical replacement

There are two distinctly different approaches to ERP implementation: firstly technology-driven implementation and secondly business-driven implementation (see Markus, 2000). Debate whether ERP implementation should be technology-driven or business-driven has arisen. Although some researchers still argue that the technical decisions override business decisions in conflict situations (Kawalek & Wood-Harper, 2002), most research suggests that business leads (such as Bancroft, 1996, Bingi & Sharma & Godla, 1999, Davenport, 2000). Likewise, Parr and Shanks (2000: 290) agree that the ERP implementation process *“is best conceptualized as a business project rather than the installation of a new software technology”*. Similarly, Wood and Caldas (2001) argue strongly that ERPs are not about information technology or information technology coupled with reengineering, but about change and business transformation. Furthermore, researchers (Bingi & Sharma & Godla, 1999) contend that the exercise is also an “organizational revolution”, including major changes in the adopting organization.

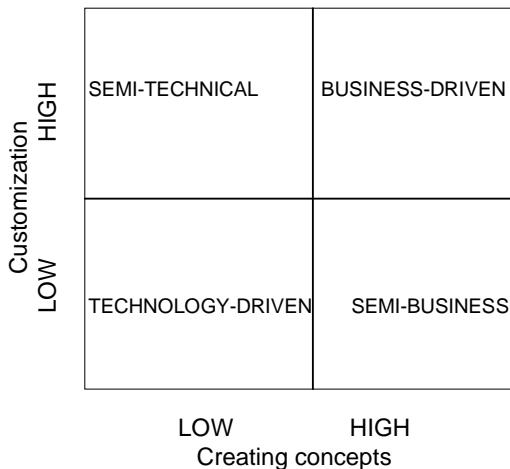


Figure 26. ERP implementation approaches
(Author's conceptualization)

The ERP implementation approaches and their relationship between customizing and creating concepts are highlighted in figure 26. Both of these activities are executed by the implementing firm and not the ERP vendor. The business-driven ERP system implementation requires more customization. The customization is based on both business and technical decisions. The term concept creation is used for methodology, in which the business decisions and business requirements are clarified for the customization (or configuration). Based on business process needs, a concept is created. They identify functionality requirements, e.g. how the ERP is supposed to perform during the defined business process. Moreover, they define what is required from the ERP to support the business process. For instance, the technology-driven ERP implementation seeks minimal concept work and minimal customization. This is implementation of the standard ERP. However, to create competitive advantage firms seek novel business operations that are not necessarily included in the ERP. Those need to be created in the ERP. This requires a business-driven approach with more concept work and customizing. This research assumes that the implementation is business-driven. This selection of perspective simply implies that the implementation is strategically business-dependent and led by business drivers more than by technological decisions. Therefore, the lead comes from the business domain (the line management) and not solely from the IT function

ERP implementation affects business processes and thus it can be seen as an opportunity to enhance or streamline the business processes. It is, however, suggested that the business processes must conform to the ERP model (Bingi & Sharma & Godla,

1999). This creates difficulties for firms. Firstly, it must decide whether to re-engineer the business processes according to the ERP vendor's business processes embedded in the ERP system (i.e. implementation of the standard ERP) or to modify the ERP system according to the focal firm's specific business processes. The more enhancements the system includes, the higher the utilization costs, especially during potential upgrades later on. Implementing ERP that include only programming is suggested in exceptional cases (Gulla & Brasethvik, 2002). Some company-specific business processes may be so unique that there is no equivalent in the ERP system. The likelihood exists that standard, packed ERPs do not always fit with the firm-specific business models, business processes, organization structures, management cultures (Prahalad & Krishnan, 1999,, Lee & Lee, 2000, Wood & Caldas, 2001). According to Bingi et al. (1999), research shows that the ERP could meet only 70% of the organizational needs at best. For the purpose of this research, it is important to note that off-the-shelf ERPs can be changed by customer (the focal firm) and by application vendor before, during, or after implementation. The application provider does not typically suggest that the customer's implementation differs from the provided standardized package (Davenport, 2000). On the contrary, application providers base their promises on their own development and standardized approach.

Implementation is a pre-requisite for use and management of the system. Therefore, much of the research has focused on the initial implementation. This generates other activities as discussed in chapter 1 that are often disregarded in the existing literature. This may be due to the fact that standardization of the ERP package by the vendor aims to reduce tailoring of the system (Kawalek & Wood-Harper, 2002). Wassenaar (1998) explains the growing interest in implementing standard ERP packages to direct the focus for implementation. Some researchers (Lee & Lee, 2000) suggest that organizational capability adjusts to internalize business processes inherent in ERP systems (best practices). This approach assumes that firms first configure the system processes into business and after realizing that they conflict with the existing business values, try to internalize and assimilate them by changing the firm's values. Implementing ERP to fit the organization's business model without losing the potential benefits is therefore an interesting topic. How this is resolved is a major question during ERP implementation. There are several possibilities to bridge the gaps, for example, by customizing the functionalities according to the firm's business processes. This also poses further questions, such as how the firm's business processes are used as a model business process. In an MNE, the business units may have different processes for same area of business. Decision of the harmonization of the business processes and institutionalization

of them across firm's units is required. This dilemma also affects the organization of the implementation. The archetype of an MNE is therefore an important element.

Each ERP implementation is also unique due to the different levels of adaptability of the system (Hedman & Kalling, 2002). The question of the integration level of the ERP system and its implications to implementation was discussed in chapter 1. MNEs typically implement multiple and separate instances of ERPs (Sarkis & Sundarraj, 2003, Swanton, 2003). However, according to a recent report (Swanton, 2003), the consolidated ERPs may be the only way to accomplish the strategic goals of a firm. Accordingly, IT savings alone cannot justify consolidation. Other benefits reported include business process standardization, capability to provide a single face to global customers, real-time geographical presence, and global coordination of supply-demand chain. This study focuses on a single instance ERP and it is therefore a special case. The case company description (see chapter 2) reveals the strategies and reasoning for the single instance.

Several implementation strategies have been suggested by recent research; these include the Big Bang and the Small Bang (see Bancroft, 1996). The Big Bang approach is more risky and includes an implementation decision of all modules. It is the most challenging and risky approach. The Small Bang approach is more experimental by nature; the modules are chosen and implemented by business unit and may include only a few of modules, not all of them. With the experience, more modules are implemented later on. Koch (2002a) suggests three common approaches to implement an ERP package: The one similar to Bancroft is 1) **The big bang.** 2) **The franchising strategy** means several independent instances of ERP systems across the organization. This strategy applies especially in organizations that do not share many common processes. This is the most common way of implementing ERP systems according to Koch. 3) **The slam-dunk** approach suits small companies, while only some key processes are covered with the ERP system. The idea is to get the ERP installed quickly. This approach is generally referred to as a piecemeal approach to implementation (Robey & Ross & Boudreau, 2002, Stirling & Petty & Travis, 2002).

ERP implementation process models

The ERP research stream has resulted in several models for ERP implementation (see for example Bancroft, 1996, Bancroft, et al., 1998, Caldwell & Stein, 1998, Davenport, 2000, Parr & Shanks, 2000, Sarker & Lee, 2000, Al-Mashari, 2003). There are consensuses among researchers about the nature of the ERP implementation. Enterprise

recourse planning system implementation models incorporates various activities into stages or phases. In general, three phases can be found: pre-ERP installation activities, ERP installation activities and post-ERP activities. Furthermore, ERP systems are integrated with other, forthcoming information systems. Thus a structured decision-making framework was developed to assist in developing the installed ERP system further (Stirling & Petty & Travis, 2002). The earliest models from the mid-1990s were clearly activity-oriented, focusing on pre-implementation and actual implementation. Even though the ERP implementation work is generally described as a project, it is actually a process itself (Parr & Shanks, 2000). However, the organizing perspective is not exhaustively incorporated.

In general, the implementation models are very similar to each other. They seem to have a temporal focus, which is visible in the lack of longitudinal perspective and organizing issues. All of the suggested models are linear, causal, and straightforward. They assume that the phases are cut clear and when a phase is finished, the move to the next phase can be done. Each of these process steps includes activities, tasks and decisions to be made by the project team. Nevertheless, the focus is not on the capabilities of the teams to make those decisions.

In essence, these models have different assumptions and perspectives towards implementation as in the present research. They do not consider the integration level of the ERP system or the dimensions for longitudinal use. Furthermore, they do not provide a model to overcome issues such as how standardization and integration decisions in an MNE are achieved or managed. The process models reviewed do not seem to capture this organizational aspect of ERP implementation. In an MNE, implementation may also take place on a rolling basis due to the limitations of resources. Still, these concerns have received surprisingly little attention in studies.

A slightly more utilization focused model was defined by Parr and Shanks (2000) (see figure below). It is based on the extant models of Bancroft, Ross, and Markus and Tanis. The PPM model focuses distinctively on the implementation project phase, although it recognizes the planning and post-implementation stages from the models and also the factors that affect the outcome of the project. The PPM model has three major steps: an implementation planning phase, an implementation project phase, and an enhancement phase.

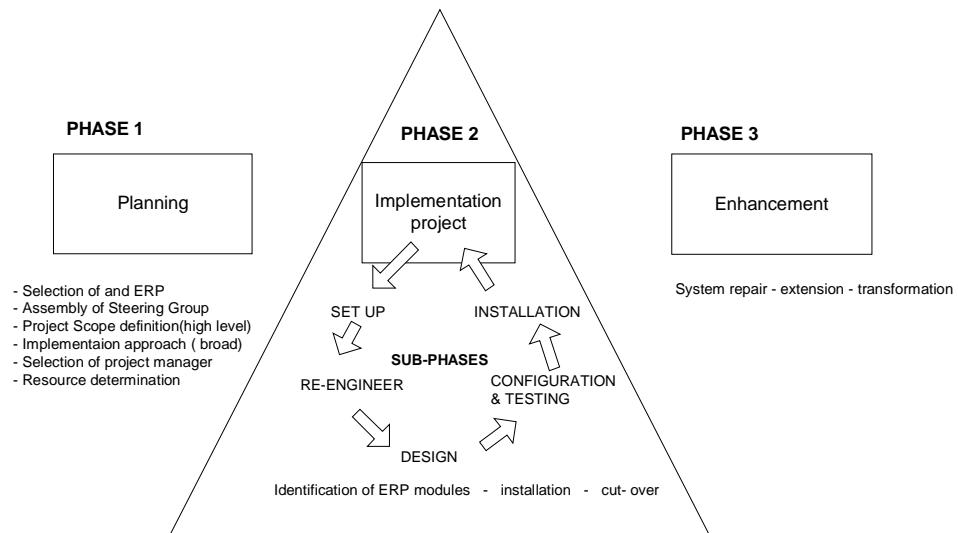


Figure 27. The PPM model of ERP implementation
(adapted from Parr & Shanks, 2000)

The figure above describes the PPM model by Parr and Shanks. The focus area of the model is marked with the triangle. Again, neither the firm configuration nor the longitudinal perspectives of use are considered make it rather simplistic view of implementation.

Recently, Sarkis and Sundarraj (2003) used a process-oriented perspective in their single case study of an ERP implementation. Their study concentrated on three stages, namely start-up, handling go live, and post-audit implementation. These stages are aligned with the models of ERP implementation discussed. The period of the research was not extended to the use phase of the ERP system. However, productivity dip and failing to reach delivery targets were noted. The findings regarding the implementing organization were consequently similar to those presented in this report. Interestingly, all the implementing organization members were transferred to the external company, which managed the implementation resources. There was no indication of how future enhancements or version upgrades would have been handled with the externalized resource base.

Slightly different is the integrative model for ERP application by Al-Mashari (2003) in which a wider perspective was taken with interrelations of five groups of factors: strategic management, process improvement, ERP system deployment, project organization and organizational change management. Although providing a more management oriented approach, the model still focuses only on the implementation cycle. Furthermore, the

organizational changes are interrelated with the user organizations. Also, the project focus is emphasized.

Those studies noting the MNE context discuss the multi-site ERP implementations, which are not unusual. The multi-site project especially faces the challenge that project team members may be in various parts of the world, speak different languages, and represent different cultures (Weston, 2001). The organizational scope of ERP not only defines the extent of potential benefits, but the managerial autonomy, task coordination, and business process integration in the business units of the enterprise (Markus & Tanis & van Fenema, 2000). Several management approaches to multi-site ERP implementation have been identified (Markus & Tanis & van Fenema, 2000):

1. Total autonomy for organizational business units
2. Minimal headquarters control over local processes
3. Headquarters coordination of transactions between business units
4. Network-type coordination among business units
5. Total centralization; headquarters control over local decisions
6. Hybrids of the above mentioned arrangements

Although the level of ERP integration is noted, it was not considered with these different multi-site options. The approaches suggested indicate several possibilities, but do not suggest any organizational configurations. The approaches are not discussed in relation to the dimensions of long-term use.

There has been discussion about the second wave of ERP or the post-ERP era (Caldwell & Stein, 1998). Increasingly, the notion of ERP systems to be only the beginning of overall development, and not the end result as such (see for example Caldwell & Stein, 1998, Skok & Legge, 2001, Koch, 2002a). In this research, the utilization perspective is important because it is directly linked to the integration level of the ERP system and the long-term use dimensions.

Critical success factors (CSFs) in ERP implementation

Critical success factors (Rockart, 1982) comprise few areas in which the satisfactory results ensure competitive performance for the firm. If results in these key areas are not adequate, the firm's efforts may be less than desired. By examining the critical success factors, the factors that positively contribute can be analyzed. The increasing volume of ERP-related research has contributed a wide variety of studies (see the following table),

identifying critical success factors in ERP implementation. In essence, Bancroft's 9 critical success factors defined in 1996 have influenced later research. Those factors are relatively little challenged. Exceptionally, Skok and Legge (2001) note the hybrid teams that clearly challenge the ideal project team construct of Bancroft, which includes IT specialists as developers, users and external consultants. This is further emphasized with the notion of major source of conflicts being unmotivated, untrained or low experience level consultants focusing on running the project rather than transferring knowledge.

Table 12 illustrates the wide variety of commonly perceived critical success factors in ERP implementation. The table also shows the research interest in identifying individual factors that can contribute to ERP. Their compatibility is not challenged in the analysis. This has resulted in a wide variety of factors fragmented to all aspects of management. The table also confirms the Standish Group's (1994) success criteria for software development projects. The critical success factors have been recently examined in other situations such as the senior executive's perspective in the development of executive information systems, which are more often embedded in ERP systems (Poon & Wagner, 2001).

Researcher(s)	Type	Focus/Notes	Factors identified
Bancroft 1998 (1998 2nd ed)	CSFs (9)	Corporate culture	Complete and fit business processes before implementation
Bingi, Sharma & Godla (1999)	Critical issues	Top management commitment	Reengineer existing business processes
Plattin (1999)	Recipe for success	Create team of super-users (managers)	Set-up systems for debugging and problem solving
Parr & Shanks 2000	CSFs	(Top) Management support	Communication
Davenport 2000	Success factors	Project treated as a business initiative	Led by business managers
Nah, Lau & Kuang (2001)	CSFs (11)	Based on literature review; factors were classified into Marus & Fabis ERP life cycle model	Change management program and culture
Stock & Legge (2001)	CSFs	Comparison to Bancroft 9 model	Executive champion, Managing director level sponsorship
Legge 2002	Steps for successful implementation	CSFs plus new findings; this with consultants	Communicate to all stakeholders, including users, manager, customers, ERP change vision and manage expectations
Hong & King (2002)	CSFs	Individual, group and organization characteristics	Leadership to foster business change perspective
Umble and Umble (2002)	CSFs (10)	Organizational fit perspective	Organizational fit of ERP implementation
Sarker and Lee (2003)	Key social enablers	A lot can be solved before ERP implementation	Implementation is viewed as ongoing process
Umble, Haft & Umble (2003)	CSFs	Strong and committed leadership	Open and honest communication
Akkermans & van Helden (2002)	CSFs (10)	Most prominent CSFs based from the existing literature	Clear understanding of strategic goals
Nah, Zuckweller & Lau (2003)	CSFs (11)	Interactions between top management support and top management	Project team competence
Bradford & Floring (2003)	Factors	CSFs (Nah et al 2001) and CIOs perceptions on them	Business plan and vision

Bancroft, 1998 (1998 2nd ed)	CSFs (9)	Corporate culture	Complete and fit business processes before implementation	Communication	Championship	capable project manager	A balanced project team	Good project methodology	Training everyone	Commit to change (expect problems)		
Bingi, Sharma & Godla (1999)	Critical issues	Top management commitment	Reengineer existing business processes	Integrate other systems to ERP	multiple skills (functional, technical, interpersonal)	the length of implementation	selection of the right employees to participate and employee morale	Training everyone	Implementation costs	Implementation	ERP vendor selection	
Plattin (1999)	Recipe for success	Create team of super-users (managers)	Set-up systems for debugging and problem solving	Join user groups	Well intensively with employees	Create & maintain processes, simply roadmaps (before impl.)	ERP implementation (before impl.)	Formal recognition of ERP roll-out				
Parr & Shanks 2000	CSFs	(Top) Management support	Communication	Balanced team (business analysts, technical experts, users and users' and users' needs)	Empowered decision makers (project team members)	Deliverable dates (realistic milestones and end date)	Champion	Vanilla ERP implementation (minimal customization)	Smaller scope of the ERP implementation	Definition of the scope and goals	Commitment to change	
Davenport 2000	Success factors	Project treated as a business initiative	Led by business managers	Outcomes clearly defined and measurable	A clear strategy before implementation	A long-term perspective and constancy for	Go-live is not the end of ERP project					
Nah, Lau & Kuang (2001)	CSFs (11)	Based on literature review; factors were classified into Marus & Fabis ERP life cycle model	Change management program and culture	Top management support	Business process reengineering with minimum customization	Project manager's political astuteness	Monitor and evaluate performance	Effective communication	Software development	Testing and trouble shooting	Project champion	Proprietary business and IT legacy
Stock & Legge (2001)	CSFs	Comparison to Bancroft 9 model	Executive champion, Managing director level sponsorship	Change corporate culture, including behavioral changes to fit ERP	Business process changes	Hybrid team (both IT and business knowledge)	Strong leader to monitor progress	Tailored training	Expect problems to arise	Staff retention	Managing consultants	Cultural and business process changes
Legge 2002	Steps for successful implementation	CSFs	Individual, group and organization characteristics	Leadership to foster business change perspective	Empowered and effective ERP implementation project structure	Incentives for ERP team members	Restructure around ERP capabilities and business strategy	Measure ERP and business benefits	Celebrate success			
Hong & King (2002)	CSFs	Organizational fit perspective	Organizational fit of ERP implementation	Implementation is viewed as ongoing process	Best workers into implementation teams	Middle management involvement	Excellent project management techniques	Monitor and measure implementation	Aggressive and achievable schedule	Successful change management techniques		
Umble and Umble (2002)	CSFs (10)	A lot can be solved before ERP implementation	Strong leadership	Implementation is viewed as ongoing process	Best workers into empowered team	Excellence project management	Eliminate all old systems	Aggressive and achievable schedule	Successful change management techniques	Extensive education and training (begin training before		
Sarker and Lee (2003)	Key social enablers	Successful ERP implementation	Strong and committed leadership	Open and honest communication	Balanced and empowered team	Extensive training	Extensive training	Multi-site issues acknowledged	Successful change management techniques	Extensive education and training (begin training before		
Umble, Haft & Umble (2003)	CSFs	Most prominent CSFs based from the existing literature	Clear understanding of strategic goals	Top management commitment	A great implementation	Data accuracy	Extensive training	Multi-site issues acknowledged	Successful change management techniques	Extensive education and training (begin training before		
Akkermans & van Helden (2002)	CSFs (10)	Interactions between top management support and top management	Project team competence	Interdepartmental cooperation	Clear goals and objectives	Project management	Interdepartmental communication	Management of expectations	Project champion	Project champion	Careful package selection	
Nah, Zuckweller & Lau (2003)	CSFs (11)	CSFs (Nah et al 2001) and CIOs perceptions on them	Business plan and vision	Business process reengineering	Change management	Communication	ERP teamwork and competition	Measurements of the system impact	Project champion	Project management	Software development, testing and trouble shooting	
Bradford & Floring (2003)	Factors	Organizational factors and environmental factors measured against user satisfaction and organizational performance	Technical comp ability	Perceived complexity	Business process reengineering	Top management support	Organizational objectives consensus	Top management performance	Training	Competitive pressure	Top management support	

Table 12. Critical success factors identified in the ERP implementation literature
 (Bancroft, 1996, Bingi & Sharma & Godla, 1999, Plotkin, 1999, Davenport, 2000, Parr & Shanks, 2000, Nah, et al., 2001, Skok & Legge, 2001, Akkermans & van Helden, 2002, Hong & Kim, 2002, Legare, 2002, Umble & Umble, 2002, Bradford & Floring, 2003, Nah, et al., 2003, Sarker & Lee, 2003, Umble, et al., 2003)

However, those individual factors can be roughly categorized into four categories according to their relation: management, project team and it structure, methods and tools used, and technology (see the following figure).

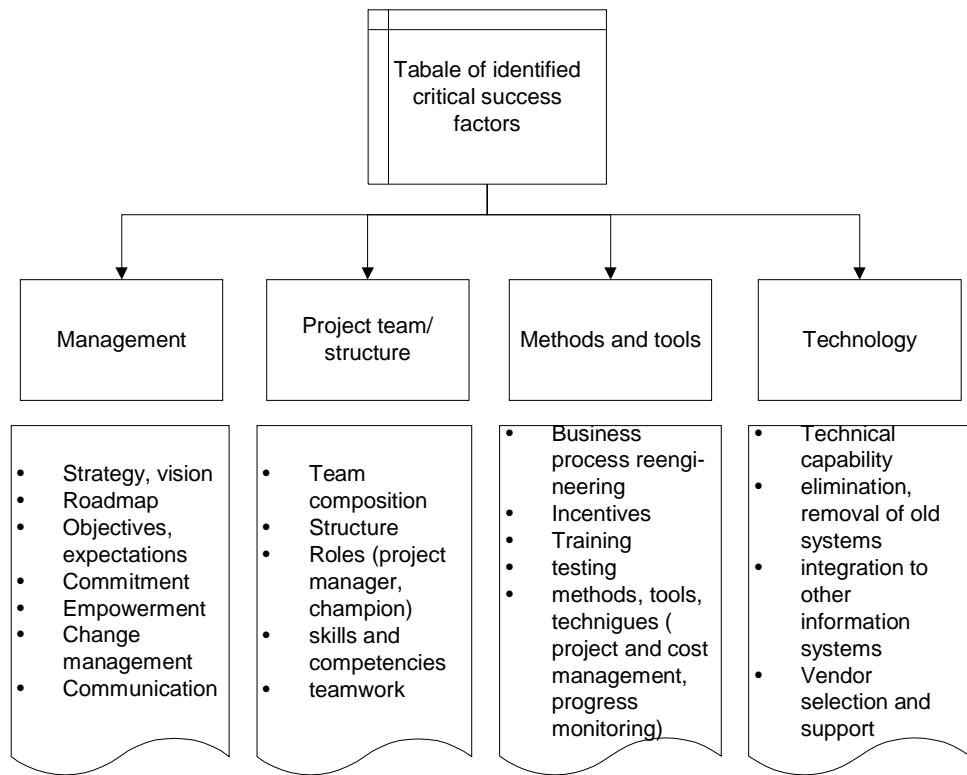


Figure 28. Categorization of identified critical success factors

Categorization allows analyzing the factor groups noted to positively contribute to the success with ERP. Management related factors do not seem to capture the firm characteristics such as size, internationalization level or management style. Project team and structure factors do not discuss the roles, their compliance and their relation to management category. Methods and tools seem to be mostly posited and noted for contributing to the work. The technology category does not capture or indicate any difference between the levels of integration of the ERP. Based on the analysis of the commonly perceived critical success factors, the research suggests a further examination of the project team and structure category. Furthermore, the compliance of the management, project team and technology requires further examination. In contrast to the critical success factors, the reasons for the ERP failure are examined. The next section discusses the reasons for failures.

The reasons for ERP failure

Although the critical success factors can be inversely understood as reasons for failure, pitfalls in ERP implementation, ERP implementation failures in relation to human aspects, communication breakdown, and failed ERP attempts have been studied (Burns, et al., 1991, Brown, 1993, Bingi & Sharma & Godla, 1999, Mendel, 1999, Davenport, 2000, McAlary, 2000). Increasingly, there are reports of failed ERP implementation attempts (Davenport, 1998). Failures with ERPs have been reported (Davenport, 1998). It was recently reported (Johnson, 2003) that ERP approaches are successful in approximately 20 to 25% of the large MNEs but more achievable for SMEs. Umble and Umble (2002) reported in a recent survey of 63 firms that the average ERP implementation costs were \$10.6 million and implementation lasted 23 months. They estimated that 50-75% US firms experience some degree of failure in implementing advanced IT and 65% of the executives are said to believe that the ERP implementation may hurt their business. More than half of the organizational information systems have been perceived as unsuccessful by their users (Whyte & Bytheway & Edwards, 1997). Hedman and Kalling (2002) argue that as in the case of success of ERPs, the failures of ERPs are also directly linked to the people. Al-Mashari (2003) noted the concentration on technical aspects in the explanations of many ERP failures. It is estimated that more than half of the ERP implementations fail in terms of planned costs, time used and need for scaling back (Legare, 2002)

Davenport (2000) gives three failure reasons: 1) the goal of the project implementation of a standard ERP regardless of the firm's own needs, 2) IT managers are in charge of the project, and 3) everything is turned over to external consultants. McAlary (2000) has defined three pitfalls that can affect ERP implementation: 1) modifying ERP prior to pilot testing, 2) inadequate training, and 3) insufficient implementation support. Legare (2002) reports a case study research, in which the ERP implementation was reported to be technically successful, but it did not achieve the hoped for organizational changes. Some research (Krumbholz, Galliers, Coulianos, & Maiden, 2000, Krumbholz & Maiden, 2000) fails to identify the organizational impacts. Culture-related clashes in relation to the implementation team are discussed, but do not define nor describe the team, organization nor the activities.

Besides the failure reasons, there are several **risks** and disadvantages associated with the ERP systems. The disadvantages for ERPs may include end-user organization resistance. Also, the changeover from old systems to new systems may mean that data errors carried throughout the system were high. The maintenance costs are high and it is time-consuming

(Gupta, 2000). Detrimental use could result in lower company profits and bankruptcy as a worst-case scenario.

The number of failed ERP implementation attempts clearly shows that there is room to improve ERP implementation capability. Umble and Umble (2002) argue that the organization needs to be reengineered, staff will be disrupted and productivity will drop, the company's culture may be disrupted, extensive training may be required or mishandled customer orders may occur before the ERP benefits are realized, thereby reducing the bottom line results. Combining perspectives, the success factors and failures, in the ERP research review demonstrated that success is by no means a coincidence when implementing an ERP system.

3.4.3 Organizing enterprise resource planning system implementation

This chapter has so far focused on introducing several elements related to ERPs. Although, existing research has widely covered critical success factors, failure reasons, risks, the implementation process, and acknowledges the business drive in all this, the implementing organization was only recently included in the research. The realization that ERP implementation is more than a typical software project has contributed to research on organizing the ERP implementation and utilization (Koch, 2002a, 2002b). Different perspectives have been embedded such as the impact on organizational knowledge (Baskerville & Pawlowski & McLean, 2000). Although success and failure is linked to the people (Hedman & Kalling, 2002), it is typically linked only to the adopting (end-user) organization and not to the implementing organization. Since the ERP system must reflect the business strategies and operations, a purely technical implementing organization composition seems less applicable as illustrated in figure 1.

The current literature provides less discussion of the specific organizational challenges of ERP implementation to MNEs. This may be due to the less integrated approach of the ERP. As discussed earlier, the MNEs have not typically chosen a single instance ERP. Therefore, the implementation is smaller considering the geographical scope. The similarity of the ERP system in a geographically diverse MNE was examined by Koch (2002b). He reported an example in which installations followed the 70-20-10 rule in implementation, i.e. standardization. Following that 70% of the implemented ERP was similar in the US and in Europe (7 countries), 20 % was common to all eight countries, and 10% was specific to each country.

In early research on ERPs, the long-term impacts of ERPs on IT support and maintenance as well as other elements of organization were unknown (Baskerville & Pawlowski & McLean, 2000). However, the existing literature (for instance Hall, 2002) acknowledges the organizational and management change associated with ERP utilization. Still, this is mostly associated with the adopting organization, the end-users of the system. The rare investigations (Bingi & Sharma & Godla, 1999, Skok & Legge, 2001, Hedman & Kalling, 2002) of organization that implements and provides long-term support for the ERP, suggest that there is a need for more detailed research on this specific area of ERP systems.

An MNE may force changes in an ERP system but these need to be selected without losing the potential benefits of the ERP system. The ERP may force changes in an MNE. Again, the MNE is required to analyze those changes and their implications in order not to lose the firm's competitive advantages. The challenges culminate during the implementation. Therefore, the role of implementing organization is significant. Implementers need to ensure that the MNE can run its business operations with the ERP system.

The organization structures and roles related to ERP system

From the research of critical success factors in ERP implementation, the research has selected the project team and structure for closer analysis, because the main argument of the dissertation is that ERP activities cannot be achieved successfully with the conventional organization structure (see figure 1.) The research on implementing organization design, structures and members is relatively scarce, and vague if it does exist. For example, Bancroft (1996) describes team composition as a 'balanced team' including IS and business members. Wassenaar (1998) gives the overall responsibility to vendor and consultants. The internal stakeholders included IT specialist, IT managers, end-users, and the top and middle managers (in end-user organizations). Sarker and Lee (2000) included that a balanced and empowered implementation team was selected by IT manager. Davenport (2000) has defined a "cadre of specialized roles" that needs to be created to ensure successful completion of the project with the desired business results. These roles are executive sponsor, project manager, process owners, super users (from management level), visual and planning team, implementation team and the role of IT (configuration and technical specialists). Skok and Legge (2001) identified participants in an ERP project to include management, developers, users and consultants. Hedman and Kalling identified three key groups for organization: senior management, users, and IT staff (Hedman & Kalling, 2002). Legare (2002) suggested use of a creativity framework to create organizational characteristics that may improve the development and implementation of ERPs. He

suggested that success can be increased if the appropriate amount and type of organizational resources for each phase of the project are acquired. The structure suggested included functional, technical and consulting leaders with team members from the business units. Furthermore, three teams were established -a global team, change management team and technical infrastructure team to integrate individual activities. Legare suggests, for instance, defined team roles and responsibilities, open information sharing, and team diversity as key organizational factors supporting success. Furthermore, creativity and motivational factors were suggested. Al-Mashari (2003) is one of the few researchers to include the project organization in his integrative implementation model. The model itself focuses on activities and practices rather than resource, structure and organizing perspectives. The enterprise characteristics (such as size, management style, internationalization level etc.) are not discussed in relation to the model. Although, some of the characteristics of project organization are identified, the approach is far from complete. However, Al-Mashari's model is a step towards recognition of the importance of organizational matters because it integrates the organizational elements in the ERP implementation model. The emergence of organizational interest has been noted in ERP research. For example, hybrid teams (Skok & Legge, 2001) were studied.

ERP systems have transformational effects on the business and the installation people (Koch, 2002b). Consequently, Koch argues that the project teams are very valuable to the organizations because they not only know the system but also the business. Knowledge creation and learning are immense. On a personal level, Koch states that if the ERP team members do not get equally challenging tasks after the project, the organization is likely to lose them or that ERP team members had to move to the IT department after the project ended. Implementation organization design is a difficult question. Bingi et al. (1999) go as far as to claim that companies implementing an ERP should dedicate their best employees to the project work in order to succeed. Feeny et al. (1996) point out that there are reports of difficulties between the relationship of IS professionals and other professionals in organizations. Furthermore, Bancroft (1996) contends that in SAP R/3 implementation has caused changes in the role of IS experts because ERP is customized rather than modified, and customization can be even done by users. Therefore, IT experts found themselves either in advisor roles or in project teams customizing, coding or programming the system.

Hedman and Kalling (2002) state that it is crucial to bridge differences on knowledge, power, language, and culture. This is achieved by reducing knowledge gaps, improving the general level of IT literacy, and acknowledgement that IT is part of every day life and provides certain benefits. Hedman and Kalling still see IT as a separate function, the location and structure of

which depend on the overall strategy and structure of the firm. IT development experts and business process development experts need more in-depth knowledge of each other's expertise. However, on the individual level, this implies that knowledge becomes more divergent. Nevertheless, organizational and technological knowledge has become more concentrated in a few individuals. Thus, ERP affects the organization through knowledge convergence. (Baskerville & Pawlowski & McLean, 2000)

Earl, Edwards and Feeny (1996) analyzed IT organization configurations in 1980s and found five ways to configure IT organization. From those, the centralized, decentralized and federal organization structures were found ideal for complex organizations. Similar conclusions were drawn by Davenport (1998, 2000) with the focus on enterprise resource planning systems. There are three options for a firm; these are the centralized, decentralized or federalist alternatives for decision-making regarding enterprise system implementation and related matters. The centralized and decentralized are well-known approaches. The federalist approach culminates in decisions regarding which information and business processes should be common throughout the firm. In contrast to implementing one system, a global ERP, the federalist alternative implements multiple systems (or versions). Davenport (2000) suggested that the globally-wide adoption of an enterprise system may even lead to new organizational forms. It has recently been shown (Wang, 2003) that the degree of internal alignment in a firm's organization structure can be achieved by configuring the information processing capacity. Wang acknowledged the potential of enterprise resource planning systems as a means to centralize control over information and standardization of processes. The interplay between a firm's structure and information system was noted, but from the perspective of the adapting organization. The role of implementers in achievement of the information processing capacity configurations was not discussed.

The current research provides several interesting opinions related to the implementing organization. However, several issues are not handled with the organizing discussions. First of all, the firm size, type, globalization strategies, and management style are important. The present research focuses on less hierarchical MNEs, which can be described as a transnational network. Therefore, the coordination and control methods become important, not only as reasons for implementing the ERP but also how to organize the implementation. Furthermore, the integration level of the ERP system defines the tasks of the implementing organization. The present research focuses on single instance ERP implementation, during which the standardization and integration are on the highest level. Therefore, agreements on what is global and what is local need to be made. The longitudinal perspective is visible with the implementing organization discussions. The temporality of the project teams is expected.

However, the case company illustration suggested that a lot of enhancing activities will take place after the ERP is implemented. Therefore, organizational capabilities are required. The review noted some changes within the IT function. This is part of the utilization perspective that should be included in the discussion of the implementing organization.

Summary of the research on enterprise resource planning systems

The aim of this chapter has been to introduce the ERP research by providing an overview on the system and by examining various perspectives related to the ERPs. Several interesting research results were discussed such as critical success factors, reasons for failures, implementation models and organizing issues. This chapter offered a limited view of current research on ERP systems. Against this examination of recent research on ERPs, it is surprising how little attention is paid to activities after ERP implementation and organizing of ERP utilization. The analysis of the recent ERP research has resulted in a notion of general themes. They are the following:

- Time perspective: Temporality. Projects are temporal by nature; once the ERP is up and running the project teams disband. What happens after implementation is seldom discussed in the context of implementation.
- Organizational perspective vague. Find the best and brightest from functional areas for the project team or use end-users during the project. No criteria, division of the work, tasks or organizational structures are suggested.
- Technology-driven project. Treat ERP project as any other software projects. The IT department directs the work.
- Negative implications to business. Business performance drops after go-live. Most firms face loss of profits.
- Technical set-up. Standardization and minimal customization.

The motive for this research can be expressed in Cobb's paradox (Standish Group, 1996):

"We know why projects fail, we know how to prevent their failure -- so why do they still fail?"

Maybe a longitudinal perspective to the implementing organization, its structures and roles can answer this question. Therefore, it calls for further research.

3.5 DEVELOPMENT OF CONCEPTUAL MODEL

The inductive research approach defined for the research strategy does not rely on one specific theory. However, a theory orientation can be established in the light of recent theory development and research results from the field. It can be used as an assumption when conducting the research. Furthermore, it provides an avenue for the interplay between academic conceptualizations and emerging themes from the data. In this chapter, the recent

developments in the research have been discussed; first the grand theories with more focus on the emerging complexity science and then the corporate level organizational archetypes and coordination mechanisms literature. As a part of the review of the related literature, the social organization structures of MNEs has been reviewed according to the international business research tradition. The structure of an MNE must be compatible with the sub-organization and departmental level of the MNE. The condition under which the MNE is functioning is central. As Marchand and Horton (1986:142) point out,

“There are no correct solutions to the problems of determining appropriate configurations, degrees of centralization, or management styles. There are just some approaches that may give better results under some conditions.”

The present study examines the conditions that were based on strategic decisions. These conditions include the management style of less hierarchical organizations and the selection of single instance enterprise resource planning system to be used globally within the MNE. Then the literature review discussed the ERP specific research in detail.

Accepting the suggested research approach and thus the interplay between academic pre-conceptualization and description from the empirical reality, the pre-concepts were first identified and discussed. The traditional theories include scientific management and systems theories. The new theories include the complexity sciences. The complementary nature of both paradigms and an understanding of both of them can bring more value to the explaining phenomenon than the single paradigm approaches. The research has been conducted using the selected methodological approach, which was extensively discussed earlier.

The difficulty of design changeable organizations with intended outcomes is noted (Parker, 1994) yet it is not surprising when noting the systems theories approach on management. With constant change, deterministic and accurate planning and predictability are becoming impossible. Another approach is needed. Stacey, Griffin and Shaw (2000) argue that systems theories and scientific management do not explain, how true novelty arises in organizations or how organizations change. The flattened structures would characterize the new models of organizations. Furthermore, the mode of operation in those flat organizations may be converted from a sequence-based to synchronized mode, requiring more self-control or self-regulation from the workers. This was also suggested by Drucker (1995:17), who stated that *“To build achieving organizations, you must replace power with responsibility.”* Hence, the command approach must be replaced by knowledge and information flows. This requires fundamental changes from traditional organizations and traditional managers. Since change is constant, organizations use change as a way of putting knowledge to work.

Drucker (1995) suggests that to be capable of continuous change, organizations must also be highly decentralized; an organization's structure needs to support quick decision-making. In decentralized organizations, the power of decision-making is located evenly around the firm. The reflection time is saved while the decisions are not escalated to higher or centralized hierarchies.

This chapter has discussed both the scientific management and systems theories and the complexity sciences. Several key concepts were introduced and illustrated. The concept of self-organizing was highlighted in several theories. The increasing interest in applying the complexity science paradigm in the organization and management research was noted. The unpredictability, instability, and existence of complexity alongside the other characteristics of complexity thinking are embedded in organizations. Therefore, instead of controlling organizations, managers should influence them differently. All actions have an effect and these effects cannot be predicted precisely. Therefore, in systems such as organizations, the behavior of management is typically one of the following: 1) top-down control leading to an ultimately steady or rigid state, which in turn leads towards the death of the organization; 2) complete instability as a result of large scale redundancies or re-organizing that sends organization members off in different colliding directions. This approach also leads towards failure. 3) A mixture of the previous alternatives. An organization at the edge of chaos or bounded instability may have better chances of survival than the alternatives 1 and 2 because creativity and adaptation take place.

The administrative heritage of a company has affected the current structure and limits the future options (Bartlett, 1986). MNEs are structurally evolving due to a variety of factors (economic, technological, informational, political, globalization, competition), including the efficiency drivers (Pettigrew & Massini & Numagami, 2000). Summarizing the previous research on contemporary MNE architectures, four perspectives have been used. These include the strategic perspective, hierarchy perspective, network perspective, and the environment perspective. As such, internal networking rose as a key theme in organizing. Several attributes such as capabilities and competencies, flexibility, knowledge and positioning were suggested. If MNEs are seen as "networks of knowledge flows" (Gupta & Govindarajan, 1994), this poses challenges for management. Based on the above discussion, the knowledge needs to be allowed to flow, and furthermore it needs to be managed. The organizational networks are autonomous units voluntarily working together. The role of headquarter in this network may become more influential, if, for example, implementation of a corporate wide system is decided. This chapter has discussed the organizational architectures of MNEs. All of these organizational archetypes are based on

similar assumptions. Moreover, they all display a slightly different solution for overcoming the hierarchical structures and for increasing flexibility, information creation and transfer within the firm.

The theoretical analysis conducted during the present study is grounded in the complexity sciences. The complexity sciences perspectives have been selected. Change in social situations, such as organizational contexts, requires changes in people's worldview. Hence, the present study proposes a complexity science worldview. These theories provide the lenses through which the study analyzes and explains the emergent phenomenon. After selecting the worldview, the new structural models of multinational organizations were discussed. As a result of the review on recent literature, the theory orientation is on complexity sciences. Based on the theoretical orientation, four models of organizations were introduced: the transnational model, heterarchy, the networked model, and the flexible organization form. These models are designed to respond to the challenges of an environmental turbulence. Three features are characteristic in these models: the theoretical orientation, approach on strategic management, and approach towards the required global coordination.

The difficulty in applying complexity sciences is in its developmental state. Furthermore, the theoretical alternatives are close to each other, and partly intertwined. Therefore, instead of selecting only one complexity science theory as the theoretical framework, the present study has chosen to include a more holistic approach. The study assumes that creativity is enhanced with the selected theoretical framework. This creativity can be visible in organizational activities, the way of finding solutions and thinking. The uncertainty faced by an organization may not merely be external but also internal. For example, the strategic decision to invest in enterprise resource planning systems creates uncertainty novel to the organization. The uncertainty may relate to the system functionalities, their suitability to the management style or organization structures, or it could be related to the technology, for example.

Theoretical framework applied in the development of the model

Organizational structures display the management of a firm. However, the management of the firm is about to change, and managing may no longer be based on the command authority (Drucker, 1995). The organizational form of an MNE and its coordination mechanisms are closely interrelated. The previous review of recent research has revealed that in the last two decades coordination mechanisms have evolved from formal mechanism

towards more subtle and informal coordination mechanisms. Concurrently, new structural forms of MNEs have been identified. This tendency can be partly explained by a shift in the underlying theoretical orientation. Organizational forms have been of wide interest among scholars. Some research has mainly focused on restructuring and been less concerned about the emergence of new organizational forms. Some of these new organizational architectures have been conceptualized, focusing especially on the features and characteristics of them (see extensive discussion in Lewin & Volberda, 1999). The changes in the theoretical assumptions are visible within the MNE research. Drawing on studies of MNEs, coordination mechanisms, organizational change, information system literature a conceptual model will be outlined. The purpose of the present study is to understand attributes positively influencing the success of ERP systems. One of the key contributors for the success is the implementing organization. The analysis focuses on whether there is an organizational transformation motivated by ERP utilization in a multinational enterprise.

There is a relatively large amount of research dealing with critical success factors in IT general implementation and especially ERP implementation. The commonly perceived critical success factors suggested by the reviewed research are presented earlier. Based on the theoretical framework, other potential factors were included. These elements will be tested in the survey part of the research. The survey variables are escalated from the reviewed literature reflected in this chapter. The present study aims to identify the key constructs related to development of the proposed model. Two new constructs were created: first the dimensions of utilization of ERP, and second, the levels of ERP integration. This construct has a two-dimensional perspective including integration and standardization perspectives for both the ERP and the MNE. The idea of time perspective and the idea of dimensions of ERP activities led to some preliminary conceptualizations. Therefore, the starting point for the development of the model is presented in the figure below.

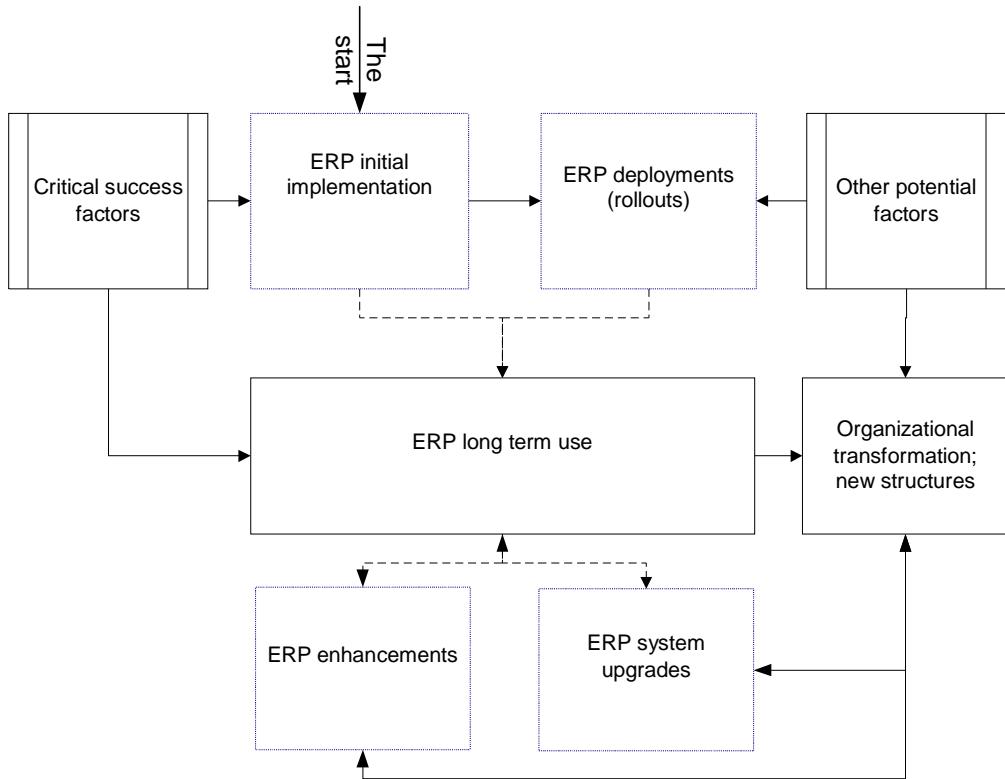


Figure 29. The starting point for the model development

The starting point for the model development was the notion of the longitudinal use of the information system. Therefore, this element is placed in the center in the figure above. The initial model describes the relationship between the initial implementation of the ERP, the following deployments of the same ERP in various geographical locations (sites), and the long-term use (including enhancements and upgrades). It is suggested that the commonly perceived critical success factors (variables) support implementation of the ERP, but may not support utilization of the system. Those were included in the model. However, including all the long-term use perspective and the high integration level of the ERP, other factors were observed. They were closely related to complexity science. The result of observations was the emergence of new organizational structures that cope with all the dimensions mentioned. The development of the conceptual model began with the information-system-specific requirements and their impact on the work ahead. The technical dimension of ERP implementation cannot be ignored, but neither should it be overemphasized. It is proposed that the complexity science variables be included in the examination of an ERP implementation and enabling long-term use.

Building on the complexity sciences, the present research argues that the ability to transform an organization during ERP utilization is supported by complexity science variables. Hence, they are included in the model as new potential factors. Furthermore, it is argued that the long-term approach to ERPs will result in different tasks and several structural changes. This is proposed in the model. In the proposed conceptual model, the transformation is escalated to the central position suggesting the removal of the technology as central focus. This illustrated the shift in the model development: from ERP system technology focus to organization focus. The model highlights the organizational transformation over the technical dimensions. Both the critical success factors and the complexity thinking variables are included in the model. The present study undertakes to examine the structural development proposed in the model and to discuss the new factors that influence this transformation. The factors suggested are based on the complexity science theory and were discussed earlier. Based on the empirical evidence, the proposed model will be revisited.

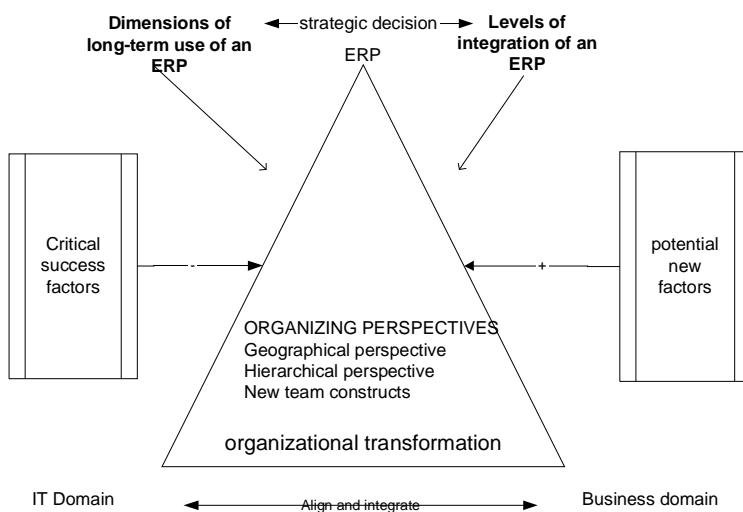


Figure 30. Proposed conceptual model

The organizing perspective chosen and illustrated in the model includes geographical and hierarchical perspectives. The ERP implementation is a multi-project activity in an MNE. Therefore, the geographical and hierarchical perspectives become important. The team constructs are included to display the development of the organizational structures. These elements form the basis for the organizational transformation. The proposed conceptual model follows the logic of the research framework. The key elements of the proposed conceptual model are grouped into three areas: technical, structural, and enabling factors. The model outlined lacks direct support from the literature. However, if the model is analyzed

in parts, support from the literature can be found. For instance, the organizational perspective in ERP implementation was recently supported by Koch (2002b), Legare (2002) and Davenport (2000). The technical factors are subject to the strategic decision and include the dimensions of long-term use of an ERP system and levels of integration of ERP. The dimensions of ERP use are discussed in the implementation process models, but not yet incorporated as a comprehensive utilization construct. However, some of the recent studies such as Caldwell and Stein (1998), Koch (2002a) and Skok and Legge (2001) increasingly suggest that ERP systems are only the beginning, and not the end result as such. Managing parallel dimensions on at least two timescales requires specific attention on the organizing perspective. The structural element includes not only the transformation itself but also the perspectives. These elements can be found in both the MNE literature and the complexity sciences literature. The model elements can be found in the existing literature. For example, the strategy level of the model is noted by Markus, Tanis and van Fenema (2000) and Weston (2001). The critical success factors were widely discussed in the previous chapter. Similarly organizational capabilities have been noted in the context of adopting organization (Evgeniou, 2002). The theoretical framework developed in this chapter supports the search for other factors. The enabling factors are constructed from the critical success factors found in the existing research (discussed) and the theoretically constructed enabling factors. Furthermore, to evaluate the model, an empirical investigation is suggested.

The model is based on the assumption that strategic choices related to the information system and dimensions of the utilization reflect organizational decisions. This model positions enabling factors that suggest dynamical organizational structures.

4 CASE STUDY ANALYSIS

This chapter presents the case study. As discussed in chapter 1, the research aims to link a business phenomenon closely to academic research by using the inductive research approach. The present study aims to understand the organizational transformation associated with the information system utilization context. The emphasis of the empirical research path, and the interplay between literature and empirical data becomes more visible in this chapter. The chapter describes the process of abstraction data into concepts used later in the model.

The empirical research on ERPs that was presented earlier shows the quality of the contemporary research. It implies several problems in the validation and generalization of the results. The present study will overcome this with multifaceted evidence by providing a wider variety of data and a larger sample (respondent) size. The empirical evidence was collected in different methods including documentation, observation, the semi-structured interviews, and the survey instrument. Furthermore, the present study extends the viewpoint from senior management to include a variety of respondent profiles. Thus, the selected case company offers a unique opportunity for both a critical and revelatory case study as supported by Yin (1994) for examining why the ERP was success and how a new organizations were established. A single case study is defended by the rarity of single instance ERP implementation into MNEs. The case study was conducted over time. After analyzing the case study, this chapter ends with a summary of the key results of the case study.

4.1 SECONDARY SOURCES

Secondary data sources are typically created for other purpose than the research. Secondary sources are useful for their historical value, for evaluating primary data, for establishing chain of events, and for establishing comparisons. They can be divided to internal and external based on their origins. (Ibert, et al., 1999)

Internal secondary data collected for the research include materials in presentation forms such as strategy communication (PowerPoint) slides. Other internal secondary information included case-company-related and specifically created materials (Nokia, 1998), Nokia annual reports 1995 to 2003, and memorandums (company confidential material). Information was also collected from the Nokia Intranet. Other secondary sources of data for

this research included presentations, process descriptions, standard documentation such as plans and schedules produced during the programs and various projects. This material is by nature both formal and informal, including personal notes and comments. This material has been collected from individuals and from common databanks. Unofficial materials were used, for example, in identification of the potential respondents for the survey. Most of the information was collected from several separate databases, by discussion with company representatives, and by recalling the various participants. The case company has not created an official analysis of the ERP implementation or evaluation of the implementation. The utilization has been evaluated in the last couple of years. Secondary sources of information included also informal discussions with Nokia employees throughout the research process.

External secondary data included printed documentation that provided background information about the case company such as books (Jahnukainen & Vepsäläinen, 1998, Steinbock, 2001, Häikiö, 2002), and other reports (Datamonitor, 2004).

4.2 PARTICIPANT OBSERVATIONS

The applied research methods support active participation and observations (Glaser & Strauss, 1967, Van De Ven, 1976, Eisenhardt, 1989, Yin, 1994, Dawson, 1997, Pettigrew, 1997, Ibert, Baumard, Donada, & Xuereb, 1999). The researcher was employed by the case corporation and had worked in all of the implementation projects. Based on the experience gathered through participation and observation, the interpretations of the statistical analysis results and especially factor analysis results can be deepened. Information acquired through participation and observations has been used throughout the research process. Especially, in the early phases of the research, the observations provided a way to collect information on larger scale than actually included in the research scope. Interviewees were selected and interviews were conducted as a result of researcher's observations. Together with the results of the interviews, the survey instrument was created and potential respondents were identified. The analysis of the potential survey respondents relied solely on the research observational data, because the case company did not have comprehensive lists of the participants. The interpretation of the analysis is subject to the experience accumulated during the participation and observation period.

Overview

For the case company, logistics played an important role in ensuring the competitiveness (Steinbock, 2001). Organizational structural changes in the case company from historical perspective imply evolutionary change. The starting point was two separate units. The global logistics organization was introduced. Simultaneously with it, the information management organizations were presented. The IT organization was clearly a function, comprised fragmented separate units. These units did not operate under the same governance.

There are several boundary events crucial for the transformation: the selection of a single instance ERP is one of the most important decisions. Although this decision in the mid-1990s covered only one region to start with, it forced the decision makers to focus on the standardization issues. The strategies suggested change in the logistics processes due to the crisis, and together these two activities intertwined into a common approach. The requirement of not only analyzing existing processes but also creating new and re-developing existing ones (BPR activity) was decided and defined, but not implemented before the system implementation phase. This caused a variety of opinions. Some of the project participants noted that this project and concept work especially in 1997-98, was very time-consuming. Especially the technical specialists were keen on starting the system work. They also implied that it was not good to do concepts, i.e. the functionality requirements, separately from the system.

”...an awfully lot of time was spent on doing the concepts, and they were not according to the system (SAP). The concept work was done without thinking about the system capabilities...it felt like the project would last forever.”

Generally, the implementation projects were a process of trial and error. Implementation strategy and approach were agreed. Based on that, a lot of freedom was granted to sub-teams and individual actors. The complexity of the ERP system and the large number of parallel activities created edge-of-chaos situations at times. Especially, the weeks before a go-live date, when most of the final testing and training of the end-users took place, could be categorized as edge of chaos. This is also clearly visible in factor 2. Strategies guided the overall activities. Those strategies were not clear in all geographical locations. The SuLo project team, especially the global concept owners, did not expect to become strategy distributors. Especially, in the Americas region, there was no alternative but to begin the business process discussion from the strategic decisions. The global concept owners made numerous visits in the first year to explain the global logistics strategies and their implications to their regional counterparts. All this time was naturally taken away from the

actual business process and concept definition work. However, the knowledge was shared and partially contributed to the acceptance of global concept owners. A basis for networking was established. A trusting climate was to emerge. The planning for the projects was approximate, but increasingly detailed with increasing the number of implementations and experiences. A milestone structure in project planning was adapted from the product creation process and it proved functional.

4.2.1 Transformation of the implementing organization structure on department level

On an organizational level, several events indicated the organizational transformation trend. From the historical perspective, these events seem evolutionary. One can even argue that they were planned. However, the engineered change program related to the system implementation was directed solely towards the adopting organization, e.g. the daily end-user organizations of the ERP system and not towards the implementing organization.

The first event in the organizational transformation took place after the initial implementation of the ERP system. The acquired level of the system was rather narrow, and was thus called a base line. The Finnish and German site ERP implementations with narrow scope were achieved with a rather conventional project setting, which was partly dissolved after the work was accomplished. A new project structure was established when a wider scope for the system was decided. A further transformation took place when the geographical scope was widened. The transformation deepened with the changes in the tasks involved. Recall the identification of the dimensions of long-term use in figure 5 (chapter 1). Thus, the extensions of the dimensions in use forced further sub-units structuring to the original organizational setting. Since the ERP system itself covers the transactions involved with the supply chain and related financial transactions, several other information systems were used alongside the ERP system. Some of those systems are interfaced directly to the ERP system, some include batch data transfer between the systems, and some systems are standalone systems with respect to the ERP system. The extension of all information systems used grew the organizational structures.

The chapter 2 looked first into case company strategies, and then activities related to the enterprise resource planning system implementation and activities thereafter. Organizational structures evolved during the period of analysis. Focusing on the department level transformation, several events can be traced.

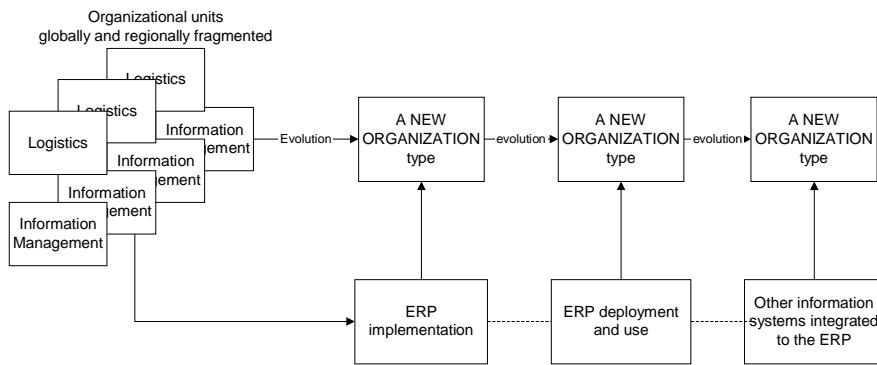


Figure 31. Organizational evolution high level
(Author's conceptualization)

The transformation of the organizational structures is presented in figure 31. The events can be named as follows:

- Concept structure
- Closer cooperation of global logistics (business domain) and IT departments
- Nokia Process Solutions structure
- Nokia –wide Information Management (IT) organization structure
- Nokia Delivery Process Solution structure
- Nokia Business Infrastructure structure

The concept structure was described in chapter 2. The other events are briefly described below. The roles described in chapter 2 are embedded to these organizations.

The Nokia Process Solutions (NPS) organization was established in December 1999 for creating feasible roadmaps through NPS and hence to manage IT resources efficiently. The assumption that fragmented development within each business entity creates the fastest and customer-focused results were considered illusory. The throughput of the IT organization does not support this, and as a result, all entities suffer from poor capability to deliver concrete, deployed solutions. To correct this, all business groups were to align and share process, concept and IT development. Consequently, NPS had a central role in developing the integrated, modular and company-wide business processes and information systems to support all business groups and further e-Business needs. Roles and responsibilities were defined in detail level. Business process roadmapping, project prioritization and management were the main activities. NPS had seven sub-units. The headcount in spring 2000 was 108 professionals.

Information Management (IT) Platform organization was established in 1999. This organization included a unified IT approach. Thus, the organization structure was created to enable development of a truly global organization with IT professionals. It embedded disciplined management practices and clearly assigned roles and responsibilities in the area of strategy and information management. Organizational (engineered) change was done in stepwise from fragmented IT entities towards a centralized IM organization.

Following the NPS, Nokia Delivery Process and Solutions (NDPS) organization was established in 2000. Especially focusing on the business processes, the NDPS organization guided the ERP implementation overall, but especially the enhancements. E-business applications became another important information system development stream requiring interfaces to the installed ERP system. Therefore, ERP system was developed further in conjunction with other information technologies and systems. The movement from process thinking towards solutions thinking became visible. Sub-units were considered solutions and they were not restricted to a single application, system or technology. Solutions were responses to the business requirements and problems. A modular organization was established. Thus to solve a business challenge, a more holistic view is taken.

The next organization development was the Nokia Business Infrastructure (NBI) organization, which was announced at the end of May 2001 and finalized in 2002. Here the case company focus was shifted clearly on the corporation focus. The main objective of the NBI organization was to provide value-adding business infrastructure for business units so that they could concentrate on business activities. Operations and support arrangements included processes and information technology. Improved effectiveness and efficiency through corporate-wide business benefit analysis and program prioritization formed key operating principles. Cross-functional programs were the vehicles for solution creation, service creation and deployment. Targets of speed, flexibility and cost efficiency were achieved through plug-and-play architectures and common system platforms. NBI included two large sub-units: Business Infrastructure Solutions (BIS) and Information Management Services (IMS), which were supported by several common support functions. The regional units were aligned accordingly. **The BIS** unit was more focused on creation and development whereas the IMS unit maintained the information systems. Consequently, BIS included solution units and related application development units. The solution units had the ownership and responsibility of business infrastructure solutions and solution creation programs. They included development of business process and concepts, business requirements management, managing the development roadmaps, managing the creation

programs, providing process deployment support and end-to-end responsibility for solutions in the use phase. The application development units were responsible for selecting, creating, and deploying developed applications and systems. **The IMS** was more focused on the operational IM activities such as networks and servers. It was also responsible for IM services management, operations and support for all Nokia businesses, end-users, and customers defined by Nokia businesses. The resulting organization, NBI, is responsible for the information systems and information technologies used by Nokia. The NBI organization is multi-national, global unit representing 60 nationalities in 40 countries. The number of personnel (the statistics are from June 2002, Nokia internal documentation) was approximately 2700 divided by region as follows: Europe 2150, Asia 250 and Americas 315. The organization is relatively diversified. Employees' average age was circa 33 years. Over 1000 persons joined Nokia and the NBI organization in 2000. This indicates that most of the organization members were relatively new, and therefore may not possess experiences of the organizational transformation process, which started in the mid-1990s. Furthermore, these professionals managed external service providers of the outsourced activities.

The NPS organization proposed the role of process and concept development in association with IT capability. It extended to other solutions areas in the NDPS organization. The IM platform organization provided a holistic approach to all information management and information system management activities. With the experience, NDPS and IM platform units were rapidly merged into one unit NBI, which can be signified as a hallmark of novel organization. The organizational focus area of the research within the NBI organization was the BIS unit. The IMS unit represents the IT departments with the IT infrastructure services. The NBI organization was modular, built on the established concept area thinking. A cellular form of organizing has been suggested by Miles et al. (1997). All development activities in business operations and processes would be analyzed and information system solutions were always developed as part of the solution. The business development and information system development were bridged together also organizationally. Management of information systems was extended to include both the technical development and maintenance and the business driven approach. Each ERP functionality, interface and later other information system development were conducted with a cooperative effort focusing on the end-users requirements and strategies. The information age quickly introduced e-business applications and other novel information technologies. They were managed under the same organization structure in a similar modular manner. The centralized perspective became visible already at the NDPS organization, which stressed the scales of economies ensuring implementation of developed solutions globally. The NBI organization was formed to implement business processes with the aligned IT solutions. Technology architects,

information management services and business process improvements were the core areas of the NBI. The NBI organization represents the centralized structure (Häkiö, 2002). The ERP experience influenced the contemporary factors and resulted in a business infrastructure unit.

Depending on the timeframe used for the observations and the perspective (past, present, future), the characteristics of changes suggested by Ackerman (1986) can be depicted. Organizational units represent the main events of the changes. Looking from 1996 towards 2001, the overall transformation was not foreseen. In each state of the event, the changes seem transitional from event to event. Looking back, the changes seem more evolutionary. The longer the time perspective the more variety in the nature of the change can be observed. The changes took place both on macro and micro levels. The transition state included several mini-scale transformational events with self-organizing as a key characteristic. On a wider perspective, the whole organization transformation can be categorized as an open-ended change (Stacey, 1991): over a period of time the consequences may become major. This escalation of consequences is visible in the organizational transformation of the NBI unit. The future of the unit is open. The possibilities of activities and management of closed change and contained change remain. The growth of the unit has been rapid and the actors are largely new. Therefore, at times more manageable changes are needed to ensure the coherence of the unit.

This evolution suggests the alignment of two organizational entities through another organizational unit. This implies both unit level and actor level integration. The notion of bridging activities in aligning business and technology is noted by Sauer and Willcocks (2002). However, they suggested bridging on an actor level defining the role an organizational architect. This role was on strategy level and not on operational level.

4.2.2 Transformation on actor level

The direct integration between business domain and IT domain is difficult in complex multinational organizations in which the tasks of the users are very fragmented and geographically bound. A global view could not be achieved, yet required, due to the high level of standardization. An end-user in one specific department, function or geographic location cannot make decisions concerning the entire corporation while his/ her current position may not provide expertise or information for fact-based decisions. Furthermore, it may be impractical to tie the end-users directly in to the system implementation while they should be concentrating on the line organizational tasks.

At times the complex web of project participants, business representatives, and external partners created situations in which the information flows and the phase of decisions did not meet each other. The number of participants in the implementing organization became large. Having worked with the projects for a long time, the participants had already established way of working and communicating with each other. Some participants that who joined the project later found it difficult to follow the parallel communication and information flows.

The role of concept owners created during the ERP implementation represent the role of the "hybrid manager" (Skyrme, 1996). The concept owner role is clearly a hybrid manager role with the ERP. In order to capture the business requirements in a centralized manner, a cadre of concept owners was appointed. Some project participants would have wanted the implementers to move more quickly and directly to implement the system. This clearly speaks for the inhibitions earlier noted (Lohmeyer & Pogreb & Robinson, 2002) to align business activities closer to the IT function. Actors originating from the IT function were more open in complaining about the length of the time spent on process development and design and concept design. The role of concepts was to translate business requirements into technical system requirements. This activity was new and new role/ position was established, e.g. the concept owner role. There is a great deal of criticism about the transfer of business requirements into the system requirements (Lockett, 1996). The concept owners had "*one leg in business and one leg in IM*". The fact that most of them came from the line organizations ensured closer relationships with the end-users. The participant observations resulted in the notion of another hybrid manager group. These were the configuration owners while many of them to some extent developed their role into that of hybrid manager. The configuration owners came from the IT functions, but were required to learn basics of the business domain activities, strategies and reasoning. Their interest beyond the technical side of the implementation was observed.

Before the notion of hybrid managers and hybrid teams, the information system literature was based on the assumption users and IS specialists would be integrated directly (DeSanctis & Courtney, 1983, Feeny & Earl & Edwards, 1996). In the case company similar efforts were made. Through service level agreement (SLA), Nokia IM organization agreed with NMP (business organizations) on services and their management. SLA standardized and formalized the dialog between IM and NMP management. It described cooperation on different levels in organizations. However, this formal agreement did not directly bind the concept owners who worked for different department (NDPS). The SLA was most visible in the global support model (see appendix 7). The concept owner role was defined in it. This

implies that the hybrid manager role, such as concept owner role, is not organizationally bounded. The supportive role given to them was without a mutually agreed mandate.

Self-organizing took place throughout the implementation projects. Respectively, individual actors sought both formal teams and ad hoc teams to solve the problems they faced. They integrated with the business representatives beyond the hierarchical structures. The business expertise was sought to ensure that the implemented functionalities do not cripple the real business activities (Davenport, 1998). With the increasing maturity of the organization but also with the increasing knowledge from the ERP system, the 'chaotic behavior' of individual actors decreased. Hence the suggested flexibility forms trajectories (Volberda, 1996) were noted.

The idea was not to limit concept teams too much with the system capability restrictions. Furthermore, it was important that those business processes and business requirements important for NMP were embedded in the system, regardless of whether the system originally supported the capabilities. This increased the number of modifications to the system. The discussions with global configuration owners about a requested function that the system did not support were challenging. The number of modifications was to be kept small. However, strategy-based business operations would be included in the system. Also, in several areas such as the European Union regulations were not fully developed in the ERP system. For example, the EU member states are required to inform the EU of the external (Extrastat) and internal (Intrastat) trade. This data is used to by the Union to compile trade statistics. The reporting functionality was not fully available, but was required to comply with the EU legislation. This required changes not only in the actual material movement side, but also in financial modules. Similarly, a novel sales planning approach was established to ensure better customer service. The planning approach needed to be visible and thus included in the ERP system, in which is crossed over several key processes. Several warehouse related operations were defined and modified in the ERP system. The concept owners need to negotiate with the configuration owners about the functionalities and modifications. The reasons for requesting a new functionality could range from legal regulation to business requirement. Some of the new functionalities were requested because of saving money or time. The negotiations were typically open and information was shared. They could range from simple discussions to the approval request. The business owner, i.e. top management, signed the approvals.

Despite the challenges, unique approach was taken in the European regional SAP implementation project: the concept owners could freely define their requirement without

considering the ERP system functionality. The primary task was to follow the strategies defined, the business departments' requirements, and their own experience, which were combined in analysis to produce the concept. Similarly, the complimentary solutions (for other than ERP system such as i2, MQR and MMCS) concept implementation was acknowledged. This approach frustrated yet challenged the system specialists. The concepts were drafted, and then verified with the business representatives and the system specialists. The system specialists mostly involved with the concepts were the configuration owners. Again, a new task arose from to the selected system. The configuration owners' main task was to make the ERP system resemble the approved concepts. In the early phases of the ERP implementation, the cultural collisions were inevitable, but with time, the cooperation improved. The bi-directional knowledge transfer between configuration owners and concept owners was enormous. Respect grew over time along with the closer relationships. The system specialists learned more about business process and operations, whereas the concept owners learned about the information system specifics.

Summary of the participant observations

Throughout the transformation process, several simultaneously events have expanded the organization into a currently corporate level organization with regional and local hierarchical levels. Most of the information systems were under the governance of the transformed organization (NBI). The technical infrastructure management was surely the largest part of the new organization. The technical infrastructure part of the organization (IMS) resembles the information management organizations. However, in comparison with the extensions of the new organization several differences and additions were noted. The liaison roles were added between business experts and IT experts. Furthermore, process development activities were moved from line organizations to the new organization. This increased the economies of scale and implementation of standardized processes. With the maturity of the new organization, the project and program management were included. The new organization was transformed not only in terms of ERP-related activities, but also along with activities related to other information systems. The trigger towards the new organization, however, can be traced to the early structuring of ERP related work.

The observed organizational transformation from several fragmented units to a centralized platform organization is supported by Hodgkinson (1996) who pointed out the constant restructuring of IT function. The movement between centralized and decentralized IT organization was suggested. However, the difference here is that the emerged platform organization cannot solely be categorized as an IT function due to the several business-

related activities and roles included within the organization. In brief, the organizational structures influenced by the ERP system implementation could not be predicted in 1994/1995. Neither was these structures planned. Looking back in 2003, the transformation was visible and can even be described as evolutionary. A chain of evolutionary incidents can be traced.

The central themes that emerged through participant observations can be summarized as follows: 1) continuous transformation of organizational structures, the transformation was not planned or included in the strategies 2) overall positive attitude towards the transformation, the transformation was not perceived negative as matter, although, it did create confusion among the participants, and 3) new roles and organization structures were considered beneficiary.

4.3 THE INTERVIEWS

The interview phase of the present study focused on analyzing the conditions for the organizational design decisions and to support the development of the questionnaire used later in the research. The focus of the interviews was on the early years, which in practice included activities during 1995-96. Some basic information about early decisions was gathered through interviews retrospectively. The researcher had observed interesting events in the case company. This triggered an interest to the research topic. Simultaneously, the existent literature did not discuss the topic of organizing. The intention was to clarify the conditions. Furthermore, the interviews were conducted to evaluate the research focus proposed earlier. Therefore, the nature of this phase was qualitative.

4.3.1 Interviewees

The interviews were considered a supportive data collection method. Therefore, an attempt was made to keep the number of in-depth interviews small. Hence, seven of the case company employees were interviewed to analyze the strategic decision and organizational design for the ERP implementation.

In the research, the sample of the interviewees was decided on the basis of the approach applied. To widen the perspective, different levels of actor groups were represented. The representation of the conducted individual interviews was broad including end-users, different technical expertise areas, and the project and business management areas (see

table below). Actors who had participated in the initial implementation were interviewed to analyze the strategic decision of the case company made for the IT strategy, the organizational design for the implementation projects, and performance of the projects. Thus the case company representatives were interviewed in order to follow the decision from the IT strategy (integrated instead of fragmented) to organization at the implementation projects.

Position	Team/ Unit	Focus/ representing
Senior Manager	Basis Team	System infrastructure and information technology
Configuration owner	Application (Materials Management module)	Application configuration
Development Manager & Project Manager for 2 projects	Global Logistics	Management/ Project management
End-user escalated to business representative	Europe/ Africa region	Procurement; End-user/ business expert
Manager, Logistics and Information Systems	Information Management	The senior (top) management
Project Manager	Global Logistics	Project manager for the third project onwards, the organizational change
Development Manager	Finance and Controlling	The financial department

Table 13. The list of interview participants

As a general remark, the interviewees spoke freely about the history of the early ERP activities. The opinions seemed to be well thought out and honest. There seemed to be no need to take any details for granted or to emphasize one's own (personal) role and influence even though it was clear that all of the interviewees had a strong influence on the implementation activities.

4.3.2 Conducting the interviews

For the in-depth interviews a general protocol was used during the interviews. It included a short overview of the case project, field procedures, credentials and agreed access, general sources, procedural reminders, initial scheduling of the field visits and the selection criteria for the interviewees. A semi-structured list of questions (see appendix 8) was created. The questions focused on the organizational issues related to the ERP implementation projects.

The interviews were held during a three-week period in January 2002. At that time, the ERP implementation had progressed and most sites utilized the system. Each session was

agreed separately with the researcher and the interviewee. Each person asked for interview accepted the request immediately. The researcher agreed separately with each interviewee about the time and the location of the interview. The interviews were held at the case company offices suitable for the interviewees: in practice at two locations in Finland. Prior to the interview, the interviewee was told a little about the research. The idea was to minimize the potential risk of influencing the participants' responses. The interviewees were told the purpose of the study and the use of the information gathered. The pre-defined list of questions guided the interviews and ensured that the same questions were answered in all of them. This increased the comparability of the answers. To follow-up the path, selected by the interviewee, some questions were made outside the list. This increased the depth of the interviews and provided further information of the organizational issues in relation to the ERP implementation extension outside European region to other regions.

The time reserved for each interview was 90 minutes. The actual interviews took 45-60 minutes. The first ERP implementation projects were conducted in Finland and in Germany. Due to the contemporary regional management decisions, Finnish managers led these projects. All interviews were held in Finnish for a purpose. Firstly, all the interviewees were Finns. Secondly, to ensure the information shared would not be compromised due to misunderstanding of the concepts or terms. Retrospectively, the choice of language, i.e. mother tongue, encouraged interviewees to speak more freely using their own words. Each interviewee was also allowed to speak relatively freely about the subject.

The interviews were recorded. The recording of the interview was agreed separately with each of the interviewees, and by permission, all of the interviews were recorded. In addition, notes were taken during the interviews. The tapes were transcribed at an accuracy level suitable for the analyzing purpose. The transcribed interview texts were sent to each interviewee for factual verification such as checking, verification and complementing. This provided the interviewees with an opportunity to correct as well as complete their answers. The aim at this point was not to provide interviewees any conclusions from the interviews, but to ensure the quality of the interviews. No changes were requested. A case study report was outlined, including information from archived documentation. A report was made to highlight the discussions and the results of the discussions. It was also sent to the participants for commenting.

The techniques for analyzing the interviews called for shortening of each transcript. The essence of the interviews was captured and analyzed. To identify themes in the interviews, the discussions were categorized. Then they were added to an Excel matrix to get an

overview. To ensure the quality of analysis, the language during the analysis was not changed. After the analysis was accomplished, it was translated in to English. One of the aims of the first phase of the study was to collect information about the early phases of the implementation activities from different perspectives. This was carried out. The rich interview data provided several interesting themes and supported operationalization of some of the central concepts later used in the survey instrument. Furthermore, the interview results were compared with documentation and reflected with the experiences gathered through participant observations. The interviews provided rich perceptions in qualitative format for comparison purposes.

4.3.3 The results of the interviews

All of the interviewees remembered the first type of project organization clearly. They could list all the core roles, and even name the individuals who held those roles. The core roles were project manager, technical specialists from the IT organization, end-users from the business organizations, and SAP consultants from SAP headquarters (Walldorf, Germany). The project organization and the activities were perceived to be technology-driven, and the role of SAP consultants was perceived as visible. Some of the interviewees noted that the organization in the first two projects was different from that in later projects. As a conclusion, the organization for the early implementations was well remembered. The project organization design was perceived as traditional and technology-driven.

Mostly, both projects in Finland and Germany were considered similar with regard to basic set-up; the roles were same, but the participants obviously came from the local end-user organizations. Both projects were finished on time within the set budget. Three themes came up: 1) the financial department and its role; The project was not considered to be related to the logistic process alone, but also included the financial services; 2) The use or need of SAP consultants were challenged (and later decreased). 3) The basic set-up for the organization was the same. However, actor level differences were noted; end-user participation was different compared with Finland and Germany. In Finland, the end-user, such as a buyer, would answer any question presented by the project team members. However, in Germany, the end-user would not answer questions. He/ she directed the questions to management level; this indicated a different business culture and management style. The end-users did not feel comfortable in providing opinions about their own work. This indicated national cultural differences in relation to management style and the organizational hierarchy.

All of the interviewees had noticed changes in the organizational design. Five out of seven interviewees highlighted the need for clarity in roles and responsibilities as a reason for organizational change. Three of the interviewees pointed out that there was a stronger need for business commitment, especially since the implementation was widened to cover the whole NMP and thus business should be driving the implementation instead of the IT organization. One of the interviewees explained that

"...the logistics organization realized that since the activities went on a global level, the IT organization can not drive the implementation since they do not have enough knowledge about business, for example, production planning. ".⁸

Summarizing the responses, the learning from the two first projects was evident. Both the scope change and the environmental change, i.e. from local implementation efforts to regional and later to global projects, put pressure on the project organization structure. There was a need to include more people in the project and clarify the roles and responsibilities. The line organization commitment was understood to be important for the success of the implementation. Thus, extended roles for the line organization representatives were needed. As the scope of the implementation widened, the ability of traditional IM organization was seen limited. The IT organization should concentrate on their expertise area and should drive the technical system implementation. There was a change in the project structure set-up. However, there seemed to be some discrepancies in the answers concerning the origin of the new organizational structure. Four participants thought that the design was an in-house invention. One of the interviewed summarized as follows:

" Well it came from somewhere I guess.... probably a sum of coincidences and the core team was established a little bit by accident."⁹

There was no clarity about the origin of the new organization structure. Still, it was mostly perceived to as in-house rather than a model copied from outside. The roles of configuration owners, concept owners and process owners on both the regional and global level were agreed later. The need to concentrate on certain expertise areas was accepted. The line organization representatives highlighted in their answers the role of business process development and re-engineering activities. In general, these activities related to the implementation and occurred throughout the utilization of the system. The need for closer cooperation, especially between configuration owner and concept owners, was noted. The IM organization representatives were more concerned about the cooperation between the various roles, and described the roles and responsibilities as "a line drawn in the water":

⁸ Author's translation

⁹ Author's translation

*“Everybody worked together and were not so worried about whether something is an MM or SD issue; everything was everybody’s problem and solutions were found together. Now, I think that everybody concentrated on his or her own issues only and do not worry about issues outside their own area of responsibility. Now, it is difficult to get persons to become interested in getting a holistic view. And since we are in integrated system, you need to remember to verify the interfaces to neighboring modules.”*¹⁰

Also, it was noted that the implementation was not only the replacement of an old system with a new system, but required process development and system enhancement as well. The early projects’ organizational structures and operational models were seen to be relevant, considering the smaller scope of the project both geographically and content-wise. The selection of project participants was seen as a clear success factor. It was noted that the operational models were not fully developed and this created some challenges and duplication of the work. The new organizational set-up was seen as a clear success factor for the overall implementation. Without the new roles and increasing clarity in responsibilities, the activities and the management of whole, the client/ server instances, technology, and development of business operations simultaneously could not progress. The IT organization representatives felt that too much time was spent on actual creation of concepts and on analysis of the business process operation’s analysis. They thought that it would have been better to get inside the SAP R/3 and work from there. *“Too much time was spent on describing (as-is) processes...we should have started the system work earlier”*¹¹ The line organization representatives, on the other hand, saw the opportunity to learn existing business processes and to develop logistics activities related to the business operations with the implementation of the new system introduction. The information system implementation has different levels and relations. The implementation was considered as more of a business improvement activity than just a replacement of information systems. The new organizational design was seen as successful in handling complex activities in a manageable manner.

With a hint of hesitation, it was suggested that some controlling efforts were present in setting the organizational structure. Nevertheless, all interviewees agreed that the aim of the new organizational structure was coordination. The new organizational design had two perspectives. First, the geographical focus of the local, regional, and global. Second, the expertise areas were clearly defined, letting the owners concentrate on configuration or concepts with process development, not autonomously but in good cooperative and integrated manner. The coordinative nature of the organization became more visible on

¹⁰ Author’s translation

hierarchical perspective. The holder for a global position was not a direct manager for the respective regional or local actors.

4.3.4 Issues outside the semi-structured interviews

The themes brought up in the interviews outside the pre-defined questions are discussed next. Some flaws were pointed out during the interviews. They were related to matters such as the lack of mode of operations during projects. It was noted that the development project methodology took a relatively long time. It helped to focus on the contents rather than on setting documentation rules, for example.

From the cultural perspective, the whole implementation had a very strong Finnish perspective and drive. The location of the headquarters, Finland, had a strong influence. The cultural issues arise when describing the information system itself and its relation to IT experts. Since the system selected and implemented was the product of a Germany-based company, including a very strong "*model example of German organizing*", it was seen to influence the technical approach. The ERP system had to be set up in a certain way and used in a predefined manner. Thus, the implementation can be done either by the book, which will lead to a fixed system, or the other way, with less support by the system provider. Furthermore, it was noted that the system clearly guides and limits the implementation activities regardless of what the project's own approach. The third theme related to the cultural issues was the notion of one specific geographic location posing challenges during the implementation, namely the Americas region. Five participants out of seven pointed out the challenges with the Americas region during the system implementation.

The strategic themes and developments related to business operations introduced before, during and after the system implementation were discussed. When the system work begin in late1994 in the Europe & Africa region, the overall situation of the company was not good. Several company-level strategic decisions were made. These strategic decisions included a new way of operating in the Europe & Africa region, which implied changes in logistics. Manufacturing centers and distribution centers were physically integrated and the logistics processes were streamlined accordingly. The strategic decision supported the estimated growth in production volumes and thus required more manageability from the supporting information systems. The IT strategy was created. The strategic choices and finished process re-engineering created a unique situation, in which the company already had similar logistics processes as a starting point. The aim was to get "one set of numbers" to compare

¹¹ Author's translation

business units and their operative success. The strategic decision had a great influence, since the impact of logistics processes development was combined with the information system implementation.

Responses to the management changes reflected that "*the team cannot be one-sided, decisions are needed quickly, and there is a need for a common set of game rules*". A highly integrated system does not allow just any kind of site-specific functionalities configured, but a consensus of functionalities. However, the markets, customers and other stakeholders have differences on a global scale, and their demands should be fulfilled accordingly in order to stay in competition. These assumptions guided the organizing. The organization should have the different perspectives represented.

4.4 THE SURVEY

The analysis of the interview resulted in some interesting themes. To collect data from a larger number of respondents, an electronic questionnaire was created. The data collected with this survey would be used to specify concepts for the model. This part of the study is quantitative. An electronic questionnaire was created for the study to collect more empirical data from the case company.

To have a broad base of respondents, the questionnaire was distributed electronically via the Intranet. The electronic survey was linked to the several web pages on the Intranet. To increase the response rate, the survey was advertised on several intranet pages and a separate email was sent to potential respondents. Both the questionnaire and the email included a message from the management in support of the study. A second round of emails was sent two weeks after the initial email to remind the potential respondents to complete the questionnaire. The responses were anonymous.

4.4.1 The survey design

The questionnaire instrument included a total of 80 questions, of which 70 were mandatory and 10 non-mandatory. Three types of questions were presented: Likert scale, selection and open-end format. The 5-point Likert scales were mainly used to capture the perceptions of the respondents. To clarify their response or provide an opportunity for further information, eight open-end questions were included.

The questions were grouped into four sections (forms) due to the technical constraints of the tool used (Website Builders Forms, WSBF, version 2.6 in Lotus Notes). This technical constraint is visible when evaluating the responding tenacity. The respondent saw the questions one after the other. The logic of the survey instrument is presented in figure 33. The survey instrument is shown in appendix 9.

The figure illustrates the logic used in the survey instrument. The coding part of the instrument was used to categorize the respondents. The coding data were also used for validation and comparison purposes. The questions in forms 2 and 3 dealt with a variety of issues and were developed on the basis of the literature and observations. The critical success factors were found from the ERP research. The potential factors were found from the complexity sciences. The last section (form 4) included questions directly linked to the observed organizational evolution. The transformation variables were needed to measure the characteristic of planned and emerged. Also success variables were created and were measured. This logic is in line with the selected approach discussed in chapter 1.

The respondent filled in the survey on the Intranet and the researcher received automatically the results in separate Lotus Notes database. English was used in the questionnaire. This should not, however, create a bias in the results since the official language of the case company is English. The questionnaire was also pre-verified by a native English-speaking translator to reduce misunderstandings. Three case company employees also tested the questionnaire. They answered the survey and suggested improvements in areas such as the terminology used, or the selection lists provided or the order of the questions. Technically, the empirical data collected with the survey instrument were stored in a special case database. Then the data were transferred to Excel format for the univariate and bivariate analysis. Finally, they were uploaded from Excel to the Statistical Program for Social Sciences (SPSS) version 10 for Windows for the multivariate analysis.

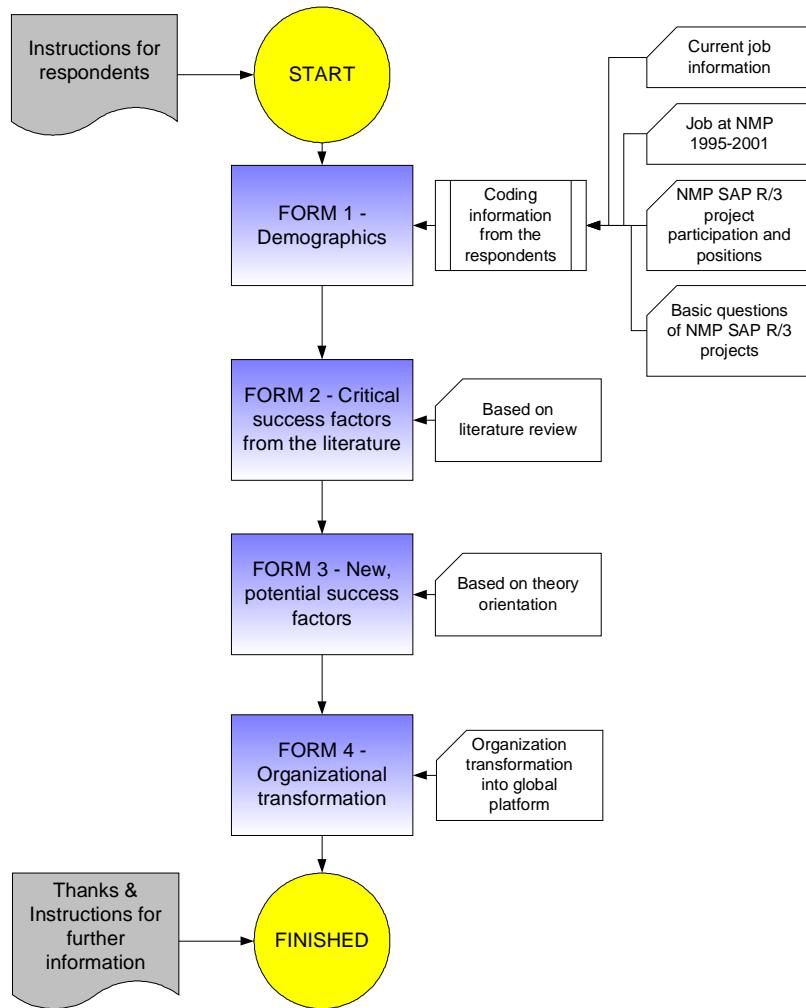


Figure 32. Survey instrument logic

Selection of analysis techniques for the survey data

There are different choices available for analyzing the empirical survey data. The present research uses multiple methods for analyzing the collected data. The data analysis techniques include univariate and bivariate analysis to identify distribution and relationships between only one or two variables. The purpose of the univariate and bivariate analysis techniques is to bring up interesting themes and issues found in the data. These techniques are used for example to compare data between respondents. They were made with Microsoft Excel. The Pivot functionality was especially useful in this part of data analysis.

The Statistical Program for Social Sciences (SPSS), version 10, was used to provide some descriptive data. However, the SPSS was mainly used in the multivariate analysis.

To select the multivariate data analysis technique, the research uses a structured approach introduced by Hair et. al (1992). The intention is to identify the structure of the interdependencies among the variables. The structure of the interrelationships (correlations) among the variables was analyzed by defining the common underlying dimensions (factors). Factor analysis is (Hair, Anderson, Tatham, & Black, 1992:88) "...a technique particularly suitable for analyzing the patterns of complex, multidimensional relationships encountered by researchers." The decision between a (principle) component and common factor analysis was based on the research approach defined in chapter 1. The principle component factor analysis is used for confirmatory studies and hypothesis testing, e.g. with the deductive research strategy. Therefore it is not a suitable method for the present research strategy. A common factor analysis is used when the objective is to identify the latent dimensions or constructs represented in the original set of variables. Thus it is applicable for the present research. The **common factor analysis** (hereafter factor analysis) will suggest some latent factors from the broader number of variables. Especially in dealing with large numbers of variables, the factorizing can be used to condense or summarize data into smaller set of factors. Thus, a factor is defined as a set of variables composing a common underlying dimension. The variables are factorized to concepts, which will formulate the model. This method is supported (Huberman & Miles, 1994, Mbengue & Vandangeon-Derumez, 1999) as a suitable technique for analyzing empirical data derived in the inductive approach. The summarization purpose of the factor analysis suggests that a smaller number of concepts than the original individual variables can be used to describe the data. As an interdependence technique, all variables are simultaneously considered and related to each other. The latent factors show new constructs embedded in the empirical evidence. The factors are interpreted in order to revise the proposed model.

Factor analysis is generally assumed to be a suitable technique when there are more than 50 observations; the preferable size is 100 observations. Sufficient correlations to justify application of factor analysis can be determined in several ways. First, visually: a substantial number of correlations should be greater than .30 to be appropriate; second, by using Bartlett's test of Sphericity; third, by using a measure of sampling adequacy (Hair, Anderson, Tatham, & Black, 1992), which is similar to the Kaiser-Meyer – Olkin (KMO) measure of sampling adequacy (Sharma, 1996). KMO is a measure of whether the distribution of values is adequate for conducting factor analysis in the first place. The computer applications, such as SPSS, calculate all possible factors. Based on the latent root criterion, only the factors

having latent roots, i.e. 'Eigenvalues' greater than 1, are considered significant. Factors with Eigenvalues of less than 1 are disregarded. The extracted number of factors accepted is typically five. The percentage of variance criterion that accounts for 60% of the total variance is satisfactory in social science solutions. Visual inspection of the scree plot curve also shows the number of factors to be included; the point where the curve becomes horizontal indicates the number of factors to be included in the analysis. The applicability of using the common factor analysis technique was verified. The results are summarized in the following table.

Criterion characteristics	Requirement (min.) (Hair et. al. 1992)	Research	Requirement met (Y / N)
Number of variables	>30	57	y
Communalities for each variable	>.600	min .599	y
Number of observations	>50, preferable 100	96	y
Visual analysis of correlations	>.30	>.250	n
Bartlett's test (sig.)	.000	.000	y
Kaiser-Meyer-Olkin (KMO)	>.500	0.63	y
Eigenvalues included	>1	>1	y
Percentage of variance	>40% (60%)	47%	y
Number of factors extracted		6	
SPSS total number of factors extracted		17	

Table 14. Summary of the factor analysis applicability criteria

Table 14 summarizes the characteristics used by Hair et. al (1992) to decide the applicability of the analysis technique. The table also provides information on the factors extracted. Since the case study sample meets the requirements, the empirical evidence can be analyzed with the multivariate analysis and more specifically with factor analysis technique.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,630
Bartlett's Test of Sphericity	Approx. Chi-Square	3302,341
	df	1596
	Sig.	,000

Table 15. Kaiser-Meyer-Olkin and Bartlett's test results

Table 15 depicts the summary of the standard test data. The Kaiser-Meyer-Olkin (KMO) was used as a measure of sampling adequacy. The result .630 indicated a semioocre level of adequacy in using the FA technique. The KMO measure results and the Bartlett's test results suggested a fairly good sampling adequacy. Hence, common factor analysis as a statistical

method is a valid technique. The results for the extraction of common factors, i.e. Total Variance Explained (TVE) results, are presented in the following table.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Loadings			Sums of Squared	
	Total	Variance	%	of Cumulative	Total	Variance	%	of Cumulative
1	12.439	21.823	21.823	21.823	12.112	21.250	21.250	21.250
2	4.357	7.644	7.644	29.467	4.026	7.063	7.063	28.313
3	2.891	5.072	5.072	34.539	2.527	4.433	4.433	32.746
4	2.477	4.346	4.346	38.884	2.142	3.758	3.758	36.504
5	2.341	4.108	4.108	42.992	1.998	3.504	3.504	40.009
6	2.305	4.044	4.044	47.036	1.915	3.360	3.360	43.368
7	1.941	3.405	3.405	50.441	1.594	2.797	2.797	46.166
8	1.799	3.157	3.157	53.597	1.438	2.524	2.524	48.689
9	1.661	2.915	2.915	56.512	1.279	2.243	2.243	50.933
10	1.637	2.871	2.871	59.383	1.263	2.216	2.216	53.148
11	1.474	2.587	2.587	61.970	1.139	1.997	1.997	55.146
12	1.381	2.424	2.424	64.394	1.015	1.781	1.781	56.927
13	1.298	2.276	2.276	66.670	0.931	1.634	1.634	58.561
14	1.281	2.247	2.247	68.917	0.926	1.625	1.625	60.186
15	1.138	1.996	1.996	70.914	0.780	1.369	1.369	61.554
16	1.098	1.927	1.927	72.840	0.733	1.285	1.285	62.840
17	1.036	1.817	1.817	74.658	0.683	1.199	1.199	64.039
18	0.970	1.701	1.701	76.359				

Table 16. Total variance explained table

Using the principal axis factoring as the extraction method resulted in the extraction of a total of 17 factors. Table 16 shows that the first component (factor) explains over 21% of the cumulative variation. Six components (factors) explain over 47% of the total variance. The final factor solution for six factors was identified. Thus, the final solution will represent 47% of the variance in the data. The correlation matrix is provided in appendix 11.

The survey respondents

The target group of respondents¹² comprised persons actively participated in the SAP R/3 implementation projects or represented the adopting organizations. The lack of a single repository of implementing organization participants was overcome with analyses of

¹² Note: there are no official records on project participation lists. The researcher has used internal documents to gather such a list for the email notification purposes. Short review of the potential respondents: the case corporation no longer employs several individuals from key positions in 2001. Comparison with all potential users of the system revealed that the case corporation has employed most of the current system users within 2 years and thus their knowledge about the historical development is less valid.

secondary data. Access to the questionnaire was theoretically for all case company employees: There was no restriction on who could fill the questionnaire. Guidelines were given with the limitation of being somehow linked to the studied implementation projects and willingness to provide the information requested. It was possible that some of the respondents were not members of the target groups as such. However, these respondents may also have provided information concerning the ERP activities. 157 respondents filled the first section of the survey but 96 finalized the survey. Thus the final sample size for the survey was 96. To evaluate the bias between 96 and 157 responses, two variables were analyzed for both respondent amounts. These include responding tenacity and perception towards the rewards related to the ERP implementation projects. However, the rest of the survey analysis uses the final sample size of 96 responses. The following table summarizes the characteristics of the respondents included in the final sample.

	Adopting organization representatives	Implementing organization representatives	Total
Number of respondents	34	62	96
Countries represented	11	9	15
Australia	1	0	1
Austria	1	0	1
Canada	4	3	7
China	0	5	5
Denmark	1	0	1
Finland	6	17	23
France	1	0	1
Germany	5	5	10
Mexico	0	3	3
Philippines	1	0	1
Poland	1	0	1
Singapore	0	1	1
South Korea	0	4	4
United Kingdom	3	1	4
USA	10	23	33
Regions represented (of 3)	3	3	3
Employment duration			
less than 1 year	0	0	0
from 1 to 3 years	0	2	2
from 3 to 6 years	17	26	43
from 6 to 10 years	13	23	36
over 10 years	4	11	15
Employed by NMP during the ERP implementation	34	62	96
yes (the whole period)	26	47	73
partly	5	8	13
no	3	7	10

Table 17. Respondents summary table

Table 17 summarizes some characteristics of the survey respondents. For example, of the 15 countries represented in the survey the top three are the USA, Finland and Germany. Most of the respondents (94) had been working in the case corporation by at least three years. This suggests a group of experienced respondents. Furthermore, the respondents were distributed according to their current unit: 62 respondents worked for NMP, 22 in global

platform organization, 7 in Nokia Head Office (NHO), 3 in Nokia telecommunication (NET), 1 in Nokia Ventures Organization (NVO) and 1 respondent was an external (not employed by the case corporation Nokia). Some of the resources are on corporate level (Nokia) and not on divisions (NMP). The job rotation and changes of the unit of employment are regular. Among the respondents were both technically and business oriented respondents. The hierarchical analysis of the respondents revealed that all levels of hierarchy including top management were represented. The analyses of the respondents suggest a distributed and experienced group, which increases the validity and reliability of the present study.

Responding tenacity as a sample validation measure

To discuss the validity of the sample (96), the responding tenacity was measured. The responding tenacity was measured with the statistical, single variate method. Several variables were analyzed against the responding tenacity:¹³ The results of the responding tenacity measures are summarized in the following table.

Variable	Characteristics	Responses in F1 only (n= 157)	Responses in F4 (n=96)
Q1	Business group	5	6
Q2	Business unit or platform	11	18
Q3	Current country	9	15
Q3re	Current region	3	3
Q4	Nokia employment duration	4	4
Q5	Employment at NMP	3	3
Q7	Member in ERP projects (Y/N)	2	2
Q9	Number of projects represented	21	48
Q10	Number of positions represented	23	48
Q10re	Positions grouped	5	5
Q11	Number of priority projects	13	24
Q12	Number of primary positions (roles)	13	18
Q12re	Primary positions grouped	4	4

Table 18. Responding tenacity summary table

Table 18 shows the responding tenacity compared with the characteristics of respondents who only started (but not necessarily finished the survey - F1) and those who had finished the survey (F4). F1 and F4 refers to the forms of the survey (see the figure 32). The number of respondents was respectively 157 and 96. Recall that the final sample size is 96. The characteristics of the respondents measured with 13 variables showed that the distribution was more heterogenic among those who finished the survey. This indicates that the

¹³ Qi refers to the number of the question (variable) in the survey instrument.

respondents finishing the survey were more distributed than among those who ended the survey after the first section. It also indicated that a wide variety of the respondents had finished the survey.

The distribution of the respondents is therefore considered good. For example, the sample includes the implementing organization (participation in the ERP projects) and representatives from the adopting organization (end-users of the ERP system). Second, all of the geographical regions were represented; respectively 15 countries were represented. Third, the roles and the participation in various projects were disjointed. The results show that the respondent sample included a heterogeneous group of individuals distributed in all areas and several countries, mostly representing the NMP business group. These results also indicate that the sample included several different role representatives and participation activity was large. The validity discussions of the sample conclude that the sample was large and heterogeneous and represents the case company well. Hence, both the external validity and internal validity are present.

4.4.2 Univariate and bivariate analysis results

For analyzing the survey results, some univariate and bivariate variate analyze were carried out. Descriptive data and summary of pretest data are presented in table19. The research uses this as the pretest data. The descriptive statistics table depicted that the average of the values, in general, seem to be quite high; mostly over 3. Only seven variables received an average value by slightly under 3, which indicates disagreement. The lowest value (2.63) was for variable 17, indicating respondents' perception reward system. This variable will be analyzed separately. The highest average value (3.89) was for variable 47, indicating that of respondents' perception at the establishment of the new roles was important. The standard deviation values ranged from 1.12 – 0.67. This indicates that the measured perceptions are relatively close to the average (mean). It is noteworthy that 14 (of 57) questions did not receive the minimum scale value of 1 (strongly disagree), whereas all questions received the maximum value of 5 (strongly agree).

Two survey questions received differencing responses, namely Q39 (smaller ERP scope) and Q41 (standardized business processes implemented before ERP implementation). The mode for both questions was the lowest: 2. The most frequent response in these questions was 2, which differs with the other questions. These two questions are examined further. 42% of the respondents indicated that implementing fewer modules simultaneously would not have been a better implementation approach (smaller SAP R3 scope). 26% of the

respondents supported the smaller ERP scope. Only with business representatives (respondents grouped according to their primary position in to three groups of business, management and technical) were the responses spread evenly: 22% against and 22% supported (25% did not take side in this question). Based on the univariate analysis of question Q41, almost 48% of the respondents felt that the business processes were not similar before the ERP implementation began. Circa 22% of the respondents indicated that the processes were similar before the implementation began. Grouped the respondents according to their primary position (business, management or technical) did not reveal differences in responses. In all groups the implications of less successful BPR efforts were noted. The importance of standardized business processes is extended with the single instance implementation. Therefore, the knowledge of the status of the process standardization is interesting. The case company description indicated that the business process re-engineering would have been finished before the implementation began.

The descriptive statistics (table 19) indicate which of the individual variables might be useful to analyze separately. The results of the descriptive statistics guided the selection for analysis of some of the individual variables. These included the ERP success (Q18 and Q19), organizational transformation (Q61 and Q63) responses, the commonly perceived CSFs such as the reward system (Q17) and new potential success factors found such as the self-organizing variable (Q48 and Q49).

Question# / variable	Label	Number of valid responses	Average (mean)	St Dev	Mode	Median	Min	Max
Q15	TRAINBEF	157	2,99	1,12	4	3	1	5
Q16	TRAINDUR	157	3,15	1,07	4	3	1	5
Q17	REWARDS	157	2,63	1,10	3	3	1	5
Q18	TIMECMET	157	3,12	0,94	4	3	1	5
Q19	SUCCESS	157	3,64	0,80	4	4	2	5
Q21	CORPCULT	120	3,68	0,82	4	4	2	5
Q22	NATCULT	120	3,69	0,67	4	4	2	5
Q23	BPRBEF	120	3,88	0,84	4	4	2	5
Q24	PROSFIBE	120	2,96	0,96	4	3	1	5
Q25	PRORGBEF	120	3,08	0,96	4	3	1	5
Q26	CHAMPION	120	3,22	0,78	3	3	1	5
Q27	TOPMGTSU	120	3,52	0,90	4	4	1	5
Q28	PSPONSOR	120	3,78	0,76	4	4	2	5
Q29	MGTSUVIS	120	3,48	0,94	4	4	1	5
Q30	PROJMGR	120	3,60	0,83	4	4	2	5
Q31	BEXPFULL	120	3,25	0,98	4	3	1	5
Q32	BALTEAM	120	3,35	0,89	4	4	1	5
Q33	PROJMETH	120	3,48	0,81	4	4	1	5
Q34	REALMILE	120	3,31	0,87	4	3	1	5
Q35	CHANGECOM	120	3,41	0,78	4	4	1	5
Q36	COMMUNICA	120	3,30	0,88	4	4	1	5
Q37	FORGTRAI	120	3,25	0,93	4	3	1	5
Q38	MINCUSTOM	120	3,35	0,98	4	3	1	5
Q39	FEWMODUL	120	2,96	1,02	2	3	1	5
Q41	GLPROSBEF	114	2,70	0,88	2	3	1	5
Q42	SIMPROS	114	3,19	0,91	4	3	1	5
Q43	CONCEPTS	114	3,65	0,76	4	4	2	5
Q44	MGTCOMMIT	114	3,54	0,81	4	4	2	5
Q45	BUSDRIVEN	114	3,39	0,83	4	4	2	5
Q46	PROJSTRUC	114	3,57	0,82	4	4	1	5
Q47	NEWROLES	114	3,89	0,88	4	4	1	5
Q48	SELFORG	114	3,47	0,74	4	4	1	5
Q49	SELFDIRPT	114	3,58	0,79	4	4	1	5
Q50	BIGBANG	114	3,41	1,01	4	4	1	5
Q51	ALLOWCC	114	3,68	0,79	4	4	2	5
Q52	EXPERIMEN	114	3,20	0,93	4	3	1	5
Q53	BUSVARIA	114	3,19	0,87	4	3	2	5
Q54	COPYEXAC	114	2,94	1,02	3	3	1	5
Q55	COLLEAGU	114	3,69	0,81	4	4	1	5
Q56	FLEXORGs	114	3,32	0,86	4	3	1	5
Q57	NWORKT_SO	114	3,32	0,84	4	3	1	5
Q58	COLLBEHA	114	3,35	0,74	3	3	1	5
Q64	GKNOWTR	96	3,31	0,86	4	3	1	5
Q65	LEARORG	96	3,59	0,78	4	4	1	5
Q66	DYNORG	96	3,41	0,85	4	4	1	5
Q67	RELSEVO	96	3,42	0,79	4	3,5	1	5
Q68	STDECFILE	96	3,33	0,78	3	3	1	5
Q69	ORGCTRL	96	3,46	0,75	4	4	2	5
Q70	ORGCOOR	96	3,59	0,67	4	4	2	5
Q71	INTMUTUA	96	3,58	0,82	4	4	1	5
Q72	OTRIGTR	96	3,35	0,68	3	3	1	5
Q73	ITSTRTRIG	96	3,39	0,76	3	3	1	5
Q74	R3TRCHAN	96	3,66	0,84	4	4	1	5
Q75	MODIFR3	96	3,82	0,74	4	4	2	5
Q76	INTERACT	96	3,49	0,86	4	4	1	5
Q77	INFOSH_SO	96	3,39	0,83	4	3,5	1	5
Q78	OPENINFO	96	2,91	1,08	4	3	1	5

Table 19. Descriptive pretest data summary table

Evidence related to the ERP success

To evaluate whether ERP implementation was successful, the present study used four measures: first the respondents' perceptions from two perspectives, net sales, and operating profit. The success perception of ERP implementation was measured according to time criteria (Q18) and according to a general perception (Q19).

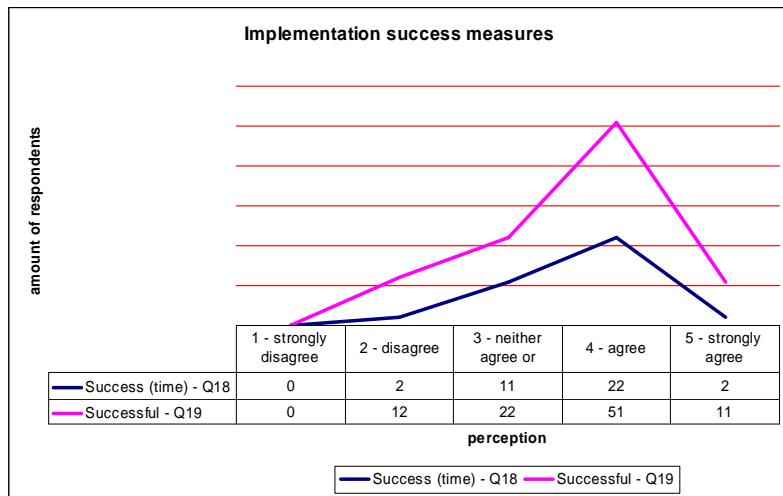


Figure 33. Implementation of success measures

Figure 33 depicts that the perception towards ERP implementation success was clearly positive. The number of respondents distinctly perceiving the ERP implementation to be successful was five times greater than the number of respondents perceiving the ERP implementation to be unsuccessful. It is noteworthy that none of the respondents perceived the ERP implementation to be distinctly unsuccessful (1 – strongly disagree). The overall success measured showed even stronger perception towards the success.

The level of net sales and operating profit is reported to have suffered from an ERP adoption (Sarkis & Sundarraj, 2003). The empirical study revealed that neither net sales nor operating profit decreased due to the ERP system use (see appendix 3 for facts and figures of the Nokia). On the contrary the contrary results are noted. It is also significant that the operating profit steadily increased. Based on these measures, the ERP implementation throughout the case company can be described as successful.

Evidence related to the organizational transformation

The survey was conducted retrospectively in 2002 after the major transformation had enfolded. The events were retrospectively identified within Nokia. The assumption of the research was that the organizational structures were not the result of a planned change program but an emergent transformation. To evaluate this, the respondents were asked their perception towards the predictability and visibility of the transformation.

The respondents' perception of the predictability of organizational transformation (Q61) was measured. This perception was measured with 3 - scale: 1 - yes (transformation was predictable), 2 - I don't know or 3 - no (transformation was not predictable). The predictability of the organization transformation towards NBI was diversified. 35% of the respondents (34) predicted that the organization would be transformed. 14% of the respondents (13) could not predict the organizational transformation. However, 51% of the respondents (49) were not able to share their perception towards the organizational transformation. In conclusion, the organizational transformation was not predictable to the majority of the respondents.

To analyze further the transformation (Q63), six change events were suggested (see figure 34). Among the respondents perceiving some predictability of the forthcoming organization, the new organization structure became visible to most roughly in 1999, with the creation of the Information Management platform organization. A second stronger event was then the actual announcement of the new platform organization 2001. Most of the respondents (55%), who claimed to predict the new organization, were characterized as belonging the group "business", totaling 19 respondents in comparison with management (24%, 8) and technical (21%, 7).

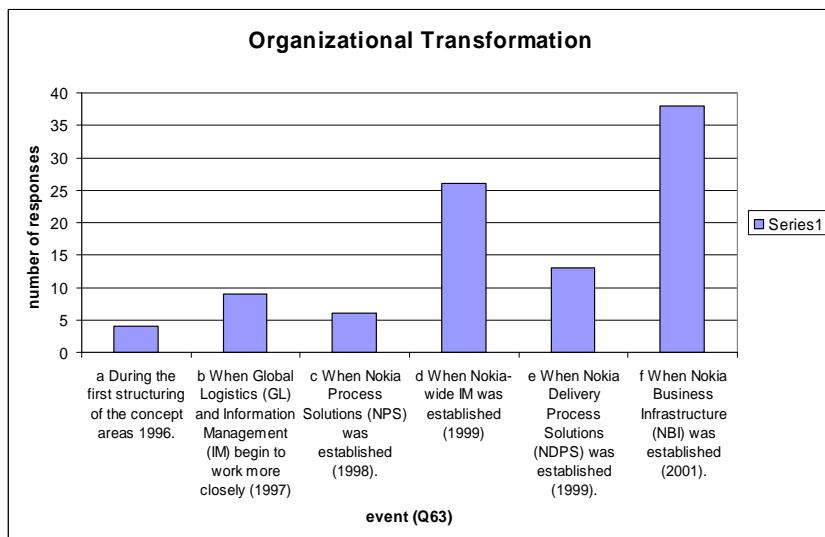


Figure 34. Organizational transformation events

The geographical distribution of the responses did not reveal big differences among the predictors; the percentages show that respondents representing the Americas and Europe/Africa areas were more inclined to predict the new organization (45% and 43%), whereas 12.5% of respondents from the APAC region inclined to predict the new structure. The figure shows clearly that the organizational transformation to a platform (NBI) organization was not visible to the majority of the respondents until it was introduced. The evidence shows that the respondents had little prior information about the organizational structuring. Therefore, the evidence suggests that no change management program aimed towards the implementing organization was carried out.

Triggers for the organizational transformation were analyzed with two questions. The perception that the information technology strategy triggered organizational transformation (Q73) was similar, regardless of the business group (Q1), unit (Q2) or region (Q3re), employment duration (Q4) or participation (Q5 and Q7). The IT strategy was seen to trigger the organizational transformation. Whether the implementation project structure was seen as a trigger to the organizational transformation, the results were similar. To the question whether the implementation organization triggered further organization transformation, 38% of the respondents perceived the implementation organization to be favorable to the new organization structure transformation. Summarizing the organizational transformation discussion, the results indicate that the transformation was not perceived as predictable and was not clearly foreseen by the respondents.

Evidence related to the commonly perceived critical success factors

The rewards have been highlighted as one of the critical success factors in the existing literature (see chapter 3). In the survey, Q17 asked whether the reward system (bonus, incentive, recognition etc.) for the participants was satisfactory. The question of satisfaction with the received rewards in this study showed overall dissatisfaction. Only respondents from the Americas region indicated some satisfaction with the rewards. This can be explained by the notion that the regional reward systems were different. Team Americas was rewarded on a regular basis, whereas for example the global teams did not have a project-specific reward system. Hence, the results indicate contrast with those of other research. In contrast to other research, the rewards system was not a motivational mechanism for achieving good results.

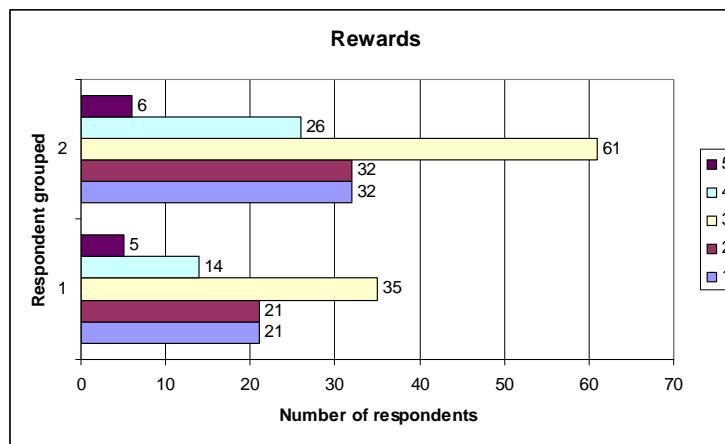


Figure 35. Regional distribution towards the satisfaction of the rewards

Since the question of received rewards was placed in the first form of the survey, the results can be analyzed also for all respondents who started the survey. This would allow comparison between the differences of the larger sample sizes. Figure 35 shows the responses to rewards according to the sample size (N=96 (1) and N=157 (2)). The figure implies that the larger sample size reflects the similar results than the smaller sample size. Less than 5% of the survey participants strongly agreed that the rewards were good (3.8%, n=157 and 5.2% n=96). 20% of the respondents in both groups were somewhat satisfied with the rewards system.

Question 47 dealt with the importance of the new roles established with the success (see figure below). 75% of all respondents indicated the importance of the new roles. From the

organizational perspective 65% of the respondents belonged to the implementation team (1-I) and 35% to the adopting team (2 - A). Both the organizational perspective and the regional distribution of the responses indicated that the new established role contributed the success.

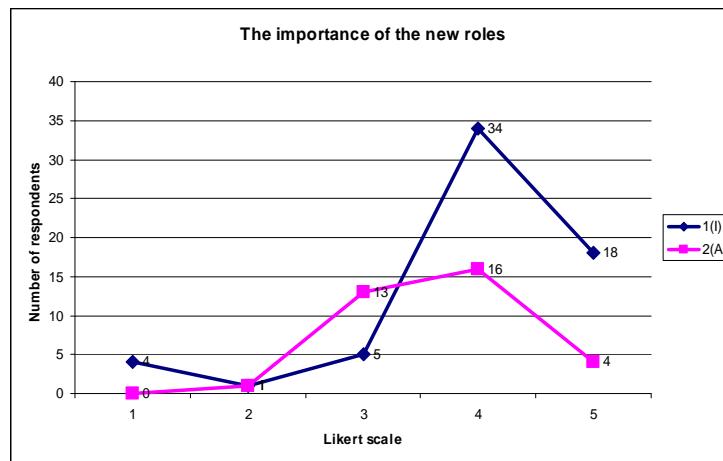


Figure 36. The importance of the new roles

The univariate analysis results suggest that on average, both scientific management characteristics and complexity science characteristics were enabling factors. However, a closer analysis of the statistics shows some difference. The emphasis with scientific management characteristics was evenly spread. The complexity science characteristics show more positive perceptions. This indicates stronger and more focused support of the complexity science characteristics. The comparison is illustrated in appendix 10.

Self-organization was suggested as a key capability in complexity sciences to create novelty and new organizational structures (see discussion in chapter 3). The comparison of respondents from different regions and their attitude towards the perceptions of self-organizing is presented in the figures below. Self-organizing was evaluated with four attributes: self-organizing as a contributor to the success (Q49) and self-organizing frequency (Q48). The results reveal that self-organizing occurred frequently and was perceived to be a success factor for the ERP implementation. Self-organizing capability was also included in questions 57 and 58.

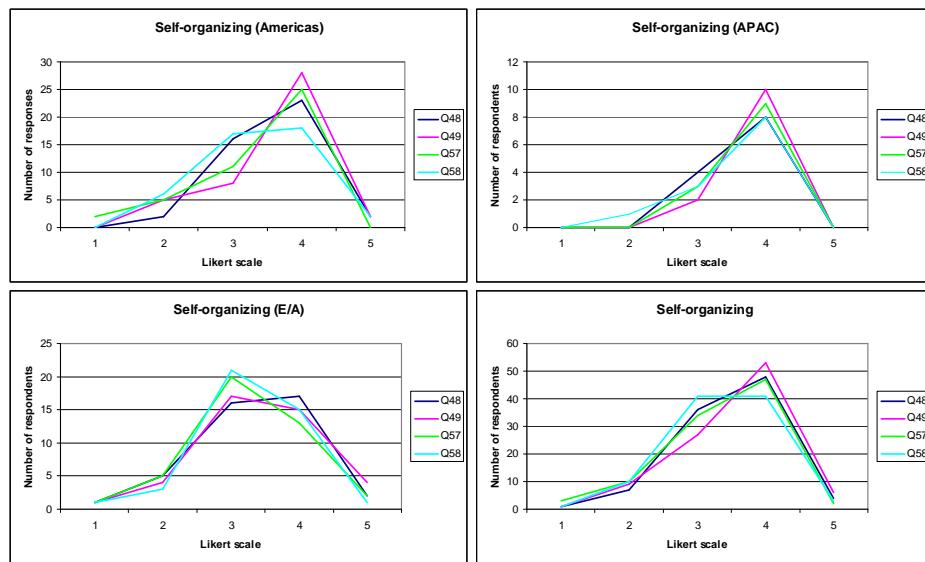


Figure 37. Comparison of self-organizing attributes among regions

The comparison of self-organizing attributes in figure 37 reveals a high perception of self-organizing overall. A slightly less self-organizing attitude was measured among respondents from the Europe/ Africa region compared to other regions. These tables indicate the importance of the self-organizing.

The response trends of the variables identified in the research literature as commonly perceived critical success factors and the derived new potential factors suggest the more positive support of those new potential factors. The graphic illustrations of the trends are found in the appendix 10.

4.4.3 The multivariate analysis results

The results of the extraction in unformatted order are presented next. Table 20 depicts summarized data of the factors and their loadings. The communality column calculated indicates how much the factor explains the variable in question. Communalities were calculated with the Excel SumSQ functionality. As a final analysis, 57 variables were included to calculate general groupings of factors. In order to condense the number of themes in the FA solution a value of loadings was examined. For the purpose of this analysis, the loadings $> |0,250|$ are considered significant. This yielded 6 categories, which will be introduced next.

Variable	LABEL	Factors						Communality
		1	2	3	4	5	6	
Q15	TRAINBEF	0.587	-0.405	0.112	-0.255	0.185	0.096	0.630
Q16	TRAINDUR	0.594	-0.295	0.107	-0.207	0.298	-0.034	0.584
Q17	REWARDS	0.362	-0.146	-0.086	-0.169	0.055	-0.191	0.228
Q18	TIMECMET	0.512	-0.093	0.302	-0.206	-0.222	-0.023	0.454
Q19	SUCCESS	0.654	0.174	0.086	-0.144	-0.089	0.156	0.518
Q21	CORPCULT	0.389	0.086	0.242	0.054	-0.200	-0.251	0.323
Q22	NATCULT	0.211	-0.154	-0.025	0.112	-0.323	-0.113	0.198
Q23	BPRBEF	-0.184	0.396	-0.330	0.217	-0.018	0.240	0.404
Q24	PROSFIBE	0.357	-0.293	0.124	0.063	-0.254	-0.201	0.337
Q25	PRORGBEF	0.351	-0.294	0.299	0.122	-0.154	-0.172	0.367
Q26	CHAMPION	0.415	-0.224	-0.116	0.431	0.232	0.101	0.486
Q27	TOPMGTTSU	0.598	-0.230	-0.325	0.038	-0.089	0.103	0.536
Q28	PSPONSOR	0.378	0.070	-0.318	0.285	-0.136	-0.214	0.395
Q29	MGTTSUVIS	0.537	-0.255	-0.289	0.208	-0.038	0.009	0.482
Q30	PROJMGR	0.717	-0.228	-0.177	-0.019	0.059	0.158	0.626
Q31	BEXPFULL	0.490	-0.437	-0.151	-0.128	-0.108	0.141	0.502
Q32	BALTEAM	0.717	-0.114	-0.117	-0.190	0.107	-0.042	0.590
Q33	PROJMETH	0.523	-0.211	-0.073	-0.027	0.275	0.197	0.438
Q34	REALMILE	0.435	-0.435	0.125	0.185	-0.178	0.072	0.466
Q35	CHANGECOM	0.455	-0.360	0.133	0.407	-0.121	-0.202	0.576
Q36	COMMUNICA	0.610	-0.396	-0.032	0.124	0.136	-0.153	0.587
Q37	FORGTRAI	0.533	-0.365	-0.032	0.090	0.210	-0.055	0.473
Q38	MINCUSTOM	-0.103	-0.295	-0.014	-0.024	0.187	0.436	0.323
Q39	FEWMODUL	-0.234	-0.272	0.426	0.393	0.321	0.000	0.568
Q41	GLPROSBEF	0.351	-0.169	0.274	-0.068	0.029	0.041	0.234
Q42	SIMPROS	0.413	0.073	0.165	-0.138	-0.125	0.117	0.252
Q43	CONCEPTS	0.446	0.493	-0.112	-0.015	-0.126	0.213	0.516
Q44	MGTCOMMIT	0.495	-0.222	-0.229	-0.004	-0.158	0.064	0.377
Q45	BUSDRIVEN	0.314	0.255	0.149	0.194	-0.100	0.056	0.237
Q46	PROJSTRUC	0.611	0.379	0.176	-0.051	0.067	-0.192	0.592
Q47	NEWROLES	0.507	0.450	0.074	-0.042	0.142	-0.136	0.505
Q48	SELFORG	0.367	0.411	-0.095	-0.016	0.215	-0.298	0.448
Q49	SELFDIRPT	0.628	0.294	-0.039	-0.040	0.091	-0.215	0.538
Q50	BIGBANG	0.525	0.244	-0.326	-0.269	-0.273	0.012	0.589
Q51	ALLOWWCC	0.481	0.198	-0.475	0.093	-0.033	0.178	0.538
Q52	EXPERIMEN	0.251	0.065	0.490	-0.063	-0.099	0.200	0.361
Q53	BUSVARIA	0.277	-0.238	-0.001	0.219	-0.073	0.077	0.192
Q54	COPYEXAC	0.340	-0.179	0.123	-0.041	-0.325	0.117	0.284
Q55	COLLEAGU	0.273	0.123	0.016	0.142	0.112	-0.417	0.296
Q56	FLEXORGs	0.587	0.220	0.046	-0.297	0.281	0.010	0.562
Q57	NWORKT_SO	0.500	0.064	0.071	-0.160	0.551	0.059	0.591
Q58	COLBEHAA	0.148	0.108	0.288	0.196	0.125	-0.167	0.198
Q64	GKNOWTR	0.417	-0.048	0.121	-0.130	0.054	0.246	0.271
Q65	LEARORG	0.370	0.387	0.258	-0.006	0.160	-0.209	0.423
Q66	DYNORG	0.630	0.124	0.027	0.012	-0.085	-0.160	0.446
Q67	RELSEVO	0.598	0.178	0.035	0.155	-0.221	-0.185	0.498
Q68	STDECFL	0.147	0.261	0.337	0.318	0.045	0.344	0.425
Q69	ORGCTRL	0.078	-0.015	-0.004	0.526	0.186	-0.059	0.320
Q70	ORGCOOR	0.566	0.189	-0.033	0.155	-0.358	0.038	0.510
Q71	INTMUTUA	0.542	0.137	-0.045	0.072	-0.050	0.227	0.374
Q72	OTRIGTR	0.343	0.185	0.059	0.171	0.045	0.254	0.251
Q73	ITSTRTRIG	0.221	0.260	0.365	0.195	-0.153	0.491	0.552
Q74	R3TRCHAN	0.160	0.569	-0.003	0.356	0.107	0.119	0.501
Q75	MODIFR3	0.002	-0.116	-0.419	0.255	0.250	0.013	0.317
Q76	INTERACT	0.559	0.232	-0.282	-0.004	0.020	-0.010	0.447
Q77	INFOSH_SO	0.658	0.176	0.026	0.049	0.204	0.092	0.516
Q78	OPENINFO	0.632	0.037	0.153	-0.181	-0.066	0.057	0.465

Table 20. Factor loadings summarized

4.4.4 Groupings of emerging themes - factor interpretations

For the abstraction (Angot & Milano, 1999) of the results of the MVA analysis, the factors are interpreted and all information cumulated through observations, interviews and secondary sources of data is used. Summarizing the factor analysis, the study reveals differences in the factors affecting the success of the implementation of the enterprise resources planning system. The diversity of the respondent sample discussed earlier provides more holistic perceptions than top management interviews. Hence, the factors capture the overall perceptions more clearly. The highly positive loadings in factor 1 support the overall perception of the ERP implementation. This may be considered a major success factor, while the most of the focal organization was favorably inclined towards the system and did not consider it a negative change. This was also tested with the communalities. The communalities calculated for variables revealed that the factors explained the variables highly.

Analysis of the 1st factor and interpretation

Examination of factor 1 shows that of the 57 variables included in the survey, 54 are positive and 3 have negative loading characteristics. However, the negative values are relatively small and refer to the system scope and BPR. They can be excluded from the further analysis of the characteristics of factor 1. Consequently, 47 variables had a value greater than $|0.250|$. This implies that factor 1 loadings are highly positive. Including loadings $>|0.250|$ in the analysis and combined with the TVE, which indicated almost 22% of cumulative variance, the factor 1 can be interpreted to include variables that were seen as highly supportive of the success of the ERP system implementation. Therefore, factor 1 can be labeled a "successful performance factor". The variables with positive correlations indicate that these perceptions are similar among all of the respondents of this survey. Although the heterogeneity of the respondents was established, the perceptions were rather homogenous. Some small differing directions could be noted. The results suggest that the factors indicate in the survey instrument were generally perceived to be positive towards the success of the implementation and the transformation of the organization. Thus, the overall approach towards the phenomenon under study can be perceived to be highly positive. The perception was also that the suggested variables positively support the ERP implementation and organizational transformation. A closer examination of the highest loadings indicates that ERP implementation teams were balanced with good project managers. Despite the formal projects structures, they were perceived to be positive and dynamic. Since the information was open to all participants and communication was adequate, the relationships

between the teams and participants evolved during the projects, increasing integration among the participants. New work teams were established on the basis of by the self-directed project teams, suggesting self-organizing capability.

Analysis of the 2nd factor and interpretation

Analyzing further the common factor analysis results, the second factor was extracted. Table 26 depicts the interesting variables measured in factor 2. Factor 2 loadings show interesting distribution of the loadings. A closer examination of the highest loadings in factor 2 indicates that the new division of work into concept areas and all the new roles established contributed to the success. The changes demanded by the ERP system into the focal adopting organizations were not considered harmful because the organizations could handle them adequately. The survey indicated that there should have been more business experts released for the implementation work on a full time basis to make the milestones more realistic, especially because the business process reengineering was to be done before the system installation. These factor 2 loadings suggested that the training of the selected ERP before the implementation was not good enough and communication could have been improved. The self-organizing capability was perceived as contributing strongly to the success. Factor 2 is labeled a "change orientation". The underlying theme in the 2nd factor also illustrates the difficulties involved in the implementation. For instance, due to a lack of ERP system training, the implementing organization was more inclined to change the system and try different solutions.

Analysis of the 3rd factor and interpretation

17 variables were included in the factor 3 analysis and variable 52 'experimentation' received the highest loadings. A closer examination of the highest loadings in factor 3 indicates that experimentation was accepted but allowing such extensive customization and configuration of the final solution was not perceived to be positive. The results imply that a smaller scope such as fewer modules implemented simultaneously, would have been a better approach. Factor 3 suggests tighter technical application of the ERP system. The label for this factor is "ERP system impact".

Analysis of the 4th factor and interpretation

11 variables are included in this factor analysis. A closer examination of the highest loadings in this factor indicates a strong commitment onto the changes required during and after the

ERP implementation. This was partly achieved by the activity of project champions. However, the factor reveals that the implementing organization was controlling. Overall, organizational compatibility is visible in these loadings. Factor 4 could be labeled "organizational awareness".

Analysis of the 5th factor and interpretation

A closer examination of the highest loadings in factor 5 indicates that the implementing organization was not coordinative enough, which meant that the 'copy exact' philosophy was not agreed upon. The national cultures of the respondents were not seen as success contributors. However, the possibility of creating new working structures to achieve the set targets, i.e. self-organizing, was perceived to be positive. Factor 4 suggests that autonomy was not high enough. Thus, factor 4 is labeled "imperfect autonomy".

Analysis of the 6th factor and interpretation

A closer examination of the highest loadings for factor 6 indicates that participants in this survey would have preferred an implementation approach in which customization would have been minimized. The loadings suggest that organization transformation was due to the IT strategy and project organization. The participants would have preferred to work more with colleagues on the global level and in other regions. The label for this factor is "transformation triggers".

4.5 SUMMARY OF THE CASE STUDY ANALYSIS

Through observant participation, interviews, and survey, empirical information was collected from the case company. The researcher was a member of the implementing organization and participated in utilization. The secondary sources of information were widely used throughout the research process. The reason for using statistical methods, especially the multivariate analysis, is to identify concepts and variables for the model. The aim is not to explain in detail the statistical significance. Following the research approach, evidence was associated with a single case study. The data collected in the case study are largely qualitative. Considering the longitudinal research, the data are collected from the past and the present. Retrospective analysis was used in iteration of data. Analysis of the collected data revealed that two attributes contributed to the ERP utilization. These were the implementing project structure and its nature.

The case study showed the importance of understanding the global presence of a MNE. The trigger to evolution can be traced in mid1990s when strategic decisions were made to overcome the logistics crisis. Several interviews reflect this as the starting point for organizing. The globalization of the company began while during the early 1990s, NMP was concentrated in the Europe/ Africa region. The activities related to the ERP system were first based on strategies to achieve competitive advantage. Moreover, the activities required standardization within a dispersed MNE. The business processes and operations reflect the MNE form, and thus needs to be considered during the implementation and also during the utilization. Accordingly, the use as well as utilization of the ERP can support the MNE strategies. The combined efforts accumulate within the implementing organization. The member of the implementing organization will make decisions that affect the MNE now and in the future. Therefore, the relevance of the implementing organization, its members, structure, and management is of great importance. The transformation within the organization suggests dynamic situation and adaptation to changed situations.

The case company logistics strategy and included logistics information management strategy provided little information on organizational aspects from the implementers' viewpoint. The adopting organizations went through several planned engineered changes. Only competence development issues were referred in the logistics strategies. Following the strategy, an ERP was implemented and this triggered changes in the traditional IT organization and business entities. Centralized corporate wide-organization was the end result. The business processes and concept areas formed a modular structure.

Organizational transformation

The implementing organization was based on conventional model. Over the years it transformed to include variety of organizations and roles. Transformation of the organization continued, because of IT developments, business developments, inter-company developments, and the changes required by those simultaneous development activities, a need to incorporate the IT department more closely with business units was noted.

It is noteworthy that the transformation in NMP has followed the path suggested by Volberda (see figure 39). It agrees with the concept of 'lock-in' introduced by Parker (1994) that at the point of the small or random event the trajectory is set, then unknown but in retrospect can be evaluated. The trajectories suggested by Volberda are visible: The natural trajectory of routinization from chaotic forms towards flexible forms can be addressed to the early years

of ERP implementation and deployments. Respectively, the maturation trajectory indicates the transformation from flexible form towards planned form. This phase can be allocated to the development of NDPS and further towards NBI. This was the status of NBI organization in early 2003. These movements in the trajectory were not planned in the 1990s. Yet, the transformation is visible in retro perspective.

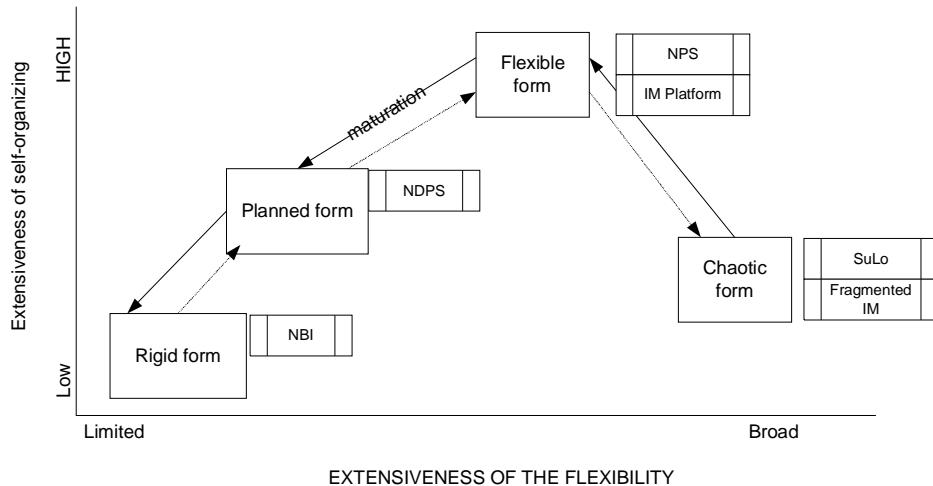


Figure 38. Alternative flexible forms and case company structures
(Volberda, 1996 modified)

The movement according to the trajectories suggested by Volberda also implicitly indicates the different levels of skills and competencies required. When the movement at the trajectory from chaotic form to rigid form happens, the hierarchy level and bureaucracy levels increase. Standardization of procedures and management are highlighted and continuously developed. This indicates that the organization becomes introverted, focusing on internal issues and less on the service to line organizations. This argument was supported by Parker (1994), who noted that non-linearity systems are changeable only if they continue at the far from equilibrium state, i.e. at the edge of chaos. This would imply more extroverted approaches.

From the establishment of the organization NBI, the formal coordination mechanisms were enforced. The internal development of the NBI internal operations increased. Several activities were launched to improve NBI operations. The organization became slightly introverted. This bureaucratization leads to slowness in action taking, and planning on each activity beforehand. The organization, which was designed to provide business infrastructure solutions and services to other Nokia units, became a mature organization. All this was

happening at other unit's expense. The NBI organization is divided in to several locations. The enlargement of a mere ERP implementation organization into NBI resulted in an all-around infrastructure organization, which in 2001 already provided service with over 50 different information system applications. The large organization with specialized roles is less flexible and may no longer be consistent with the corporate level organizational characteristics (Cross & Earl & Sampler, 1997). This was observed in the present study as well.

Each organizational unit traced in the transformation trajectories can be categorized as a complex adaptive system and complex evolving system. The unit has adapted to its environment and learned from the experiences. In each process phase, the unit has focused on the future keeping the organization flexible and dynamic. Information has been open and freely available for members. Through process of self-organizing, the members establish diverse task groups to solve problems. The required expertise was sought from the case company as well as from outside the case company. The temporary task forces were dissolved without a trace of their existence. The knowledge created would be disseminated in the following self-organizing process.

This indicates that the organizational structuring is a continuous process, and the stable states of set structure are relatively short. This continuity is supported (Sauer & Willcocks, 2003). The development of the business processes, the implementation of the ERP systems and the development of the governance structures have provided a base for the networked-organization. The envisioned "slimming down" of the IS organization (Gartner, 2003) can thus be achieved. The rigid form is routinized and outsourcing is possible, especially in the technical side of the organization.

Organization characteristics

The subsequent actions on the trajectory unfold the outcome. As the organization matures the bureaucracy also increases. The maturity of the organization is visible in the NBI organization, while it supports higher levels of standardization in all responsibility areas. It aims to build internal efficiency through centralization.

When the emphasis of the organization was the enterprise resource planning system, the entrepreneurial style was allowed. The flexibility achieved during the ERP projects was slowly reduced. This led to increased bureaucracy. Several management processes and tools have been introduced. Steering practices were established and procedures designed.

Several measurements and metrics were established and monitored continuously. The bureaucracy in internal development results with a higher degree of technology orientation to support each activity and formal hierarchical information flows. This shows a focus on supportive tools instead of setting the related processes in place. However, with other information systems incorporated in the unit, the bureaucracy was increased to manage the fragmented departments. The focus of activities changed from a creation and development focused towards a maintenance focused. Different set of skills and competencies would be required. The rigid form of the NBI resulted in a limited flexibility.

The organizational architectural development indicated that the largest number of actors incorporated into the new organization came from the former IT department. Hence, it had a strong influence on the appointments of managers and other formal hierarchical positions. The observed cultural gap between business and IT that was observed at the early stages of the evolution may return.

The organizational transformation triggered by the information system implementation has created a new type of organization. This organization can be categorized as an information-based organization (Drucker, 1988). Information and knowledge were the main characteristics. The ERP experience created an aligned organizational unit, which was highly fragmented according to variety of specialization areas. The creation of concept areas are organizational teams that support the notion of cellular form of organization (Miles, Snow, Mathews, Miles, & Coleman, 1997). According to the cellular form, self-managing teams operate with entrepreneurial style. Each cell (team, unit etc.) is responsible to the overall corporation. They are adaptive and evolving creation knowledge in each level of the organization. The cellular form may require that the level of bureaucracy is replaced by guiding protocols (Miles, Snow, Mathews, Miles, & Coleman, 1997).

The change of the basic structure of the organization was a clear indicator of the need for permanent roles. The roles were also established in geographical levels, indicating the importance of local and regional requirements, restrictions and regulations in standardization efforts. Several parallel and intertwined activities representing the dimensions of ERP were ongoing throughout the period of study. Due to the dimensions of the ERP, the organizing structure had to be established. The organizing can also be analyzed according to the levels of integration in which the single instance decision created geographical layers for the organization structure.

During the transformation of the organizational structures the division of work was not clear-cut. The corporate culture with its embedded values influenced similarly as the management style of the case corporation. The hierarchy levels were low and discussion between levels was frequent. The cooperation and solidarity were high in the implementing organization, although the members came from different departments. Quoted several time during the interviews were 'the hands on - can do' attitude combined with a good atmosphere. Since the implementing organization was formed from specialists, who posses the knowledge of how to do their work, the governance model must focus on something other than direct command-and-control management. Self-governing, i.e. self-organized teams were allowed. The specialists on the other hand, exercised self-regulation and self-control. The common plan for implementing the ERP within the estimated schedule was everybody's priority. On the individual level, the means to achieve set targets could be freely chosen. Hence, ad hoc work groups, task forces and other dissipative structures were regularly used. The wide variety of in-house expertise was considered strength in NMP. The organizational strengths developed provided a competence continuum. The continuity created carried in to the future. Combined with the "unscrupulous attitude" cultivated at the time of the ERP, installation brought new strengths and contributed to success in activities.

The interviews revealed that the changes in the organization were clearly seen as key success factors for the ERP implementation. They also revealed that there were difficulties in combining resources in both departmental and geographical levels: the two previously separate cultures of the information management department and the business line organizations. The new structure was established in that interface. The traditional organization was changed into a novel structure, which was later multiplied to include other information systems and applications used in the case corporation. The structural changes discussed also implied change from a technology-led project to a business-lead project with stronger commitment and participation from the business entities. Challenging the role of external consultants as the major resource for the activities supported this change. The geographical extension of the system created another challenge to overcome. The loss of autonomy in regional units in relation to logistics, business processes, and information system decisions was not welcomed. The experiences of a cooperative approach on configuration, concept and line management level increased common understanding and acceptance. With the experiences the geographically distributed resources also increased their decision making power.

Central underlying constructs

Based on the conducted data collection and analysis of the data, six factors representing the underlying constructs could be identified. These constructs are summarized in the table 21. The results suggest six latent factors important to the success of long term ERP use; these factors are labeled as follows:

	Variables	Label
Factor 1	Q32, Q30, Q77, Q19, Q78, Q66, Q49, Q46, Q36	Successful performance
Factor 2	Q74, Q43, Q47, Q31, Q34	Change orientation
Factor 3	Q52, Q51, Q39, Q75	ERP system impact
Factor 4	Q69, Q26, Q35, Q39	Organizational awareness
Factor 5	Q57, Q70, Q54, Q22, Q39	Imperfect autonomy
Factor 6	Q73, Q38, Q55, Q68	Transformation triggers

Table 21. Factor labels summarized

These underlying assumptions presented in the form of factors do not predict future of ERP. They were used to summarize the characteristics of a successful utilization of an ERP system in the case company. The interesting results of the statistical analysis indicate that the role of complexity thinking characteristics was slightly more supportive of ERP success than the factors usually suggested (scientific management).

Some variables were also analyzed individually to deepen the understanding and to compare for example regional differences in perception. This analysis suggested that on level a more personal the reward system for ERP implementation was not satisfactory. The rewards could not be escalated as motivational factors. Thus, the characteristics of self-organizing were examined. The results indicate that the characteristics on actor level such as self-organizing capability, contributed to success. The organizational transformation was also examined. Most of the survey participants did not predict the evolution of the platform organization of the NBI.

5 CONCLUSIONS

Chapter 5 discusses the conclusions of the present research. It revisits the proposed conceptual model on the basis of the findings in the case study analysis. It includes an assessment of the achievement of the research objectives and the main findings of the present research. It presents the theoretical and managerial contributions. The chapter ends with suggestions for future research.

5.1 SUMMARY OF THE RESEARCH

This research focused how the business domain was integrated to the IT domain during the ERP implementation and thereafter. Enterprise resource planning systems are designed to support operational activities such as logistics business processes and related monetary flows. The ERP utilization¹⁴ has provided a context for the present study to analyze how a new information system was introduced. Its role in structural changes was evaluated. The research analyzed an ERP implementation in an MNE and followed the development of the implementing organization. The organizational structures evolved during the deployment periods. When implementation was finished on one site, the end-users used the ERP during their daily operations. The deployment continued from one site to another, and from one geographical region to another. The research shows that the conventional organizing model is less valid especially with a single instance ERP, and changes on the implementing organization are required. This is due to the simultaneous efforts such as business challenges, geographical distances, and the longitudinal use perspectives.

The implementing organization evolved over the years. The research followed the structural transformation and analyzed the reasons for changes. Furthermore, the research analyzed the development of roles and responsibilities of those evolving structures.

In the research context, a collision of two different cultures was noted, namely the IT and business management cultures. The collision was overcome with clear vision that the ERP system must be implemented and satisfactorily used according to strategy to improve the contemporary logistics problems and to provide an IT platform needed for future success. Furthermore, the collision was overcome with the novel implementation organization structure and the establishment of the novel organization type. The organization was dynamic. It constantly changed and provided possibilities to actors to accomplish set targets.

¹⁴ The term utilization was defined for the context of the study to include those activities that enable long-term use of the ERP system. See chapter 1.3.3.

The research problem concerned the enterprise resource planning system influence in transformation of the implementing organization structure in a multinational enterprise. **The main research question asked** whether the enterprise resource planning system has impacts on the implementing organization. Furthermore, the study was interested on why ERP system has an impact on the implementing organization structure, and how transformation occurs in the implementing organization structures. The third sub-question dealt with the key characteristics of the implementing organization structures. The research also shows that without the single instance ERP strategy decision, and use, the case company would not have reason to change the IT organization. In this research, the organizational issues related to an enterprise resource planning system were highlighted. The social constructs create governance model for the organization. Organizations exist for a purpose and the organizational structure is a key coordination mechanism in a firm.

To answer these research questions, the present research was designed. Moreover, an inductive research approach was taken. Yin (1994:1) suggested that

"In general, the case studies are the preferred strategy when "how" and "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context."

The present study has used an example to illustrate, how an ERP has influenced the MNE's organizational structures and contributed to the formulation of a novel organization. The research answered the questions presented in chapter 1. The research has also achieved the objectives set for the study.

Theoretically, the emergence of complexity sciences in organization and management research motivated the study. Application of complexity sciences has recently been included in the international business domain, especially in research on the ideal types of a firm. The complexity science applied in the international business domain has resulted in new approaches to organizing multinational enterprises from a corporate perspective. Respectively, transnational, heterarchical, networked and flexible forms of multinational enterprises are not based on the traditional control and command management. They are models in which the organizations are considered to be complex adaptive systems. Predictability is not considered the key characteristic and a great deal of self-organizing and chaotic behavior is allowed. On a practical level, the ambiguity of ERP research and especially the notion of failures in the implementation of the ERP systems motivated the

present study. It combines these two interests and includes observations on a successful ERP utilization.

The applicability of the theoretical orientation was evaluated in the research. The complexity sciences orientation and central concepts were clarified and discussed. Following the inductive research approach, the study developed a conceptual model for utilizing an ERP system in an MNE from an organizational perspective. This model positions enabling factors, suggesting dynamic organizational structures. The model captures several novel factors as model elements less discussed with in the ERP context.

On the practical level, the dissertation illustrated a successful ERP case. The case study started with an extensive analysis of the case company history and strategies. They were examined to establish the context of analysis. The report described a case in which ERP implementation and longitudinal use are successful. Based on the researcher's participant observations of a multinational enterprise since 1994, the present study contributes to understand the triggers for organizational structuring during ERP utilization. The structuring achieved was not temporary. It became a permanent organizational structure within the MNE. Furthermore, it continued to transform when the scope of the implementation increased. Likewise, if some other dimensions were included. The case company analysis provided evidence for the model. Based on the case study analysis, organizing may facilitate ERP implementation success.

The dissertation reports retrospectively on a successful ERP case in an MNE. Evidence suggests that creating capabilities to enable adoption of the ERP into an MNE changes the organizational architectures of the implementers. On the department level, a novel implementing organization emerges. It is a combination of various departments with new positions. On the individual level, the capabilities are the results of efficient knowledge creation and transfer, which through process of self-organizing are achieved. The discussion is reflected on both the theoretical and the practical level.

The organizational transformation in the case company included several interesting phases. Complexity thinking was clearly embedded in the early stages of changes in the late 1990s, but the increasing maturity of the organization and movement on the maturity trajectory revealed the recent developments towards more traditional (functional) thinking apart from the flexible and chaotic forms that has proven to be successful in turbulent times. The question arises whether the turbulence is expected to be less in the future and therefore the organizational aspects will return to more traditional forms indicating that the life cycle of the

organization is reaching its end. Or whether the recently examined changes indicate that the competencies and skills acquired in the new type of organization are contrary to those present in the earlier phases of examination of the transformation. The strategies and management culture observed have changed with increasing planning of the structure, its role in the holistic view of the enterprise and competencies supported by staffing. It is noteworthy that business domain has recently brought process development and management competencies back into their organization. This may indicate that closer integration of the IT organization with the business organization will not last and thus eventually leads towards a more traditional type of organization, which was earlier characterized as functional.

The maturity development on the other hand suggests that the strategic focus of the company has shifted. The organization's structural evolution is no longer in the center of strategy and development activities. It has achieved an equilibrium state. At department level this might be the desired state, while at actor level this can cause problems. The actors possessing a creative and innovative approach to tasks and activities are now bounded with the maintenance mode. The creativity is not necessary the core competence required and sought after anymore by the management. The active use of self-organizing and entrepreneurship skills are less stressed. These organizational skills achieved should not be wasted in the organization. The equilibrium state of the organization aims to balance the fit. The next crisis may create another edge-of-chaos situation and trigger new changes. The organization has several choices such as the transfer the organizational skills to other area currently under focus or keep the organization in the edge-of-chaos situation to increase the creativity and innovation. The creativity, innovation, and self-organizing capability to increase knowledge may be decreased due to the increased bureaucratization.

Argumentation

In order to successfully implement and enable use, i.e. the utilization of the ERP and to achieve the suggested benefits associated with it, the implementing organization must be able to understand and react according to the strategies and their implications for MNE configuration, and the role of the ERP as coordination device and controlling mechanism. Hence, the implementing organization has to include business drive. Organizational capabilities required include new organization structures (incorporated), new roles (individual and hybrid), and a novel way of working (self-organizing).

The research argued that conventional organizing does not support ERP utilization in an MNE. In the conventional model, the implementation project team typically returns to the original organizations after the ERP implementation. This movement is not subject to the success or non-success of the implementation. The project team is dissolved after the work is done. Experiences gathered and knowledge created goes away with the parting individuals. The problems related to the geographic extent with MNEs have been of less concern. It is debatable whether the suggested critical success factors predict the success of ERP implementation when a crucial element of organizing is relatively superficially included.

The research proposes that the implementing organization must be able to support the MNE strategies, the business objectives, and contribute the MNE form. The MNE type may suggest a different level of standardization than the ERP. Therefore, the standardization may become an obstacle if the business units have used to more autonomic decision making such as in case of the less hierarchical network. The headquarter may require more standardization due to the ERP. The implementing organization must be able to negotiate the standardization because formal hierarchies do not exist in this type of MNE. The requirements of local, regional, and global responsiveness must be ensured. This in turn requires capabilities that IT organizations do not typically have. To divide the workload requires novel organizational roles that have been integrated.

The organizational transformation analyzed in the research noted a transformation trajectory towards an infrastructure organization. A key role and trigger for the transformation into infrastructure organization was the enterprise resource planning system. The decision of the single instance ERP required unforeseen integration in different parts and within the firm. The research has focused intentionally on the transformation of the implementing organization. Therefore, the analysis of the technical part is excluded. Similarly, the technical part of the organization is less discussed. It was noted that the IT part of the infrastructure that manages all information systems, hardware and networks are a major part of the new unit organization. The novelty of the analyzed organizational transformation was related to the value added part of the infrastructure organization: the business operation and business process knowledge incorporated in the organization.

The study identified two types of organizational transformation: guided and self-organized. First, the results suggest that an organization implementing an ERP system needs to be modified when the scope of the implementation increases. The conventional technology-driven project structures imply a temporary nature. The life cycle of the ERP system and the continuous changes in business environments were found to require structures that are

permanent. The study revealed that the organization structure was not temporary by nature, while the development of the information system continues after initial implementation. A permanent implementing organization structure was established. This is the main difference compared with the conventional organizing model. Permanent roles were established. However, the implementation organization structure is dynamic and evolves during the utilization, which in large corporations takes years. This organization will thus transform itself, partly with outside assistance and partly without. The differences between projects and “ordinary” organizations (Lundin & Steinthórsson, 2003) seemed to decrease. The projects blend with the ordinal organization, transforming from temporal to permanent constructs. An inherent transformation called self-organizing emerged. The actors self-organized with other actors to conduct activities. This self-organizing emerged on a continuous basis. It was visible, but did not necessarily leave a mark on the formal structures.

Based on the case study results, the present report suggests that the organizational mechanisms such as the movement from control type management to leadership style allowing self-organizing is pivotal. The formal structures were therefore strengthened by informal networks, which not only ensured the success, but also ensured the transfer of knowledge. The networking perspective in sharing information and experience has proved to be valuable. The change element was constantly present in forms of changing business requirements and strategic decisions and visible in the dimensions of the information system.

New constructs created

For the present study, enabling long-term use of the ERP system was defined through five dimensions of initial implementation, enhancements, deployment rollouts, support of the use, and upgrades. All of the defined dimensions require different knowledge and capabilities from the actors and organization. The relationship with those dimensions requires organizational integration and holistic management. The examination of the information system literature, especially the ERP literature, revealed that the longitudinal perspective is discussed less in the ERP implementation process models. To understand the implications of the long-term use of an ERP is an important finding of the study. Similarly, the integration level of the ERP was found important and was defined. The range of integration level is from a site-specific ERP system to regionally integrated systems to a single system for an entire enterprise. The strategic decision of a single instance ERP architecture in an MNE has been relatively uncommon (Markus & Tanis & van Fenema, 2000, Sarkis & Sundarraj, 2003, Swanton, 2003). The level of standardization with the single instance ERP system and with

the business processes is increased. This requires deeper understanding and holistic view of operations in an MNE. Therefore, it provides an interesting context to study. It is also a major factor in triggering organization's transformation as found in the present study.

The role of the enterprise resource planning system is emphasized when the integration level of the information system increases. Because the lower level integrated enterprise resource planning systems are utilized as separate entities, the level of standardization is lower. Moreover, standardization does not necessarily need to limit the entire corporation. However, a single instance enterprise resource planning system requires standardization on corporate level. Standardization was identified to include both the business processes and the information system. This increases the pressure to reorganize the implementing organization. Novel implementing organizational structures, organizational capabilities, and an understanding of transformation at different levels in those organizations increase the success of the ERP use.

5.2 MAIN RESEARCH FINDINGS

A major finding of the study is that the organization structures' evolution followed transformation trajectories identified by Volberda (1996). The findings of the research indicate that the organization structure moved from temporary to permanent type. Moreover, these structures became layered and project-focused. Second major finding is that the working mode of the implementing organization was greatly based on the self-organizing. Organizational capabilities developed during the ERP case. These included the self-organizing capability, networking, knowledge transfer, and teamwork.

Consequently, the research has shown that complex development projects require wide variety of competencies. Two new way of working were supported: self-organizing and hybrid teams. The respective organizational levels are actor and department. The research has also shown that these new organizational competencies required are diminished in the long run if the organizational transformation follows the maturity trajectory until the next crisis situations forces changes.

The conclusions of the present study findings can be drawn. **First**, the role of an enterprise resource planning system in organizational transformation is related directly to the integration level of the system and indirectly to the level of standardization. **Second**, an enterprise resource planning system demands novel organization structures due to the complexity of the system itself. In addition, the business-driven implementation forces more

customization and modification to the system functionalities than a technology-driven implementation. The implications require a deeper understanding of corporate strategies, business operations, and everyday business activities. Hybrid managers and hybrid teams can establish a relationship and a network to close the gap between the business domain and the IT domain. Their capability and freedom to self-organize contributes to ERP implementation success.

Third, the utilization aspect related to an enterprise resource planning system indicates continuous development of the information system. The focus on development diminishes over the utilization period. The implementing organization evolves from being implementation focused to utilization focused, during which support activities are emphasized. Respectively, the chaotic form of the implementing organization is related to the initial implementation dimension. The flexible form of organization is related to the enhancement dimension. The maturation trajectory led to the planned form of organization, which is related to the deployment, i.e. the rollout dimension. The evidence suggests that the change to rigid and inflexible form occurs when the maturity of the organization increases unless the management intervenes. The last phase on the routinization trajectory is the rigid form of implementing organization. This change can also be engineered change. This organization is associated with support and maintenance dimensions. The change of the management style depends on the strategies: whether to continue on the routinization trajectory or to turn the unit into a revitalization trajectory.

Fourth, succeeding in enterprise resource planning system calls for self-organizing capability at actor and department level. The empirical evidence of a single case study of Nokia Mobile Phones suggests that implementing organization transforms during the utilization of the enterprise resource planning system. The present study suggests that the implementing organization is characterized with self-organizing capability. The self-organization capability is related to the trajectory of transformation. The study suggests that treating the implementing organization as a complex adapting and evolving system with self-organizing capability increases success with an ERP. Furthermore, capabilities for networking and change contribute the success. The edge of chaos situation is not considered as a threat but an opportunity.

Fifth, the organizational structures are evolving and the stability is not considered as the end goal. The development of organizational capabilities within the implementing organization contributes to the success. Moreover, the research found that single instance ERP system within an MNE can be successful. In essence, the present research showed that the impact

of an enterprise resource planning system in transformation of organizational structures in a multinational enterprise is multidimensional and noteworthy. In conclusion, innovative organization structures may result in permanent structures that lead to increased strategic initiatives concerning the organization such as incorporation of different activities under an infrastructure unit.

Comparison of the results with previous studies

The present study has tied information technology, more specifically enterprise resource planning systems, into organizational transformation. The implementing organization, which was later transformed into an internal infrastructure service organization, is a consequence of the selected information system. This impact on the organization was not predicted when the system was chosen nor planned in advance.

Implementing organization provides an interesting perspective to examine ERPs. IT organization has resulted some studies of configuration choices (Hagström, 1991, Earl & Edwards & Feeny, 1996, Davenport, 1998, 2000, Markus & Tanis & van Fenema, 2000). The present study has identified the transformation phases of the implementing organization. The present study has excluded the external environment from the focus, yet these phases were found to be similar to those of flexible forms in hypercompetitive environment (Volberda, 1996).

The present study focused on examining a successful ERP case. For instance, configuration and assimilation knowledge barriers were found by Robey et al. (2002). Moreover, they found that assimilation of knowledge barriers were so significant that neither a piecemeal implementation nor a single instance ERP system were supported. The present study indicates quite the opposite; if corporate level organization configuration, strategies, structuring, and managing both the implementation and the overall utilization are considered, the single instance approach is supported. The research revealed that the management initiatives of business process reengineering were conducted before the ERP implementation began. However, those re-engineered business processes and related organizational changes took a relatively long time to be completed. The survey results and participant observations indicated that the business processes were not in place before the ERP implementation began. This increased the pressure for incorporating business expertise into the implementing organization. The notion that IT experts could not deal with business related implementation tasks were commonly accepted. This influenced the organizational structures.

The notion of a separate IT domain and business domain (Feeny & Earl & Edwards, 1996, Bensaou & Earl, 1998, Peppard & Ward, 1999, Kangas, 2000, McDonagh & Coghlan, 2001, Lohmeyer & Pogreb & Robinson, 2002, Gefen & Ridings, 2003) and their future role (Ferguson & Khandelwal, 2000) has resulted in interesting studies. Increasingly interesting is the discussion of hybrid managers and hybrid teams (Skyrme, 1996, Bensaou & Earl, 1998). The present study has contributed to that discussion and extended it by providing empirical evidence on both subjects. Hybrid teams and hybrid managers contributed to the success of the ERP utilization.

Self-directed teams have a tradition in the information system development context (Janz, 1999). Also, attempts to close the culture gap between the IT domain and the business domain have been acknowledged (Peppard & Ward, 1999). An analysis of the IT department's role and structure was conducted. The typologies provided were based on the assumption that there is not an aligned organization of business and IT. The present study extends these results by truly closing the gap between business and IT domains by combining activities into the common organization. Especially the hybrid managers and hybrid teams were found useful in closing the gap.

Information technology and information systems have been identified as drivers or enablers of organizational change. Although, the focus has typically been on the technological dimensions (Nance, 1996), the structuring deployment of IT as social phenomenon is supported (Orlikowski & Robey, 1991). Horizontal integration has emerged (Ghoshal & Gratton, 2002) to support enterprise performance. In a framework for organizational integration, Ghoshal and Gratton (2002) place operational integration in the middle. This includes standardized technological infrastructures. The enterprise resource planning system creates the means to manage, coordinate and control the entire enterprise with a single instance ERP. This study has shown how multinational enterprises can implement a single instance ERP to create the basis for horizontal integration. Organizational integration was practiced in terms of ERP projects, which formalized as permanent structures. During the ERP implementation, social and emotional integration has taken place as suggested by Ghoshal and Gratton.

The existent research related to ERP systems has focused on critical success factors, failure reasons, implementation strategies, and implementation processes. Based on the evidence from the present study, organizing influences success in an ERP. The empirical evidence from the case study suggests that a wide variety of factors contribute to ERP success. An

evaluation of criticality of those factors was not conducted. The commonly perceived critical success factors were perceived to be influential. However, differences were found. For example, the reward system was not perceived as critical the extant literature indicates. The present study has contributed to those studies by developing further the factors and concepts. The existent research was widely used in the outlining of the initial model. The model was tested with empirical evidence. This resulted in six interesting themes that captured the essence of the factors identified in other studies. Hence, the present study has extended the existing research related to enterprise resource planning systems.

The nature of the phenomenon, the organizational transformation, in the context of single instance ERP system is rare. The reported single instance ERP systems are relatively rare in multinational enterprises (Sarkis & Sundarraj, 2003, Swanton, 2003). Therefore, the situation and the phenomenon observed can be characterized as unique. Hence, further comparison with other studies with similar context is excluded.

5.2.1 Evaluation of the quality of the research

This study undertook to examine the structural development of an implementing organization related to a successful ERP case. It discussed the factors that may influence this organization.

To evaluate how well the conducted research fulfilled the validity requirements set in chapter 1.4.4. is discussed next. The quality of the research is ensured by the research design discussed earlier. The quality and validity of the research were ensured by use of objective data such as data collected with a survey instrument and internal documentation. An experienced professional subjectivity and experience were embedded in the analysis of the interviews and the analysis of empirical data. Since the focus was not to predict any behavior and because the timeframe of the research is partially retrospective, the subjectivity concern can be eliminated. “An objective subjectivity” is a sought quality in the grounding research approach in which the empirical data collected is used merely for induction and iteration, in contrast to other research methodologies (Eisenhardt, 1989).

To summarize the evaluation of the quality, construct validity was achieved by using multiple data collection methods and development of rich sets of data. The internal validity was achieved by emphasizing qualitative analysis over quantitative analysis. Reliability of the research was achieved by through and detailed descriptions of the interviews, semi-structured question lists, and a creation of a database for the survey responses. The

database allowed easy transfer of data also into Excel format without losing any information. The external validity and generalizability of the research was achieved by detailed case study description with introduction of the events with sequences of order. The research design supported the in-depth and precise description. The theoretical and managerial implications are discussed separately in this chapter. The model constructed can be used also in other socio-technical system implementation. Similarly, the elements model can also be generalized to other organizations. For example, self-organizing capability can be achieved in various organization types and is not restricted only to the implementing organization.

Silverman (2000) has warned about "anecdotalism" with qualitative research and especially with a single case study. The present research has sought intentionally to overcome this threat through research design and research methodology. The study established a chain of evidence. Different methods for acquiring information and data have been used. The study has also incorporated qualitative and quantitative research methods. The data analysis methods have been comprehensive.

The three rhetoric defined and discussed by Kasanen et al. (1991) were found helpful. They stated that in contextual generalization rhetoric, triangulation and reliable reporting of the deep understanding acquired during the case study may improve the generalizability of the study. The sample sizes of this study are seven for the interviews and 96 for the survey, and thus warrant caution in generalizing the findings. However, the number of participants contributing to the research increased its quality. The study acknowledges that a larger sample size, especially concerning several companies, would refine the results. The literature focusing on the ERP implementation commonly reports a sample size of one company. Here also, a single MNE was under examination. However, it consists of several business entities globally. This case does not represent the whole population of MNEs. In contrast, it provides a sample firm that shows the relationships to be concerned. The arguments for the longitudinal single case methodology in the contribution perspective are as follows: 1) a single case study as a methodology allows in-depth analysis of a case, 2) it advances the possibility of a deeper understanding of a complex phenomenon. In addition, multiple sources of data are used. Consequently, the managerial contributions are based on an analysis of experiences of a real business situation. The theoretical implications provide new insights. Several interesting areas for further research can be identified. The contribution of a single case is in its explanatory and descriptive power. New insights are brought up to expand the discussion. Similarly, the limitations of the current study require

caution in interpretation the results. The limitations, however, provide simultaneously opportunities for future investigations.

5.2.2 Revisiting the conceptual model

A conceptual model was proposed in chapter 3. The empirical evidence from the case study suggests some changes for the initial model. The initial model identified variables in the existing literature. Since a wide variety of factors were found to contribute to the success with ERP systems, the research used multivariate analysis to incorporate factors into more holistic themes. Thus, the model is based on the initial model developed in chapter 3 and complemented with empirical findings. According to the revisited, and hence, final model, the MNE was enabled to function through the relationships between the information systems and business domain organizations, which is a key feature of the MNE organizational transformation capability. It takes place at the organizational level. Self-organizing was identified as a key contributor to organizational transformation and to success in ERP utilization in an MNE. The revisited model is presented in the figure below.

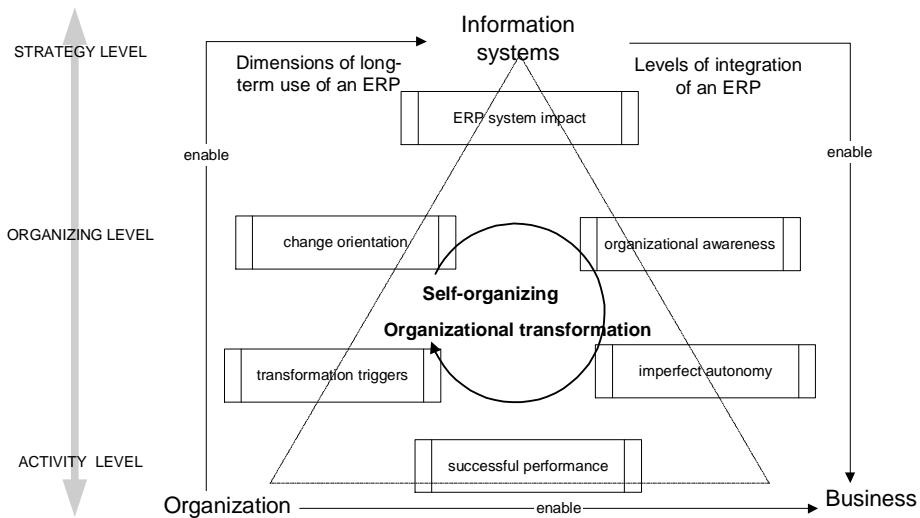


Figure 39. Conceptual model revisited (the final model)

The conceptual model is called the 'triangle of dynamics'. The properties of the dynamics are the organizational transformation and self-organizing capabilities. Both are needed and found useful. The elements point to specific areas to which concern should be directed. The

elements of the model should be considered holistically. The boundary elements of organization, business and information system define the examination.

According to the final model, organizing and management of the utilization of an enterprise resource planning system in an MNE can be explained by the following elements: 1) organizational awareness, which demonstrates itself through organizational control, suggests project champions, and commitment to change. 2) Imperfect autonomy may become a difficult element because of the corporate level strategies and management styles. The less hierarchical structures and tendencies of networked organizations may resist in the lost autonomy related to the utilization of the ERP in an MNE. At the actor level, new working teams and structures may emerge spontaneously as a result of self-organizing. The established implementing organization is perceived to have a coordinating role. 3) Change orientation supports the structuring of concept areas and the creation of the new roles of configuration owners, concept owners, and key-users. Furthermore, it suggests that business experts are released for the work accordingly. The change orientation is also associated by the demands the ERP changes in the focal organization. 4) Transformation triggers are reciprocally related to the information technology strategy. Consequently, the standardization reduces flexibility in the business domain. Minimal customization is suggested. The transformation triggers suggest closer relationships with local and regional levels. This in turn supports the self-organizing approach. On strategic level concerning the information system, the selection of the system (ERP), the dimensions related to its longitudinal use, and the level of integration of the ERP, are noted. The empirical evidence showed that 5) the ERP system impact supports experimentation, minimized customization, and modifications. The scope of the ERP modules suggests that fewer modules are installed simultaneously. The critical success factors and potential new factors derived from the literature were considered to be positive contributing factors. These factors are embedded in the construct of 6) successful performance. It demonstrates the wide variety of individual factors contributing to the success. These elements have relationships with each other. ERP system impacts the organizational awareness, which is linked to the autonomy decisions. The study argues that these elements construct reciprocal relationships within the boundaries of information systems, business domain, and implementing organization.

If adaptive and flexible IT infrastructure is the goal (Nance, 1996), the organization governing its different parts must capture similar characteristics. The IT infrastructure was created and managed by the business infrastructure organization. The organization was not predicted. It emerged through a process of actor- and team-level self-organizing and department -level transformation. Self-organizing among the actors and the establishment of dissipative

structures during the utilization activities indicate the transformative capabilities of the organization.

Discussion of application of the model

The application of the model requires acknowledgements of risks. The guiding theoretical approach of complexity sciences is present in the model. An understanding of the shift between scientific management and complexity sciences is required. The corporate structures imply less hierarchical structures. The model is applicable in those circumstances.

As stated earlier, the organizational transformation in the case company was the result of an evolution in specific conditions such as strategy and is as such difficult to copy to another context. The model has taken attributes from the case. The model depicts those attributes to which management should pay attention. The model can be applied if the conditions and overall management characteristics and structures are met. The trajectories identified by Volberda (1996), especially routinization, cause concern. The rigidness and unresponsiveness of overemphasis of organization have been noted by Sauer and Willcocks (2002). They emphasize that sustaining designed organizations means flexible organizations, not permanently fixed establishments. This concern is supported by the present research. The model elements draw attention to organization issues. Combined with the transformation trajectory, the model emphasizes dynamics and flexibility. The model is not static and should not be considered as such. Strategic, organizational alignment, and transformative elements represented in the figure as the triangle form the core of the model. This alignment contributes the operational success. To ensure the application of the model, the self-organizing concept must be in line with the management style at corporate, department, and actor levels. The model may be applicable in different technological contexts. This, however, requires a high level of standardization within the MNE.

The context of the research was the ERP utilization. However, the research assumes that with a different context, similar organizational transformation could be observed. The research also assumes that the model created during this specific context is applicable in different situations. As such, the suggested conceptual model can be applicable with other IT systems especially when requiring integrated efforts within the focal firm. The application of the model is also suggested to be valid in different type of situations such as in case of mergers and acquisitions. Integrating and streamlining the information systems in this context may require a different understanding of the dynamics between different information systems, organizations, and business processes. The suggested conceptual model will

provide a governance model to be applied when integration is a desired result. It provides the elements and key capabilities needed in successful organizational transformation required in integrating the participating firms.

5.3 THEORETICAL CONTRIBUTIONS

The novelty of the present study is the new integrated approach for organizational transformation and information system utilization. The present study uses an interesting approach of applying complexity thinking in the organizational transformation research. The ideal models of a firm, representing the international business domain, are examined concurrent with IT strategy and related IT configuration. Theoretical contribution involves conceptualization of factors influencing the ERP utilization. These are the elements in the conceptual model. Additionally, the research applies inductive research approach as a research approach suggesting a firmer link is study involving academia and real-live phenomenon.

On the theoretical level in this study, implementation and later development activities of the enterprise resource planning system were addressed from the complexity science viewpoint. Thus, this study extends and supports the theoretical discussion of MNE management from scientific management to the complexity sciences. It therefore applies an emerging theoretical approach in the study of an MNE. It extends the theoretical choices of investigating MNEs within the domain of international business. Recent research of developments in MNE forms has revealed the evolution of less hierarchical forms. This development also has strongholds in the complexity sciences. The research supported the less hierarchical forms. Furthermore, these forms have an influence on information technology strategies and investments. The heterarchical approach can be applied in the organizing the utilization of an ERP.

Complexity sciences suggest that organizations change themselves, i.e. self-organize. Especially, an edge of chaos condition may trigger creativity. This study contributes to the complexity science approach. Based on the evidence from the case study, the organizational structures related to the implementers and the evolving organization was not planned. The infrastructure organization was not a planned goal of the ERP implementation. The organizational structures of the implementing organization had evolved without an overall plan. Neither the structuring nor the transformation was predicted. However, during the ERP

implementation, the adopting organizations, i.e. the end-user organizations in the business domain, experienced planned organizational changes i.e. engineered change activities.

The integrated approach contributes to the theory of organization, where much of the research excludes information technology and its increasing influence on organizations. The management of information science domain has already included organization into their domain, yet, still analyzing the problems from the technical perspective. It is beneficial to the organization theories is to include IT in research objects as (manufacturing) technology has been included. The scattered and ambiguous information system and management research was elaborated and focused clearly on ERP systems. ERP implementation research was examined and two constructs are created to elaborate the impact of the nature (type) of the system: the dimensions and integration level. The critical success factors and processes of ERP implementation were investigated and the temporal perspective was shifted. This contribution involves the conceptualization of the ERP implementation from temporal project go-live focused activities to a persistent longitudinal activity. This is slightly reflected in some research, but not fully established as a major factor for success and trigger for transformation. The contribution to the ERP research is also the perspective chosen in the present study. The multidisciplinary approach combined elements from a variety of domains incorporating them. The rather technical orientation was therefore minimized, yet included as supplementary.

Contrary to the common deductive research approach, the present study has used an empirical and inductive research approaches. The interplay between data and theory support the same logic. The practical orientation present during the research process also contributes to the methodological contribution. The wide gap in research between academic and practical experience is noted. The typical role of a researcher is that of an external observer. The drawback of an external observer may cause superficial analysis or a connection with the object of the research. The author's role as a researcher differed from that of typical external observer. The author is employed by the case corporation, which provides unique access to data otherwise not available to researchers. Furthermore, the author not only observed the events and the ERP utilization but also participated in the implementing organization. Consequently, the grass-roots experience of utilization and the transformation events provides unique insights into the case.

A comprehensive theoretical framework was created and an outlined conceptual model was introduced. The contribution of the framework is its holistic nature. The framework facilitates understanding of the multidimensionality that is faced with the ERP in an MNE. The many

conditions and causal links are present in reality. The model describes the organizational transformation in relation to the ERP. The conceptual level of the model shows the importance of evolution in organizational architectures over time.

This research contributes to an understanding of how an MNE with extensive international operations transforms and manages organizational capabilities related to IT that fits with the strategic focus. The theoretical work of the international business research was tested and linked to international organizational transformation and management. By examining the phenomenon from a less used theoretical perspective of complexity sciences, the research found that this perspective is applicable for studying transformation in an MNE. It is also applicable for studying MNEs in the context of information system implementation. Complexity sciences argues that systems such as organizations are at their best at the edge of chaos or in bounded instability, which contributes to the emerging behavior visible in self-organizations and dissipative structures. Balance is not a long-term goal. The transformation can be examined and explained by the complexity science factors. Hence, the explorative power of the complexity science is supported by the present study.

The operationalization of complexity sciences in the context of MNEs and ERP utilization was illustrated in the model. The outlined model and the revision of the model that was inductively built is a contribution of the present study. The complexity sciences have not been previously used as a theoretical framework for examination of organizational transformation in the context of enterprise resource planning systems. This research supports and implies the usability of the complexity sciences as theoretical framework.

5.4 MANAGERIAL IMPLICATIONS

Several managerial implications are outlined. For managers, this research clarifies the role of organization structures in IT capability. Information system implementation, its utilization and the whole IT infrastructure pose major challenges to MNEs, not only due to fast technological change, but also due to the social constructs of the firms. These challenges are complicated by international business orientations and strategy changes, which necessitate the constant revision of IT capabilities, business processes, and the organizational arrangements. For managers, this notion implies that organizations should be transformed to better reflect the needs posed by strategic, operational, and technical changes.

For an MNE with several operative units in different geographic locations, the internal complexity is increased by external factors and internal factors such as national cultures, conduct of business, national laws and regulations, and various time zones. They need to be incorporated into the overall MNE configuration. Enterprise is organized to coordinate diverse tasks. The complexity science approach suggests an understanding of different causalities, limited hierarchy, acceptance of turbulence, and the state of non-equilibrium conditions. The type of MNE configuration follows the assumptions of network and flexibility. Hierarchy and control are seen as less desirable characteristics. The forms of MNE influence the sub-units. This research has demonstrated extension of an MNE mode to its sub-unit, or more specifically to a new organization structure that was transformed from the IT organizations and business organizations in to a single integrated and comprehensive department to respond to challenges posed by technological innovations. The described non-hierarchical, networked, and flat MNE organizations can also applied in the sub-organization.

The study shows that the integration of IT domain closer to business domain is possible. The organizational transformation observed has resulted in a platform organization currently known as the infrastructure organization. The accomplishment of the activities (dimensions of ERP) and the change of the management style suggest a new dilemma: whether to continue on the routinization trajectory or to turn 180 degrees into a revitalization trajectory. A complex adaptive system cannot return to exactly the same organization structure that it was before because the initial conditions are changed. Similarly, the experiences and learning within the system prohibit this. The strategic choices influence whether it is more desirable to have a mature organization and to accept a rigid organization form. The strategic decision for the management to consider is to evaluate the strengths and characteristics of the flexible organization. It may be more desired state if the organization seeks increased creativity and flexibility in their activities. The movement on the suggested transformation trajectory can be reversible as well.

The study does not, however, suggest a conclusion that same organization that installed ERP into an MNE would be the organizational solution to maintain the technical architecture created in the long run. One conclusion directly found in the present study is that while the information systems integrate, the organizational structures become more fragmented. Although the business drive achieves required technical installations, the organizational fragmentation may become too large to govern. The organizational complexity increases. The organizational fragmentation shows in specialization. The capability of broader view becomes an increased strength. The moves in organizational transformation trajectories

imply the maturity of the system in the use. Different competencies and skills are managed differently during the transformation phases. The flexibility created needs to be maintained.

The time dimension was noted. The temporality of the ERP implementation project organization is no longer a valid assumption. The constant need to refine the system requires permanent resources. The study results imply that the ERP implementing organization will continue to exist after the initial implementation is finished due to the other utilization activities. Hence, the original organizational structure and its transformation will have long-term effects on a focal MNE. Managers need to focus on these dynamic organizational transformation and social construct matters found in the research.

The study has shown that MNEs have different choices in their selection of ERP system integration level. This should be taken into account when deciding the integration level. The study has suggested a different approach to organizing single instance ERP utilization in an MNE. The direct implication for managers is to reconsider and analyze the suitability of conventional organizing with the ERP utilization. The organizational issues are important. Management of the different forms of the transforming organization compared with the infrastructure organization is different. It poses concerns to managers because the role of the infrastructure organization has shifted and the capabilities need to be ensured.

The self-organizing teams were found to contribute to success with ERP. The role of self-organizing in organizational transformation in an MNE was noted. The highest level of self-organizing was observed in the chaotic and flexible forms. The increase of rigidness decreased the self-organizing. The benefits of self-organizing may be useful in other contexts too. The transformation was compelled by the technological attributes and the company attributes, such as strategy and management. It resulted in a hybrid organizational structure extended to all business process areas and all information technologies. The transformation trajectory provides managers with a tool to evaluate the desired state of the organization. The alternating motions along the trajectories require strategic and managerial decisions. Managers have an option to direct this movement. These are some of the issues managers have to consider.

5.5 SUGGESTIONS FOR FURTHER RESEARCH

The focus of this research was the phenomenon of transformation of organizational structures. This organizational transformation was contextualized to ERP. The main unit of analysis was a department in a multinational enterprise.

Information technology research should be more closely incorporated in the study of international business organizations. International business organizations are more dependent on the information technologies and capabilities, whether they are technical, operational, or managerial. Based on the alignment of strategy and information technology noted by several researchers in the literature review, the study suggests the continuity of similar alignment with research on information technology and management of organizations.

While the purpose of the present study was to analyze in a narrow context a successful ERP and the factors of success, the contribution can be escalated on a more general level. In the future, the dematerialization will lead to the questioning of current technologies, which will inevitably lead to adaptation of new technologies. The collision of assumptions and perspectives is also inevitable. Hence, by integrating the actors in a common structure, allowing self-organizing and freedom, the set targets can be achieved. The ERP case examined and discussed provided a context for manageable practicing in the future. The learning perspective has not been the core in the present study and it therefore remains open for examination in future research. The knowledge acquired and the knowledge transfer is a subject for future research.

Knowledge management and knowledge transfer together with organizational learning are closely related to the present study. Future research would benefit from a broader examination of the knowledge management perspective on ERP success. Knowledge-worker performance such as that of the specialists in this study working with ERP and securing its use has only been briefly discussed. However, it has been suggested that knowledge-worker performance (Davenport, et al., 2002) unites separate tasks such as organizational design and IT investments. The future research may include testing of the model. The operationalization of the constructed variables in the model is another suggestion for future investigations.

The structure of interdependent relationships of variables was analyzed in the present study. However, future research would benefit from identifying the structure of the relationships

between cases or respondents. The suggested model could be tested with multiple case analyses. Similarly, the structure of interdependence relationships among respondents would provide further information about interesting phenomenon. The data would allow this examination.

The research emphasized that the phenomenon of the organizational transformation was closely associated with the single instance ERP utilization. The rare case of single instance enterprise resource planning system was examined in the present study. An interesting approach for future research would be to study whether the organizational capabilities found in the present study would improve the success of less integrated ERP systems.

The international business research would benefit the analysis of changes in different MNE configurations due to the single instance ERP. The present study has examined the implementing organization transformation. It would be interesting to examine the organizational transformation associated with the adopting organization in a case where a less hierarchical MNE adopts a single instance enterprise resource planning system. Especially an analysis of less hierarchical and networked MNE structures and the ERP utilization would provide an interesting line of inquiry for future research. It may provide interesting insights for the IT development if the ERP systems for example would be found less suitable for the networked or federalized MNE.

Combining complexity sciences and key concepts of the complexity sciences in the research on management and organization would open a new several possibilities for future research. On the more general level, the management of projects generates another stream of inquiries. It would be useful to examine why the experience of actors and the project organization do not necessary result in shorter projects. The knowledge transfer and learning issues were excluded from the research. Yet, they might provide complementary results. Moreover, future research could examine why the routinization of an organization seem to decrease the self-organizing capacity.

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APPENDIX 1 – ERP VENDORS LISTED IN RANK ORDER

A list of ERP vendors ranked by the company revenue (2001 status) – 30 biggest (Kraus & Shepard, 2002:6):

1. SAP
2. Oracle
3. PeopleSoft
4. J.D. Edwards
5. Sage Group
6. GEAC
7. Lawson Software
8. Intentia
9. Baan
10. SCT
11. IFS
12. Microsoft Great Plains Business Solutions
13. QAD
14. Computer Associates
15. Navision
16. Mincom
17. Exact Software
18. Epicor Software
19. PSI Penta
20. MAPICS
21. CINCON Systems
22. SSA Global Technologies
23. Frontstep
24. Systems Union
25. BRAIN International
26. Deltek Systems
27. American Software
28. Softbrands Manufacturing
29. infinium Software
30. Glovia International

APPENDIX 2 – SAP AG INTRODUCTION

Systeme, Anwendungen und Produkte in Datenverarbeitungen - Systems, Applications and Products in Data Processing AG, widely known as SAP, was founded in 1972 with headquarters in Walldorf, Germany. SAP AG and its network has 91 operating subsidiaries and representation over 120 countries (Datamonitor, 2003). The goal of SAP was to produce and market standard software for integrated business solutions. SAP's core market is enterprise resource planning systems, where it enjoys undisputed leadership. SAP is the recognized leader in providing collaborative business solutions for all types of industries and for every major market. It is the world's largest inter-enterprise software company, and the world's third-largest independent software supplier overall (Datamonitor, 2003). Bancroft (1996) estimated in 1996 that more than 4000 companies have implemented SAP R/3 worldwide. There are (2003) some 12 Million users, over 60000 installations, 1500 partners, and 23 industry solutions. SAP has over 23000 employees located in over 50 countries. The revenues of the SAP have grown rapidly from the first year of the R/3 product launch (see table 10). SAP R/3 has been implemented in firms of various sizes. (SAP AG, 2003)

SAP's current ERP product is called R/3, which is built on client/ server technology. The earlier SAP product was R/2 introduced in 1979, which was a mainframe set of software modules. Over the years, SAP has introduced more and more functionality to its core system. The current R/3 solutions were launched in 1992. It was Internet enabled in 1996. (Datamonitor, 2003)

	1999	2000	2001	2002	2003
Total revenue in € millions	5.110	6.265	7.341	7.413	7.025
Revenue change in % since the previous year	18	23	17	1	- 5
Operating income in € millions	937	1.243	1.471	1.688	1.880
Operating income change in % since the previous year	2	33	18	15	11
Number of employees year end	21488	24177	28410	28797	29610
Number of employees annual average	21029	23078	27072	29054	29098

Five year summary of SAP (SAP, 2003)

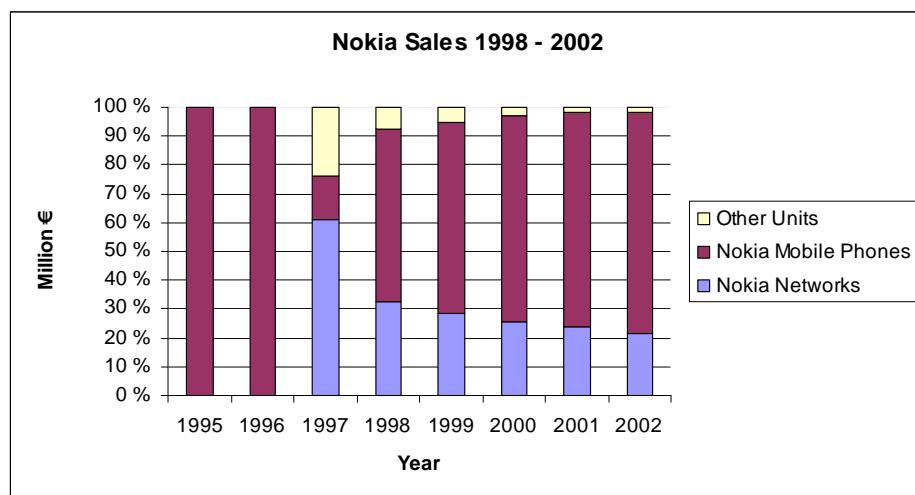
APPENDIX 3 - FACTS AND FIGURES OF NOKIA AND NMP

Source: Nokia (2004), Häikiö (2002)

Nokia net sales divided by market area (region)

Net sales by market area	1995	1996	1997	1998	1999	2000	2001
Europe	48%	53 %	59%	58%	53%	52%	49%
Americas	13 %	16 %	18%	21%	25%	25%	25%
Asia Pacific	49 %	22%	23%	21%	22%	23%	26%

<i>Sales (M€)</i>								
	1995	1996	1997	1998	1999	2000	2001	2002
Nokia Networks			18826	4390	5673	7714	7534	6539
Nokia Mobile Phones	2700	3629	4649	8070	13182	21887	23158	23211
Other Units			7239	1014	995	854	585	459
Total	6191	6613	8849	13326	19772	30376	31191	30016
<i>Personnel (average)</i>								
	1995	1996	1997	1998	1999	2000	2001	2002
Nokia Networks			15 710	19 280	22 804	235 008	22 040	18 463
Nokia Mobile Phones	10616	10927	12 631	16 064	20 975	27 353	27 320	26 090
Other units			7 149	5 747	7 398	7 847	8 356	8 161
Total	35 490	41 091	51 177	58 708	57 716	52 714		
<i>Operating profit (M€)</i>								
	1995	1996	1997	1998	1999	2000	2001	2002
Nokia	843	717	1422	2,489	3908	5,776	3,362	4780
Nokia Mobile Phones	318	258	684	1,617	3099	4,879	4,521	5201



APPENDIX 4 - LIST OF SULO DOCUMENTS

Examples of development release projects, i.e. supply logistics project documents is as follows; small variation exists between release projects:

Project management documentation

- Project plan
- Project progress reports
- Schedules
- Meeting minutes
- Issue logs
- Project closure report

Concept documentation

- Business process roadmaps
- Concept roadmaps
- Process flowcharts
- Concept flowcharts
- Process description document
- Concept description document (i.e. concept) = system requirement document
- Functional description document
- Gap analysis document
- User guides
- Responsible, process owners, concept owners and key users; common templates used in all projects

R/3 system related documentation

- R/3 configuration documentation
 - Global configuration, client level
 - Site specific configuration (country specific, factory specific etc.)
- System solution documentation
 - Global system solutions SAP standard and Nokia specific processes
 - Site specific system solutions
- Programming requests, programming documents
- Transport documents
- Responsible creators: configuration owners, common layout to be used in all projects

APPENDIX 5 - NOKIA MASTER PLAN FOR SAP R/3 PROJECTS

Nokia Master Plan for R/3 projects Note: for 1998 - 2000 only (Nokia internal documentation)

New implementations

Americas

Alliance DC (Americas Sales and Distribution)	Estonia
Alliance MC	Export control for NMP
Argentina	"Finland (NTC, NDP, NMP)"
Brazil (Manaus + Sao Paulo)	France
Canada	Germany
Chile	UK conversion + FSP
Columbia	HR master data Europe
Mexico FSP	Hungary FSP (excl. NDP)
NDP USA	Hungary FSP for NDP
Peru	Hungary manufacturing NMP
Reynosa NMP MC	Internet sales Retail Europe
Reynosa NDP MC + USA SO	Internet sales Retail Europe Phase 2
Venezuela	

SEAP (South East Asia Pacific)

Australia + Sydney DC

India
Indonesia
Japan FSP
Japan logistics
Korea Masan + Seoul

Malaysia
New Zealand
Philippines
Singapore DC
Singapore regional functions study
Singapore regional functions implementation
Taiwan
Thailand

China

BNMT Beijing
BNT Beijing
"CNT Chongqing, China"
"DNMP (Dongguan, China)"
"FNMT (Fujian, China)"

GMT (Guilin)
NCIC (Nokia China Investment company)
"NST Suzhou, China"

Europe / Africa

Austria NMP
Austria NTC
Belgium
Czech Republik
Denmark

Estonia

Export control for NMP

"Finland (NTC, NDP, NMP)"

France

Germany

UK conversion + FSP

HR master data Europe

Hungary FSP (excl. NDP)

Hungary FSP for NDP

Hungary manufacturing NMP

Internet sales Retail Europe

Internet sales Retail Europe Phase 2

Latvia

Morocco

Netherlands

NDP Phase 2 Hungary

NDP Phase 2 Finland

New Ventures

Norway

NMP R&D budgeting Finland

NMP R&D budgeting Europa

NMP R&D logistics

NTC Customer Service

NTC FAS

NTC Master Data (Register)

NTC PMR Finland

NTC RAS Phase 1

NTC RAS Phase 2

Portugal

Romania

Russia

Smart Traffic Products

Sweden + Motala Phase 1

Sweden / Motala Phase 2

Transport module for NMP

Turkey

AMS (NMP After-Market Service)

Support and special tasks

Support for live sites

NMP support

NDP support

NTC support

Salcomp support

Tests and studies

APO
 BW
 IS-SW
 PDM
 Product Creation (global R&D)
 SFA
 Sales configurator

Special conversions

Euro conversion

Euro conversion for NMP
 Euro conversion for NDP
 Euro conversion for SWP
 Euro conversion for Salcomp

Merging several live systems

SWP and PMR conversion to common NTC box

Release upgrades

NMP upgrade 3.1i to 4.5B
 NDP upgrade 3.1H to 4.5B
 SWP upgrade ? to 4.5B
 Salcomp upgrade ? to 4.5B

Global agreements

Project methodology (ASAP)
 Corporate methodology (global ASAP)

Organizational structures
 System architecture
 Distribution model / ALE

Training

InfoDB installation

R/3 Infrastructure

New hardware for P10

ITS (Internet transaction server)

Development landscape

Adding Q10 system + procedures
 Interface converter
 Nokia OSS
 Vertex subsystem (USA taxes)
 Linking Manugistics to R/3

External projects

"Cooperation with other companies (SAP, ...)"

APPENDIX 6 – ROLE DESCRIPTIONS

Short illustration of the content of the roles.

R/3 implementation manager

Responsible for planning the R/3 implementation, budgeting and cost controlling respectively. Responsible for implementation planning and organization, resources and competences. Overall responsibility of the project management, implementation principles, standards and guidelines. Control project milestones and schedules, communicate project plans and status define process roadmaps and application functionality roadmap. Basically projects were divided into project phases each having a check point before moving to the next phase. The schedule was set accordingly. This role is permanent, fulltime and with global basis.

Project leaders

Responsible for planning and organizing an implementation project specific activities. The operative leadership of a project and responsible for planning, cross team activity scheduling, resource arrangements as well as the working environment. This role is permanent, fulltime and with local basis.

Concept owners

Ensure implementation of desired business objectives, processes and supporting information systems according to NMP business priorities on continuous manner. To harmonize, simplify and optimize processes and system concepts. Responsible for operation of the concept and management of changes. Working in cooperation with other concept owners and configuration owners. The role requires good understanding of desired business process development on global basis. Business process implementation include specification of business process implementation, change management in terms of training, communication and motivation and project management leadership. This role is permanent, fulltime and with global basis. Later this role was defined on regional and global level. The liaison role between business and IM system development was given to concept owners.

R/3 configuration owners

Responsible for configuration of the R/3 system in his/ her area (set per SAP modules usually) and management of system changes from the point of view of both cross-module integration and user population including testing and transport of changes into system. Development of system in close cooperation with other technical staff and concept owners. Responsible in system related documentation such as configuration documents, programming requests, technical instructions and modification specifications. This role is permanent, fulltime and with global basis. Later this role was defined on regional and global level.

R/3 key-users

Represent the end-users of the system in their own function or department. They bring in the practical operative experience. Responsible for end-user training and training documentation of their own expertise area. To support and train end-users for any later coming up changes and modifications. Includes active participation in system development, i.e. concept designing, system configuration and testing. Collect end-user feedback and make development requests being part of the support escalation process. Have good business process knowledge and experience of everyday operative practices, knowledge on system and its maintenance principles. Supported in evaluation of feasible system solutions/ processes. They document user guides and participated in testing pilot

and local system functionalities. The first point of contact for end-users locally. This role is permanent, full-time and with local basis.

Application manager/ technical implementation manager

Responsible for configuration resources and their competences development, resource allocation, application issues validation, validation of the project plan (focusing on IM issues) and validation of the technical solution, i.e. the application design. Ensure the use of common methodology in all related work. Plan and implement common application and data architecture and lead common system configuration and support teams

Development Project Manager

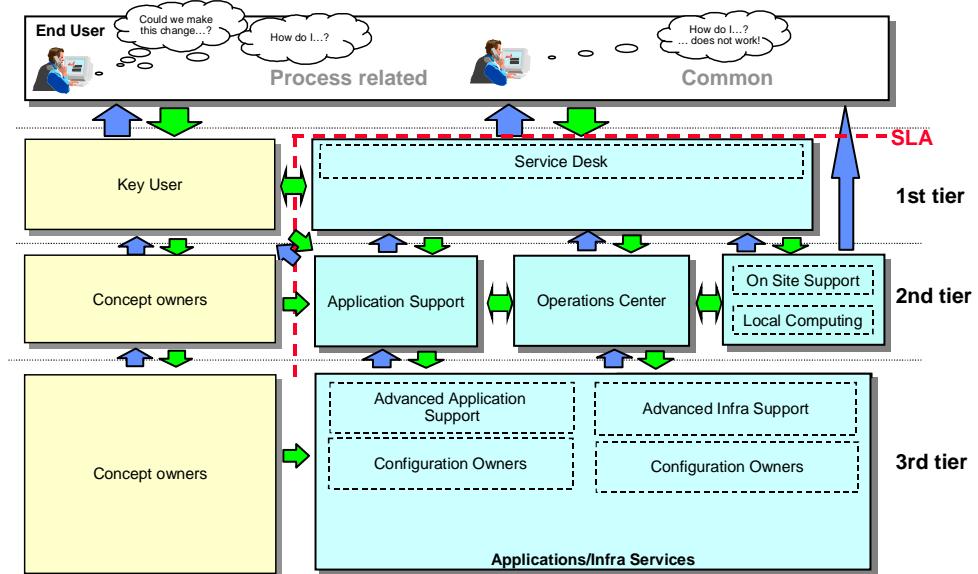
Development Project Manager had similar responsibilities as formerly defined project leaders and Implementation Project Manager. Responsible for the roll-out of system to sites.

R/3 Basis team

Basis team consist of three types of roles. R3 authorizer (s) responsible for documentation of all user master and security related changes. Program change controllers responsible for managing the program change process. R3 administrators responsible for administrating the system in general, maintain printers and changes related to databases, hardware and the operating system

APPENDIX 7 – GLOBAL SUPPORT MODEL

The following figure illustrates how the roles are intertwined in daily use of the system. The global support model service was established in June 2000 (Internal documentation).



APPENDIX 8 - SEMI-STRUCTURED LIST OF QUESTIONS

In Finnish; English translation and the purpose of the question provided herewith.

HAASTATTELURUNKO (Semi-structured interview)

Haastateltu : (interviewee)

Aika & Paikka: (time and place)

1. Lämmittelykysymys: Nimi ja nykyinen toimi sekä työtehtävät 1.ssä SAP R/3 käyttöönottoprojektissa 1995 (Salo) sekä 1996 (Bochum)?

Name and current position; your role related to the first SAP R3 implementations Salo and Bochum 1996-97? Warming-up question. Gather background information from the interviewees

2. Miten Salon ja Bochumin projektit (SAP R3) oli mielestäsi organisoitu, projektiorganisaation rakenne? Tiedätkö, miksi se oli näin organisoitu?

How the Salo and Bochum (SAP R/3) projects were organized? What was the organization structure? Do you know the reason for this organization design? Information about the organization design in the first implementation projects.

3. Miten 1.projekti muistisi mukaan sujui noin yleisesti? Mitä ongelmia esiintyi työnjakomielessä ja tehtävien suorittamisessa (projektiorganisaatio)?

How did the 1st project proceed in general according to your memory? What kinds of difficulties were noticed in distribution of work activities and duties (in project organization)? How did the 1st project operate, in general? Were there difficulties in the distribution of work and duties (in the project organization)?

4. Projektiorganisaation toimivuus Salossa ja Bochumissa? Oliko eroavaisuuksia? Millaisia? Functionality of the project organization in Salo and Bochum (projects); any differences? What kind of? Compare project organization in Finland and Germany.

5. Tammikuussa 1997 perustettiin Supply Logistics (SULO 1) projekti, jossa tarkoituksena oli Euroopan regioonan SAP R/3 käyttöönotto sekä upgrade 3.0->3.1; tässä projektissa oli erilainen projektiorganisaatio: concept owners and configuration owners (global/ regional). Miksi mielestäsi SULOssä oli erilainen projektiorganisaatio ?

January 1997 Supply Logistics (SULO1) project was established in order to implement SAP R/3 to whole Europe & Africa region, and upgrade the existing application 3.0 -> 3.1. This project has different project organization design: concept owners and configurations owners (regional/ global). Why do you think the organization design was changed? To collect opinions why the organizational design changed between 2nd and 3rd implementation project.

6. Mistä idea tälle projektiorganisaatiolle saatiiin, kopiointiinko se jostain – mistä?

Where did the idea for this kind of organizational design found? Was it copied from somewhere - where? Origin of the organizational design

7. Mitkä tavoitteet concept owner – configuration owner työnjaolle annettiin?

What were the objectives for concept owner - configuration owner division of work? Information whether the interviewees knew the objectives of the roles; what they were supposed to do

8. Miten tavoiteet toteutuivat? Mitä heikkouksia/ vahvuksia oli? 1997

How the objectives were fulfilled? Any weaknesses / strengths? -1997? Did the design work; successfullness prior 1997

9. Miten luonnehdit organisaationn onnistumista 1997 - 2002?

How would you characterize the success of the organizational design 1997-2002? Overall opinion of the organizational design success

10. Onko tämä nykyinen organisaatio enemmän luonteeltaan ja tavoitteitaan kontrolloiva vai koordinoiva? control vai coordination

Is this organizational design aiming more towards control or towards coordination in your opinion? control and coordination approach

Haluatko litteroidun version haastattelusta? Kyllä/ en

Would you like to get the transcript from this interview (yes/no)? Interested to get transcript for verificating and commenting?

Onko sinulla omalla PC:llä aikakauden materiaalia tai tiedätkö mihin dokumentit on arkistoitu?

Do you have any relevant materials in your possession that could be use in the study? Secondary information collection purposes.

APPENDIX 9 - SURVEY INSTRUMENT

The survey instrument in a list format. Unless otherwise marked 5 – scale likert scale used.

1. In which business group do you currently work?

- Nokia Head Office (NHO)
- Nokia Global Platforms
- Nokia Mobile Phones (NMP)
- Nokia Networks (NET)
- Nokia Research Center (NRC)
- Nokia Ventures Organization (NVO)
- I am not working for Nokia

2. In which business unit or platform do you currently work? – list of selection provided

3. In which country do you currently work? – list of selection provided

4. How long have you been working for Nokia?

- Less than 6 months
- From 6 months to less than 12 months
- From 1 year to less than 3 years
- From 3 years to less than 6 years
- From 6 years to less than 10 years
- 10 years or more

I am employed by an external company but working for Nokia

5. Were you employed at NMP during the NMP SAP implementation (ca. 1995 - 2001)

- Yes (1995 - 2001)
- Some time
- No

6. If your answer was "NO", in which company or Nokia unit you were employed – TEXT

7. Did you participate NMP SAP R3 implementation project(s) as an actual member of any of the project teams

- Yes
- No

8. If your answer was "NO", please, write in the text box below your role during this implementation. How were you involved with SAP R3 implementations? - TEXT

9. In which of the following NMP SAP R3 projects did you participate? Select all relevant – LIST

10. Which position(s) did you hold during those project(s)? Select all relevant. – LIST

11. In which of the projects do you consider your priority project? (only 1 can be selected) – LIST

12. What was your primary position in that project? (Only 1 can be selected) – LIST

13. If your priority role was not in the previous selection list, please describe it – TEXT

14. Did you have any experience of the SAP R/3 system before participating this implementation work?

- Yes - a lot
- Yes - some experience
- Not at all

15. The SAP R3 training I received PRIOR the project work was adequate for me

16. The SAP R3 training I received DURING the project work was adequate for me

17. The reward system (bonus, incentive, recognition etc.) for the participants was satisfactory

18. SAP R3 implementation throughout NMP was on time (time criteria met)

19. SAP R/3 implementation in NMP can be described as successful

20. What would you point out as the primary reason for the success? – TEXT

21. In general, Nokia corporate culture was a key factor in supporting the NMP SAP implementation work

22. In general, my national culture supported the NMP SAP R3 implementation work

23. The business processes should be reengineered before SAP R3 implementation

24. NMP business processes were described and fixed before NMP SAP R3 implementation

25. The process organization (integration of business functions) was in place before NMP SAP R3 implementation

26. The project had named project champion

27. The project received adequate support from the top management

28. A project sponsor was important for the project

29. Management support was visible for the project

30. The project manager did a good job in managing the project

31. The number of business experts released for the project on full-time basis was adequate

32. The project had a balanced project team

33. A project methodology was used during the project

34. The project had proper deliverable dates, i.e. realistic milestones

35. The focal organization was committed to change

36. Communications towards focal organization was adequate

37. The focal organization was trained adequately to use SAP R3

38. The approach of minimal customization would have been better

39. Implementing fewer modules simultaneously would have been better implementation approach (smaller SAP R3 scope)

40. Comments related to the questions in this section can be shared in the field below. – TEXT

41. The business processes in NMP were similar globally before the SAP R3 implementation began

42. The similarity in the business processes made SAP R3 implementation easier

43. The structuring of business processes under concept areas was a good decision

44. NMP leaders showed with their behavior they were committed to implement SAP R3

45. A business led project instead of technically led project was beneficial to the project success

46. An established project structure - global, regional, local teams - contributed strongly the success of the project

47. The new roles of configuration owner, concept owner, key-user were important to the success of the SAP R3 implementation

48. Self-organizing was frequently used to achieve set goals

49. Self-directed project teams contributed the success of SAP R3 implementation

50. Implementation of all selected SAP R3 modules at once, was a good decision

51. Minimizing, but allowing customization and configuration to support business was a good decision

52. Using experimentation over expertise was a good working approach

53. I had enough understanding of the variation in businesses and business processes

54. The "copy exact" approach (create once, deploy globally) was adequate

55. I worked most closely with my local or regional colleagues during the project

56. The project organizations (structuring and teams) were flexible

57. The project teams spontaneously created new working teams and structures to achieve set goals

58. There were frequent patterns of collective behavior during the project work such as erratic behavior when test or go-live date was approaching

59. Please indicate what kind of patterns of collective behavior you noticed during the project work. When did they appear?

60. If you want to provide further information related to any question in this section, please write it in the field below. – TEXT

61. The transformation into platform organization (NBI) was predictable

Yes

No

I do not know

62. Why was the transformation into NBI predictable/ unpredictable? Explain in the field below - TEXT

63. The transformation leading to NBI platform became visible to you - when?

During the first structuring of the concept areas 1996.

When Global Logistics (GL) and Information Management (IM) begin to work more closely (1997)

When Nokia Process Solutions (NPS) was established (1998).

When Nokia wide IM was established (1999)

When Nokia Delivery Process Solutions (NDPS) was established (1999).

When Nokia Business Infrastructure (NBI) was established (2001).

64. The SAP R3 implementation organization (project teams at local, regional and global level) was established to transfer knowledge between teams globally

65. The SAP R3 implementation organization was a learning organization

66. The whole SAP R3 implementation organization was dynamic

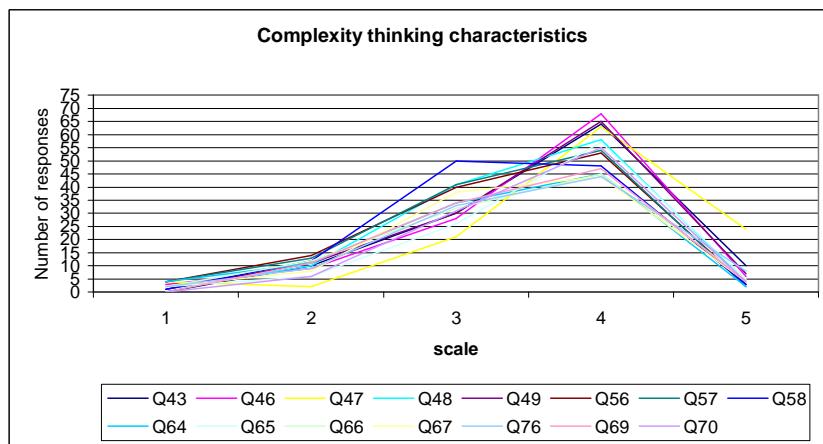
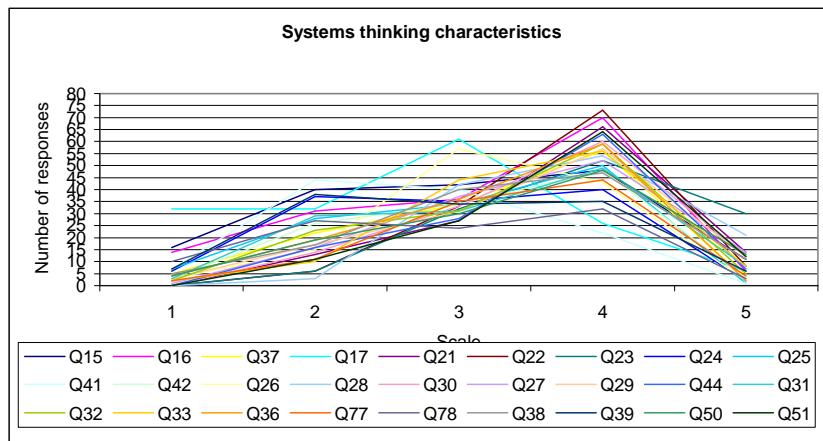
67. The relationships between various SAP R3 implementation teams evolved positively during the implementation work

68. The standardization of the business processes and IT platform decreased the flexibility in line (business) organization

69. The SAP R3 implementation organization structure was established to CONTROL the implementation and decision-making

70. The SAP R3 implementation organization structure was established to COORDINATE the implementation and decision-making
71. The integration of IM and business people into same project organization in SAP R3 implementation increased mutual learning and understanding
72. The SAP R3 implementation organization triggered the organizational transformation (towards NBI)
73. The strategy of organizational transformation from mid-1990s till today was triggered by the technology strategy of choosing SAP R3 (and later i2 and other applications)
74. SAP R3 package demanded changes in the focal organization
75. The Nokia organizations created need for changes (modifications) into SAP R3 system
76. The relationships between concept owners and configuration owners was increasingly interactive
77. When all information was shared, we spontaneously formed sub-teams to do the physical work, and we found better ways to do the work.
78. Information was open and accessible to all.
79. Please describe your opinion of the organization of SAP R3 implementation in NMP: what could have been done differently? What would you do differently in a similar project? – TEXT
80. Please share your thoughts on the organizational transformation related to the birth of NBI in Nokia: frequency, change management, success, need, structuring etc. – TEXT

APPENDIX 10 – SYSTEMS THEORIES AND COMPLEXITY SCIENCES
CHARACTERISTICS



APPENDIX 11 - THE CORRELATION MATRIX

| Correlation Matrix | | C00 | | | | | | | | | | C01 | | | | | | | | | | C02 | | | | | | | | | | C03 | | | | | | | | | | C04 | | | | | | | | | | C05 | | | | | | | | | | C06 | | | | | | | | | | C07 | | | | | | | | | | C08 | | | | | | | | | | C09 | | | | | | | | | | C10 | | | | | | | | | | C11 | | | | | | | | | | C12 | | | | | | | | | | C13 | | | | | | | | | | C14 | | | | | | | | | | C15 | | | | | | | | | | C16 | | | | | | | | | | C17 | | | | | | | | | | C18 | | | | | | | | | | C19 | | | | | | | | | | C20 | | | | | | | | | | C21 | | | | | | | | | | C22 | | | | | | | | | | C23 | | | | | | | | | | C24 | | | | | | | | | | C25 | | | | | | | | | | C26 | | | | | | | | | | C27 | | | | | | | | | | C28 | | | | | | | | | | C29 | | | | | | | | | | C30 | | | | | | | | | | C31 | | | | | | | | | | C32 | | | | | | | | | | C33 | | | | | | | | | | C34 | | | | | | | | | | C35 | | | | | | | | | | C36 | | | | | | | | | | C37 | | | | | | | | | | C38 | | | | | | | | | | C39 | | | | | | | | | | C40 | | | | | | | | | | C41 | | | | | | | | | | C42 | | | | | | | | | | C43 | | | | | | | | | | C44 | | | | | | | | | | C45 | | | | | | | | | | C46 | | | | | | | | | | C47 | | | | | | | | | | C48 | | | | | | | | | | C49 | | | | | | | | | | C50 | | | | | | | | | | C51 | | | | | | | | | | C52 | | | | | | | | | | C53 | | | | | | | | | | C54 | | | | | | | | | | C55 | | | | | | | | | | C56 | | | | | | | | | | C57 | | | | | | | | | | C58 | | | | | | | | | | C59 | | | | | | | | | | C60 | | | | | | | | | | C61 | | | | | | | | | | C62 | | | | | | | | | | C63 | | | | | | | | | | C64 | | | | | | | | | | C65 | | | | | | | | | | C66 | | | | | | | | | | C67 | | | | | | | | | | C68 | | | | | | | | | | C69 | | | | | | | | | | C70 | | | | | | | | | | C71 | | | | | | | | | | C72 | | | | | | | | | | C73 | | | | | | | | | | C74 | | | | | | | | | | C75 | | | | | | | | | | C76 | | | | | | | | | | C77 | | | | | | | | | | C78 | | | | | | | | | | C79 | | | | | | | | | | C80 | | | | | | | | | | C81 | | | | | | | | | | C82 | | | | | | | | | | C83 | | | | | | | | | | C84 | | | | | | | | | | C85 | | | | | | | | | | C86 | | | | | | | | | | C87 | | | | | | | | | | C88 | | | | | | | | | | C89 | | | | | | | | | | C90 | | | | | | | | | | C91 | | | | | | | | | | C92 | | | | | | | | | | C93 | | | | | | | | | | C94 | | | | | | | | | | C95 | | | | | | | | | | C96 | | | | | | | | | | C97 | | | | | | | | | | C98 | | | | | | | | | | C99 | | | | | | | | | | C100 | | | | | | | | | | C101 | | | | | | | | | | C102 | | | | | | | | | | C103 | | | | | | | | | | C104 | | | | | | | | | | C105 | | | | | | | | | | C106 | | | | | | | | | | C107 | | | | | | | | | | C108 | | | | | | | | | | C109 | | | | | | | | | | C110 | | | | | | | | | | C111 | | | | | | | | | | C112 | | | | | | | | | | C113 | | | | | | | | | | C114 | | | | | | | | | | C115 | | | | | | | | | | C116 | | | | | | | | | | C117 | | | | | | | | | | C118 | | | | | | | | | | C119 | | | | | | | | | | C120 | | | | | | | | | | C121 | | | | | | | | | | C122 | | | | | | | | | | C123 | | | | | | | | | | C124 | | | | | | | | | | C125 | | | | | | | | | | C126 | | | | | | | | | | C127 | | | | | | | | | | C128 | | | | | | | | | | C129 | | | | | | | | | | C130 | | | | | | | | | | C131 | | | | | | | | | | C132 | | | | | | | | | | C133 | | | | | | | | | | C134 | | | | | | | | | | C135 | | | | | | | | | | C136 | | | | | | | | | | C137 | | | | | | | | | | C138 | | | | | | | | | | C139 | | | | | | | | | | C140 | | | | | | | | | | C141 | | | | | | | | | | C142 | | | | | | | | | | C143 | | | | | | | | | | C144 | | | | | | | | | | C145 | | | | | | | | | | C146 | | | | | | | | | | C147 | | | | | | | | | | C148 | | | | | | | | | | C149 | | | | | | | | | | C150 | | | | | | | | | | C151 | | | | | | | | | | C152 | | | | | | | | | | C153 | | | | | | | | | | C154 | | | | | | | | | | C155 | | | | | | | | | | C156 | | | | | | | | | | C157 | | | | | | | | | | C158 | | | | | | | | | | C159 | | | | | | | | | | C160 | | | | | | | | | | C161 | | | | | | | | | | C162 | | | | | | | | | | C163 | | | | | | | | | | C164 | | | | | | | | | | C165 | | | | | | | | | | C166 | | | | | | | | | | C167 | | | | | | | | | | C168 | | | | | | | | | | C169 | | | | | | | | | | C170 | | | | | | | | | | C171 | | | | | | | | | | C172 | | | | | | | | | | C173 | | | | | | | | | | C174 | | | | | | | | | | C175 | | | | | | | | | | C176 | | | | | | | | | | C177 | | | | | | | | | | C178 | | | | | | | | | | C179 | | | | | | | | | | C180 | | | | | | | | | | C181 | | | | | | | | | | C182 | | | | | | | | | | C183 | | | | | | | | | | C184 | | | | | | | | | | C185 | | | | | | | | | | C186 | | | | | | | | | | C187 | | | | | | | | | | C188 | | | | | | | | | | C189 | | | | | | | | | | C190 | | | | | | | | | | C191 | | | | | | | | | | C192 | | | | | | | | | | C193 | | | | | | | | | | C194 | | | | | | | | | | C195 | | | | | | | | | | C196 | | | | | | | | | | C197 | | | | | | | | | | C198 | | | | | | | | | | C199 | | | | | | | | | | C200 | | | | | | | | | | C201 | | | | | | | | | | C202 | | | | | | | | | | C203 | | | | | | | | | | C204 | | | | | | | | | | C205 | | | | | | | | | | C206 | | | | | | | | | | C207 | | | | | | | | | | C208 | | | | | | | | | | C209 | | | | | | | | | | C210 | | | | | | | | | | C211 | | | | | | | | | | C212 | | | | | | | | | | C213 | | | | | | | | | | C214 | | | | | | | | | | C215 | | | | | | | | | | C216 | | | | | | | | | | C217 | | | | | | | | | | C218 | | | | | | | | | | C219 | | | | | | | | | | C220 | | | | | | | | | | C221 | | | | | | | | | | C222 | | | | | | | | | | C223 | | | | | | | | | | C224 | | | | | | | | | | C225 | | | | | | | | | | C226 | | | | | | | | | | C227 | | | | | | | | | | C228 | | | | | | | | | | C229 | | | | | | | | | | C230 | | | | | | | | | | C231 | | | | | | | | | | C232 | | | | | | | | | | C233 | | | | | | | | | | C234 | | | | | | | | | | C235 | | | | | | | | | | C236 | | | | | | | | | | C237 | | | | | | | | | | C238 | | | | | | | | | | C239 | | | | | | | | | | C240 | | | | | | | | | | C241 | | | | | | | | | | C242 | | | | | | | | | | C243 | | | | | | | | | | C244 | | | | | | | | | | C245 | | | | | | | | | | C246 | | | | | | | | | | C247 | | | | | | | | | | C248 | | | | | | | | | | C249 | | | | | | | | | | C250 | | | | | | | | | | C251 | | | | | | | | | | C252 | | | | | | | | | | C253 | | | | | | | | | | C254 | | | | | | | | | | C255 | | | | | | | | | | C256 | | | | | | | | | | C257 | | | | | | | | | | C258 | | | | | | | | | | C259 | | | | | | | | | | C260 | | | | | | | | | | C261 | | | | | | | | | | C262 | | | | | | | | | | C263 | | | | | | | | | | C264 | | | | | | | | | | C265 | | | | | | | | | | C266 | | | | | | | | | | C267 | | | | | | | | | | C268 | | | | | | | | | | C269 | | | | | | | | | | C270 | | | | | | | | | | C271 | | | | | | | | | | C272 | | | | | | | | | | C273 | | | | | | | | | | C274 | | | | | | | | | | C275 | | | | | | | | | | C276 | | | | | | | | | | C277 | | | | | | | | | | C278 | | | | | | | | | | C279 | | | | | | | | | | C280 | | | | | | | | | | C281 | | | | | | | | | | C282 | | | | | | | | | | C283 | | | | | | | | | | C284 | | | | | | | | | | C285 | | | | | | | | | | C286 | | | | | | | | | | C287 | | | | | | | | | | C288 | | | | | | | | | | C289 | | | | | | | | | | C290 | | | | | | | | | | C291 | | | | | | | | | | C292 | | | | | | | | | | C293 | | | | | | | | | | C294 | | | | | | | | | | C295 | | | | | | | | | | C296 | | | | | | | | | | C297 | | | | | | | | | | C298 | | | | | | | | | | C299 | | | | | | | | | | C300 | | | | | | | | | | C301 | | | | | | | | | | C302 | | | | | | | | | | C303 | | | | | | | | | | C304 | | | | | | | | | | C305 | | | | | | | | | | C306 | | | | | | | | | | C307 | | | | | | | | | | C308 | | | | | | | | | | C309 | | | | | | | | | | C310 | | | | | | | | | | C311 | | | | | | | | | | C312 | | | | | | | | | | C313 | | | | | | | | | | C314 | | | | | | | | | | C315 | | | | | | | | | | C316 | | | | | | | | | | C317 | | | | | | | | | | C318 | | | | | | | | | | C319 | | | | | | | | | | C320 | | | | | | | | | | C321 | | | | | | | | | | C322 | | | | | | | | | | C323 | | | | | | | | | | C324 | | | | | | | | | | C325 | | | | | | | | | | C326 | | | | | | | | | | C327 | | | | | | | | | | C328 | | | | | | | | | | C329 | | | | | | | | | | C330 | | | | | | | | | | C331 | | | | | | | | | | C332 | | | | | | | | | | C333 | | | | | | | | | | C334 | | | | | | | | | | C335 | | | | | | | | | | C336 | | | | | | | | | | C337 | | | | | | | | | | C338 | | | | | | | | | | C339 | | | | | | | | | | C340 | | | | | | | | | | C341 | | | | | | | | | | C342 | | | | | | | | | | C343 | | | | | | | | | | C344 | | | | | | | | | | C345 | | | | | | | | | | C346 | | | | | | | | | | C347 | | | | | | | | | | C348 | | | | | | | | | | C349 | | | | | | | | | | C350 | | | | | | | | | | C351 | | | | | | | | | | C352 | | | | | | | | | | C353 | | | | | | | | | | C354 | | | | | | | | | | C355 | | | | | | | | | | C356 | | | | | | | | | | C357 | | | | | | | | | | C358 | | | | | | | | | | C359 | | | | | | | | | | C360 | | | | | | | | | | C361 | | | | | | | | | | C362 | | | | | | | | | | C363 | | | | | | | | | | C364 | | | | | | | | | | C365 | | | | | | | | | | C366 | | | | | | | | | | C367 | | | | | | | | | | C368 | | | | | | | | | | C369 | | | | | | | | | | C370 | | | | | | | | | | C371 | | | | | | | | | | C372 | | | | | | | | | | C373 | | | | | | | | | | C374 | | | | | | | | | | C375 | | | | | | | | | | C376 | | | | | | | | | | C377 | | | | | | | | | | C378 | | | | | | | | | | C379 | | | | | | | | | | C380 | | | | | | | | | | C381 | | | | | | | | | | C382 | | | | | | | | | | C383 | | | | | | | | | | C384 | | | | | | | | | | C385 | | | | | | | | | | C386 | | | | | | | | | | C387 | | | | | | | | | | C388 | | | | | | | | | | C389 | | | | | | | | | | C390 | | | | | | | | | | C391 | | | | | | | | | | C392 | | | | | | | | | | C393 | | | | | | | | | | C394 | | | | | | | | | | C395 | | | | | | | | | | C396 | | | | | | | | | | C397 | | | | | | | | | | C398 | | | | | | | | | | C399 | | | | | | | | | | C400 | | | | | | | | | | C401 | | | | | | | | | | C402 | | | | | | | | | | C403 | | | | | | | | | | C404 | | | | | | | | | | C405 | | | | | | | | | | C406 | | | | | | | | | | C407 | | | | | | | | | | C408 | | | | | | | | | | C409 | | | | | | | | | | C410 | | | | | | | | | | C411 | | | | | | | | | | C412 | | | | | | | | | | C413 | | | | | | | | | | C414 | | | | | | | | | | C415 | | | | | | | | | | C416 | | | | | | | | | | C417 | | | | | | | | | | C418 | | | | | | | | | | C419 | | | | | | | | | | C420 | | | | | | | | | | C421 | | | | | | | | | | C422 | | | | | | | | | | C423 | | | | | | | | | | C424 | | | | | | | | | | C425 | | | | | | | | | | C426 | | | | | | | | | | C427 | | | | | | | | | | C428 | | | | | | | | | | C429 | | | | | | | | | | C430 | | | | | | | | | | C431 | | | | | | | | | | C432 | | | | | | | | | | C433 | | | | | | | | | | C434 | | | | | | | | | | C435 | | | | | | | | | | C436 | | | | | | | | | | C437 | | | | | | | | | | C438 | | | | | | | | | | C439 | | | | | | | | | | C440 | | | | | | | | | | C441 | | | | | | | | | | C442 | | | | | | | | | | C443 | | | | | | | | | | C444 | | | | | | | | | | C445 | | | | | | | | | | C446 | | | | | | | | | | C447 | | | | | | | | | | C448 | | | | | | | | | | C449 | | | | | | | | | | C450 | | | | | | | | | | C451 | | | | | | | | | | C452 | | | | | | | | | | C453 | | | | | | | | | | C454 | | | | | | | | | | C455 | | | | | | | | | | C456 | | | | | | | | | | C457 | | | | | | | | | | C458 | | | | | | | | | | C459 | | | | | | | | | | C460 | | | | | | | | | | C461 | | | | | | | | | | C462 | | | | | | | | | | C463 | | | | | | | | | | C464 | | | | | | | | | | C465 | | | | | | | | | | C466 | | | | | | | | | | C467 | | | | | | | | | | C468 | | | | | | | | | | C469 | | | | | | | | | | C470 | | | | | | | | | | C471 | | | | | | | | | | C472 | | | | | | | | | | C473 | | | | | | | | | | C474 | | | | | | | | | | C475 | | | | | | | | | | C476 | | | | | | | | | | C477 | | | | | | | | | | C478 | | | | | | | | | | C479 | | | | | | | | | | C480 | | | | | | | | | | C481 | | | | | | | | | | C482 | | | | | | | | | | C483 | | | | | | | | | | C484 | | | | | | | | | | C485 | | | | | | | | | | C486 | | | | | | | | | | C487 | | | | | | | | | | C488 | | | | | | | | | | C489 | | | | | | | | | | C490 | | | | | | | | | | C491 | | | | | | | | | | C492 | | | | | | | | | | C493 | | | | | | | | | | C494 | | | | | | | | | | C495 | | | | | | | | | | C496 | | | | | | | | | | C497 | | | | | | | | | | C498 | | | | | | | | | | C499 | | | | | | | | | | C500 | | | | | | | | | | C501 | | | | | | | | | | C502 | | | | | | | | | | C503 | | | | | | | | | | C504 | | | | | | | | | | C505 | | | | | | | | | | C506 | | | | | | | | | | C507 | | | | | | | | | | C508 | | | | | | | | | | C509 | | | | | | | | | | C510 | | | | | | | | | | C511 | | | | | | | | | | C512 | | | | | | | | | | C513 | | | | | | | | | | C514 | | | | | | | | | | C515 | | | | | | | | | | C516 | | | | | | | | | | C517 | | | | | | | | | | C518 | | | | | | | | | | C519 | | | | | | | | | | C520 | | | | | | | | | | C521 | | | | | | | | | | C522 | | | | | | | | | | C523 | | | | | | | | | | C524 | | | | | | | | | | C525 | | | | | | | | | | C526 | | | | | | | | | | C527 | | | | | | | | | | C528 | | | | | | | | | | C529 | | | | | | | | | | C530 | | | | | | | | | | C531 | | | | | | | | | | C532 | | | | | | | | | | C533 | | | | | | | | | | C534 | | | | | | | | | | C535 | | | | | | | | | | C536 | | | | | | | | | | C537 | | | | | | | | | | C538 | | | | | | | | | | C539 | | | | | | | | | | C540 | | | | | | | | | | C541 | | | | | | | | | | C542 | | | | | | | | | | C543 | | | | | | | | | | C544 | | | | | | | | | | C545 | | | | | | | | | | C546 | | | | | | | | | | C547 | | | | | | | | | | C548 | | | | | | | | | | C549 | | | | | | | | | | C550 | | | | | | | | | | C551 | | | | | | | | | | C552 | | | | | | | | | | C553 | | | | | | | | | | C554 | | | | | | | | | | C555 | | | | | | | | | | C556 | | | | | | | | | | C557 | | | | | | | | | | C558 | | | | | | | | | | C559 | | | | | | | | | | C560 | | | | | | | | | | C561 | | | | | | | | | | C562 | | | | | | | | | | C563 | | | | | | | | | | C564 | | | | | | | | | | C565 | | | | | | | | | | C566 | | | | | | | | | | C567 | | | | | | | | | | C568 | | | | | | | | | | C569 | | | | | | | | | | C570 | | | | | | | | | | C571 | | | | | | | | | | C572 | | | | | | | | | | C573 | | | | | | | | | | C574 | | | | | | | | | | C575 | | | | | | | | | | C576 | | | | | | | | | | C577 | | | | | | | | | | C578 | | | | | | | | | | C579 | | | | | | | | | | C580 | | | | | | | | | | C581 | | | | | | | | | | C582 | | | | | | | | | | C583 | | | | | | | | | | C584 | | | | | | | | | | C585 | | | | | | | | | | C586 | | | | | | | | | | C587 | | | | | | | | | | C588 | | | | | | | | | | C589 | | | | | | | | | | C590 | | | | | | | | | | C591 | | | | | | | | | | C592 | | | | | | | | | | C593 | | | | | | | | | | C594 | | | | | | | | | | C595 | | | | | | | | | | C596 | | | | | | | | | | C597 | | | | | | | | | | C598 | | | | | | | | | | C599 | | | | | | | | | | C600 | | | | | | | | | | C601 | | | | | | | | | | C602 | | | | | | | | | | C603 | | | | | | | | | | C604 | | | | | | | | | | C605 | | | | | | | | | | C606 | | | | | | | | | | C607 | | | | | | | | | | C608 | | | | | | | | | | C609 | | | | | | | | | | C610 | | | | | | | | | | C611 | | | | | | | | | | C612 | | | | | | | | | | C613 | | | | | | | | | | C614 | | | | | | | | | | C615 | | | | | | | | | | C616 | | | | | | | | | | C617 | | | | | | | | | | C618 | | | | | | | | | | C619 | | | | | | | | | | C620 | | | | | | | | | | C621 | | | | | | | | | | C622 | | | | | | | | | | C623 | | | | | | | | | | C624 | | | | | | | | | | C625 | | | | | | | | | | C626 | | | | | | | | | | C627 | | | | | | | | | | C628 | | | | | | | | | | C629 | | | | | | | | | | C630 | | | | | | | | | | C631 | | | | | | | | | | C632 | | | | | | | | | | C633 | | | | | | | | | | C634 | | | | | | | | | | C635 | | | | | | | | | | C636 | | | | | | | | | | C637 | | | | | | | | | | C638 | | | | | | | | | | C639 | | | | | | | | | | C640 | | | | | | | | | | C641 | | | | | | | | | | C642 | | | | | | | | | | C643 | | | | | | | | | | C644 | | | | | | | | | | C645 | | | | | | | | | | C646 | | | | | | | | | | C647 | | | | | | | | | | C648 | | | | | | | | | | C649 | | | | | | | | | | C650 | | | | | | | | | | C651 | | | | | | | | | | C652 | | | | | | | | | | C653 | | | | | | | | | | C654 | | | | | | | | | | C655 | | | | | | | | | | C656 | | | | | | | | | | C657 | | | | | | | | | | C658 | | | | | | | | | | C659 | | | | | | | | | | C660 | | | | | | | | | | C661 | | | | | | | | | | C662 | | | | | | | | | | C663 | | | | | | | | | | C664 | | | | | | | | | | C665 | | | | | | | | | | C666 | | | | | | | | | | C667 | | | | | | | | | | C668 | | | | | | | | | | C669 | | | | | | | | | | C670 | | | | | | | | | | C671 | | | | | | | | | | C672 | | | | | | | | | | C673 | | | | | | | | | | C674 | | | | | | | | | | C675 | | | | | | | | | | C676 | | | | | | | | | | C677 | | | | | | | | | | C678 | | | | | | | | | | C679 | | | | | | | | | | C680 | | | | | | | | | | C681 | | | | | | | | | | C682 | | | | | | | | | | C683 | | | | | | | | | | C684 | | | | | | | | | | C685 | | | | | | | | | | C686 | | | | | | | | | | C687 | | | | | | | | | | C688 | | | | | | | | | | C689 | | | | | | | | | | C690 | | | | | | | | | | C691 | | | | | | | | | | C692 | | | | | | | | | | C693 | | | | | | | | | | C694 | | | | | | | | | | C695 | | | | | | | | | | C696 | | | | | | | | | | C697 | | | | | | | | | | C698 | | | | | | | | | | C699 | | | | | | | | | | C700 | | | | | | | | | | C701 | | | | | | | | | | C702 | | | | | | | | | | C703 | | | | | | | | | | C704 | | | | | | | | | | C705 | | | | | | | | | | C706 | | | | | | | | | | C707 | | | | | | | | | | C708 | | | | | | | | | | C709 | | | | | | | | | | C710 | | | | | | | | | | C711 | | | | | | | | | | C712 | | | | | | | | | | C713 | | | | | | | | | | C714 | | | | | | | | | | C715 | | | | | | | | | | C716 | | | | | | | | | | C717 | | | | | | | | | | C718 | | | | | | | | | | C719 | | | | | | | | | | C720 | | | | | | | | | | C721 | | | | | | | | | | C722 | | | | | | | | | | C723 | | | | | | | | | | C724 | | | | | | | | | | C725 | | | | | | | | | | C726 | | | | | | | | | | C727 | | | | | | | | | | C728 | | | | | | | | | | C729 | | | | | | | | | | C730 | | | | | | | | | | C731 | | | | | | | | | | C732 | | | | | | | | | | C733 | | | | | | | | | | C734 | | | | | | | | | | C735 | | | | | | | | | | C736 | | | | | | | | | | C737 | | | | | | | | | | C738 | | | | | | | | | | C739 | | | | | | | | | | C740 | | | | | | | | | | C741 | | | | | | | | | | C742 | | | | | | | | | | C743 | | | | | | | | | | C744 | | | | | | | | | | C745 | | | | | | | | | | C746 | | | | | | | | | | C747 | | | | | | | | | | C748 | | | | | | | | | | C749 | | | | | | | | | | C750 | | | | | | | | | | C751 | | | | | | | | | | C752 | | | | | | | | | | C753 | | | | | | | | | | C754 | | | | | | | | | | C755 | | | | | | | | | | C756 | | | | | | | | | | C757 | | | | | | | | | | C758 | | | | | | | | | | C759 | | | | | | | | | | C760 | | | | | | | | | | C761 | | | | | | | | | | C762 | | | | | | | | | | C763 | | | | | | | | | | C764 | | | | | | | | | | C765 | | | | | | | | | | C766 | | | | | | | | | | C767 | | | | | | | | | | C768 | | | | | | | | | | C769 | | | | | | | | | | C770 | | | | | | | | | | C771 | | | | | | | | | | C772 | | | | | | | | | | C773 | | | | | | | | | | C774 | | | | | | | | | | C775 | | | | | | | | | | C776 | | | | | | | | | | C777 | | | | | | | | | | C778 | | | | | | | | | | C779 | | | | | | | | | | C780 | | | | | | | | | | C781 | | | | | | | | | | C782 | | | | | | | | | | C783 | | | | | | | | | | C784 | | | | | | | | | | C785 | | | | | | | | | | C786 | | | | | | | | | | C787 | | | | | | | | | | C788 | | | | | | | | | | C789 | | | | | | | | | | C790 | | | | | | | | | | C791 | | | | | | | | | | C792 | | | | | | | | | | C793 | | | | | | | | | | C794 | | | | | | | | | | C795 | | | | | | | | | | C796 | | | | | | | | | | C797 | | | | | | | | | | C798 | | | | | | | | | | C799 | | | | | | | | | | C800 | | | | | | | | | | C801 | | | | | | | | | | C802 | | | | | | | | | | C803 | | | | | | | | | | C804 | | | | | | | | | | C805 | | | | | | | | | | C806 | | | | | | | | | | C807 | | | | | | | | | | C808 | | | | | | | | | | C809 | | | | | | | | | | C810 | | | | | | | | | | C811 | | | | | | | | | | C812 | | | | | | | | | | C813 | | | | | | | | | | C814 | | | | | | | | | | C815 | | | | | | | | | | C816 | | | | | | | | | | C817 | | | | | | | | | | C818 | | | | | | | | | | C819 | | | | | | | | | | C820 | | | | | | | | | | C821 | | | | | | | | | | C822 | | | | | | | | | | C823 | | | | | | | | | | C824 | | | | | | | | | | C825 | | | | | | | | | | C826 | | | | | | | | | | C827 | | | | | | | | | | C828 | | | | | | | | | | C829 | | | | | | | | | | C830 | | | | | | | | | | C831 | | | | | | | | | | C832 | | | | | | | | | | C833 | | | | | | | | | | C834 | | | | | | | | | | C835 | | | | | | | | | | C836 | | | | | | | | | | C837 | | | | | | | | | | C838 | | | | | | | | | | C839 | | | | | | | | | | C840 | | | | | | | | | | C841 | | | | | | | | | | C842 | | | | | | | | | | C843 | | | | | | | | | | C844 | | | | | | | | | | C845 | | | | | | | | | | C846 | | | | | | | | | | C847 | | | | | | | | | | C848 | | | | | | | | | | C849 | | | | | | | | | | C850 | | | | | | | | | | C851 | | | | | | | | | | C852 | | | | | | | | | | C853 | | | | | | | | | | C854 | | | | | | | | | | C855 | | | | | | | | | | C856 | | | | | | | | | | C857 | | | | | | | | | | C858 | | | | | | | | | | C859 | | | | | | | | | | C860 | | | | | | | | | | C861 | | | | | | | | | | C862 | | | | | | | | | | C863 | | | | | | | | | | C864 | | | | | | | | | | C865 | | | | | | | | | | C866 | | | | | | | | | | C867 | | | | | | | | | | C868 | | | | | | | | | | C869 | | | | | | | | | | C870 | | | | | | | | | | C871 | | | | | | | | | | C872 | | | | | | | | | | C873 | | | | | | | | | | C874 | | | | | | | | | | C875 | | | | | | | | | | C876 | | | | | | | | | | C877 | | | | | | | | | | C878 | | | | | | | | | | C879 | | | | | | | | | | C880 | | | | | | | | | | C881 | | | | | | | | | | C882 | | | | | | | | | | C883 | | | | | | | | | | C884 | | | | | | | | | | C885 | | | | | | | | | | C886 | | | | | | | | | | C887 | | | | | | | | | | C888 | | | | | | | | | | C889 | | | | | | | | | | C890 | | | | | | | | | | C891 | | | | | | | | | | C892 | | | | | | | | | | C893 | | | | | | | | | | C894 | | | | | | | | | | C895 | | | | | | | | | | C896 | | | | | | | | | | C897 | | | | | | | | | | C898 | | | | | | | | | | C899 | | | | | | | | | | C900 | | | | | | | | | | C901 | | | | | | | | | | C902 | | | | | | | | | | C903 | | | | | | | | | | C904 | | | | | | | | | | C905 | | | | | | | | | | C906 | | | | | | | | | | C907 | | | | | | | | | | C908 | | | | | | | | | | C909 | | | | | | | | | | C910 | | | | | | | | | | C911 | | | | | | | | | | C912 | | | | | | | | | | C913 | | | | | | | | | | C914 | | | | | | | | | | C915 | | | | | | | | | | C916 | | | | | | | | | | C917 | | | | | | | | | | C918 | | | | | | | | | | C919 | | | | | | | | | | C920 | | | | | | | | | | C921 | | | | | | | | | | C922 | | | | | | | | | | 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