Jaakko Riihimaa

Taxonomy of information and communication technology system innovations adopted by small and medium sized enterprises

ACADEMIC DISSERTATION

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Abstract

Today organizations must change their way of operating by networking with other enterprises and open their typically encapsulated information systems to external partners - the transparency of the information systems must be increased to achieve sustainable competitive advantage. That is true for almost all kinds of organizations but especially for production enterprises, which in practice organize their work in forms of supply chains and supply networks.

The change from individual entities to enterprise networks sets new requirements also for information systems, and there is a lack of tools for analyzing various types of ICT system innovations reflecting the new reality. It is by the means of organizational innovation that any enterprise can and should respond to a fundamental change in its environment.

The main result of the study is a taxonomy; a classification principle of information and communication technology system (ICTS) innovations adopted by small and medium sized production enterprises.

Organizations are typically examined as independent units with certain internal functions or processes. To achieve sustainable competitive advantage organizations have various kinds of internal and external ICTSs. Also a traditional way of illustrating external issues of competitive advantage-creating, and thus illustrating information system innovations, is the Porterian value chain. It is based on a process view of an organization. An organization is seen as a system which is made up of subsystems. Each of them is included in a chain with inputs, transformation processes and outputs which involve the acquisition and consumption of resources. This kind of organizational model produces system categories with "one-way" external communication interface. For example, in this way of thinking production process systems are situated independently in the middle of the production chain, within the individual enterprise. However, if the enterprise operates within a real enterprise network, it means reciprocal, cooperative communication between the parties, and thus communication between the systems. Not only various acquisition or sales and marketing systems have reciprocal external interfaces, but also production process activities and even the products of the enterprise may form their own networked information system categories. The results of this study also point out some other remarkable ICTS innovation roles, systems not directly creating competitive advantage.

According to a typical categorization of research purposes this study is characterized as phenomenological, applying intensive case methods. The first of the data sets consists of 17 cases, which were collected totally from South Ostrobothnia within a regional development project. Another set of data were collected nationwide from 40 metal and electrotechnical enterprises in cooperation with the Federation of Finnish Metal, Engineering and Electrotechnical Industries (MET).

Keywords: Organizational innovation, information and communication technology systems, taxonomy, system categories, interpretive IS reserach, case-study, small and medium sized enterprises

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It was fifteen years ago today, when Professor Pertti Järvinen for the first time carried out his new idea of a doctoral seminar in Tampere, in which also I was involved. Since then there have been some more or less serious attempts to work up a doctoral thesis whenever the high priority of domesticity and daily work has made it possible. About five years ago I got an opportunity to cooperate with a local development project, which work formed the basis for this study. In the summer of 2000 Professor Mikko Ruohonen offered me the opportunity of planning and putting into practice with him a special research frame concerning e-business innovations. These issues supplemented my early work, and the opportunity has therefore come to give credit to those who have supported and encouraged me in different ways.

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Seinäjoki, May 2004

Jaakko Riihimaa

"Therefore we ought to attend to the undemonstrated sayings and opinions of experienced and older people or of people of practical wisdom not less than to demonstrations; for because experience has given them an eye they see aright"

Aristotle 350 BC

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1. Introduction

1.1 Description of the topic and its importance

In this dissertation I address the issue of adopting information system innovations in order to contribute towards a new theory on the issue. The term theory should here be understood as a taxonomy. It describes a classification principle of information and communication technology (ICT) system[1] innovations adopted by small and medium sized production enterprises[2] (SMEs) operating in the production industries. Today organizations must change their way of operating by networking with other enterprises and open their typically encapsulated information systems to external partners - the transparency of the information systems must be increased. That is true for almost all kinds of organizations but especially for production enterprises, which in practice organize their work in forms of supply chains and supply networks. It is by the means of organizational innovation that any enterprise can and should respond to a fundamental change in its environment (Swanson 1994).

Enterprises are changing the way they operate due to reductions in the cost of acquiring, processing and transmitting information (e.g. Malone, Yates, and Benjamin 1987, Porter and Millar 1985, Rockart and Scott Morton 1993). That makes radical changes possible in management practices, which in turn affect market structures and firm configurations. All that new division of labor (e.g. Engeström 2003) currently leads to inter-organizational information systems, such as electronic data interchange networks, shared databases and other forms of networking which connect firms. Another view guiding to networking is the concept of "Information society", which is widely discussed in various forms (e.g. Bell 1973, Masuda 1980, Drucker 1993, Castells 1996, 1997,1998). One of the most comprehensive synthesis is presented by Manuel Castells, whose trilogy gives a macrotheoretical perspective on the phenomenon, and it will be referred to also in this study. The change from individual entities to enterprise networks sets new requirements also for information systems, and there is a lack of tools for analyzing various types of ICT system innovations reflecting the new reality.

Concurrently there is also a debate over ICT's value, and questions like "Have investments in computers improved business performance?" or "Have investments in computers increased productivity?" are asked (e.g. Brynjolfsson and Hitt (1993), Brynjolfsson (1993), Hitt and Brynjolfsson (1994), Melville et al. 2004). These kind of questions are extremely important especially to SMEs which have small resources and are constrained to consider their ICT investments very carefully.

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1 In this dissertation I shall most often use the terms IT (information technology), ICT (information and communication technology), ICTS (information and communication technology system), IS (information system), ISS (information subsystem) in a quite equal meaning.

2 In the course of times there have been various definitions of small and medium sized enterprises, and the concept is quite unestablished. E.g. in the US manufacturing branch it may include enterprises under 500 employees and in Japan under 300 employees, while in the EU the SMEs are enterprises employing less than 250 persons. In Russia they have their own definitions for small enterprises. The EU criterion in its main attributes is applied in this study, the main criterion being the maximum number of employees.

SMEs play the most important role in a modern economy's competitive position and job creation (Dutta and Evrard 1999, Castells 1996, p. 155 ref. Weiss (1988), Sengerberger et al. (1990) and Glegg (1990)). On the one hand they form a dynamic and flexible element of economy (Crawford and Ibrahim 1985, Julian and Lafrance 1983, Plawgo and Chapman 1999) but on the other they may be a slightly resourced, heterogeneous community which is confronted by many limitations (Noori 1987, Van Kirk and Noonan 1982, Thong and Yap 1997). In any case in their societal role the SMEs are a remarkable group to adopt information and communication technology while they are aiming at answering the growing demands of efficiency and competitiveness and having sustainable competitive advantage (term by e.g. Day 1984, Porter 1985, Barney 1991).

1.2 Description of the problem domain and its importance

In a competitive market with free entry enterprises cannot earn maximized profits because that would encourage other firms to enter and drive down the prices. Therefore, a resource input such as ICT, which may be very productive, will not confer maximized profits to any firm in an industry if it is freely available to all participants in that industry. In balanced condition, all firms will use such an input, but none will gain a competitive advantage from it (Hitt and Brynjolfsson 1994).

However, organizations should increase their cooperation with other enterprises - operate as a part of a network - and they should adopt the possibilities of new information and communication technology. That is inevitable for keeping and increasing their competitiveness in the rapidly changing competition situation and globalization (e.g. Malone, Yates and Benjamin 1987, Rockart and Scott Morton 1993, Stabell and Fjeldstad 1998, Varamäki 2001). Financial aspects and profitability form the normal base of any entrepreneurship, but in this context these issues have even more emphasis.

This means that an innovation aspect is essential if competitive advantage is to be achieved by utilizing ICT systems. For reasons mentioned above, adopting an ICTS innovation is not just a passive action of implementing a standard template of a new idea. ICT is generic technology and it offers frameworks to the adopter. Innovations may also not appear just individually but as closely interrelated, yet distinguishable elements of technology. In the minds of its adopters an innovation may be perceived as closely related to another new idea (e.g. Rogers 1995, p. 235). The knowledge how to apply it must be generated case-specifically by the adopter. For example, Hargadon and Sutton (1997) said a firm's capability is not its resources as such but the way it is using them.

A classification principle of ICT system innovations brings new concrete views of the multifaceted and complicated reality of identifying the different roles of ITC systems and creates a base for discussions within and between ICT professionals and ICT-adopting organizations. Just as one of the respondents in this study (the CEO of a small, high-skilled metal firm) commented on both the experiences he has had of ICT professionals and the

current lack of proper, competitive advantage- creating software:

> "*It is just fruitless even to begin a discussion if you yourself are not an ICT professional, better to try to find specialists [to speak on your behalf]. We just speak different languages."*
> and
> "*...cutting an iron bar cost [to us] 0,15 euros, but the [administrational] groundwork and input routines with the software [for cutting] may cost four times that*."

The most important role of the SMEs in the society and in the working life, and thus also as ICT adopting organizations, is linked to job creation. The great number of SMEs in different economies makes them important with their big share in total employment (Dutta and Evrad 1999). In Europe the SME's share of all enterprises is 98% and a majority of the employees (60%) in the EU work in the SMEs (EU_stat 2003). The averages apply for Finland, as over 60 % of the Finnish employees work in the SMEs and over 97% of the enterprises are SMEs (FIN_stat 2003).

In discussions, the very important role of the "traditional" production industry is also often forgotten or their present ICT condition is described only by using various simple indicators such as the density of Internet connections or the number of e-mail users (see e.g. Karttunen et al. 2000, Charlton et al. 1997). These are naturally important quantities for evaluating the respective state of the art, but they give only a narrow and inadequate picture of the reality. More many-sided knowledge is needed for understanding the reality of the important SME sector.

The researchers of Computer and Information Sciences should work out the needs for which ICT systems are adopted by the very remarkable user group, and why ICT is utilized to aim sustainable competitive advantage. It is important to describe a classification principle of ICT system innovations. The categories of the classification can be tested in the IS research fields in the future.

Little research has been conducted on the topic of this study in the software development field. SMEs will need new kind of software which supports inter-organizational operations. To software professionals this dissertation open views on both research and practical development needs that have not previously been noticed adequately, such as e.g. unlearning systems or using systems for opportunistic aims.

1.3 Short presentation of the results and findings achieved so far

The IS research field has an increased interest to innovation theories since there seems to be similarities in the processes of IS implementation and innovation diffusion. The view in innovation literature in the field of IS research is voluminous and fragmented, with a wide

variety of viewpoints and focuses. Rogers' (1995) model is the most widely accepted in identifying characteristics for innovations in IS research in general, and particularly in research concerning SMEs (e.g. Al-Qirim 2003, Iacovou et al. 1995, Karahanna et al. 1999, McGowan and Madey 1998, Moore and Benbasat 1991, Moore and Benbasat 1996, Premkumar and Roberts 1999, Thong 1999).

However, some criticism e.g. against the limited scope of the IS innovation research has been expressed and more holistic adoption models have been demanded (e.g. Lyytinen and Rose 2003a, Lyytinen and Rose 2003b, Attewell 1992, Moore and Benbasat 1991, Moore and Benbasat 1996, Prescott and Conger 1995, Swanson 1994). When focusing on the IS innovation literature of networked, inter-organizational production enterprise systems in particular, previous research seems to be even more limited in number, and some parts of it are out of date due to rapidly changing situations.

One of the recognizable research literature lines has identified various emphasized characteristics of IS adoption as an organizational innovation (e.g. Kwon and Zmud 1987, Tornatzky and Fleischer 1990, Damanpour 1991, Grover 1993, Swanson 1994, Thong 1999). However, the existing theories reflect the reality at the enterprises inaccurately. The information systems are mostly researched as entities of a single organization, and typically from the viewpoint of a large organization.

Innovations themselves may also be classified (e.g. Zaltman et al. 1973, Daft 1978, Zmud 1982, Robey 1986, Swanson 1994, Damanpour and Gopalakrishnan 1998, Lyytinen 2001, Lyytinen and Rose 2003a, Lyytinen and Rose 2003b). Lyytinen (2001) demands better taxonomies for the definition of ICT innovations, more exact characterization of innovation types and modalities, better theoretical constructs for identifying and distinguishing between different innovations and better alignment with organizational theory.

One of the most fundamental and most referred works categorizing IS innovations this far is presented by Swanson (1994). His context is organizational innovations, focusing on information systems. The basis of the Swanson's model is the dual-core model of Daft (1978) for explaining the differing characteristics of administrative and technical innovations.

Swanson (1994) claims there is a lack of theoretical models, as follows: "While organizational innovation theory has been selectively applied in IS contexts, it has not been significantly elaborated upon or extended. No theory of IS innovation in its particulars is distinguishable from organizational innovation in general. There exists no useful typology of IS innovations, which in consequence are differentiated neither among each other, nor from other, non-IS innovations. Nor is IS innovation typically viewed in the larger organizational context in which innovation takes place. For these reasons, surprisingly little about the contribution of IS innovation to the business ostensibly supported can be said. This fails to serve not only IS theory, but organization theory in the long run."

In his model Swanson presented three types of IS innovations: innovations confined to the IS task (administration and technical), innovations supporting the administration of the business and innovations imbedded in the core technology of the business (process, product

and integration). Currently Swanson's typology is a bit outdated. It reflects the reality of large enterprises with their own IS units, and it has to be noted that the model was created before the powerful penetration of the Internet and decentralized computing ("…today's centralized mainframe-based IS unit…").

However, the latest studies aiming at extending the work of Swanson on IS innovations emphasize technology (e.g. Grover 1997, Grover et al. 1997, Lyytinen and Rose 2003a, Lyytinen and Rose 2003b) and have not tackled the most essential weakness of Swanson's model, the restrictions in the ways of demonstrating inter-organizational, networking innovations between organizations. In Swanson's original model the interfaces between organizations, and thus important reciprocal communication channels, are left with minor attention.

The above mentioned networking viewpoint in particular demands improving the current IS innovation categorizations. The whole innovation research field is extremely wide, but especially within IS innovation discussion new frameworks are needed. The nature of the ICT is different from the nature of many other technologies, which makes the phenomenon complicated to study, and new classification principles will help to position the future research.

Within the field of networking research the topic of the study is also important, because it emphasizes resources essential to information systems and the role of resources in networking development. Networking is cooperation between both individuals and organizations, and ICTSs lay not only the technical platform for the cooperation, but also financial, social and informative terms for the competitive advantage creation.

1.4 Presentation of the approach of this study

A noteworthy source for ideas and knowledge to this dissertation is my personal background. Working with regional ICT development and research issues, acting as a managing director for a small network firm, being a member of board in two small firms and living for years in a very SME rich area in Finland, South Ostrobothnia, have given me an good opportunity to learn and understand the SMEs' lifelines and also the personal motivation for this study. That background also gives experience and competence to describe and estimate the viewpoints presented in this study.

In 1995 I conducted a survey-based study involving small and medium sized enterprises in South Ostrobothnia, "Small enterprises as pedestrians on information super highways" (orig. title in Finnish, Mäki and Riihimaa 1995). Three different kinds of data were combined there. By using all that data it was possible to define profiles and special features of SMEs and their adoption of ICT. Those issues are still relevant. They include the effect of the size of the enterprise on the adoption process, the effect of its geographical placement, some differences between industrial branches and some early SME experiences of using telematic[3] services.

3 In the survey we used the term "telematics", which was not established in the end. Telematics means the combination of telecommunication and information technology, e.g. PC, and currently the term ICT covers it.

We also illustrated the ICT adopting curves of various branches. The figures demonstrate that in South Ostrobothnia the service industries were the first to adopt information technology. They were soon followed by the local government sector. Production SMEs on the other hand were extremely cautious in adopting information technology (computers). According to that data it looked obvious that different branches had different kinds of adoption processes and production industries were adopting ICT more slowly than the enterprises in the service branch.

The survey and its results formed the most important personal motivation base to my dissertation. From those premises this study is focused on the production SMEs, and the term "production enterprise" is mostly used. The meaning of the term is almost the same as that of "manufacturing enterprise", but in this study there are also references to slightly different kinds of firms, which make products but do not necessarily have the technical equipment, for example, in the food industry branch. In this study the area of South Ostrobothnia is seen as a "laboratory" of production SMEs.

The model adopted for describing the SME activities and the structure of an enterprise in this study is the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003). The functions are used for analyzing the empirical data of this study and transforming the results of the analysis into a theoretical model. Another way would be to describe the activities of a firm by using processes. That would make the picture more flexible but concurrently more complex because of the great variety of processes in different firms. The functional manner of representation does not exclude the use of a process model either, because functions can also be seen as systems with their internal dynamics, processes and interfaces with the external world. The eight main functions classification is exhaustive (Bunge 1967) enough for the purposes of this study and it can be applied even to the smallest firms with few employees.

In this study the systems viewpoint and the role of human resources are emphasized. Technological and human issues are tied together with other organizational resources, information and financial issues, described by the eight main functions model.

Compared to the mostly used Rogers' innovation definition Daft (1978, p. 197) formed a slightly different definition of innovation: "…an idea or behavior that is new to the organization adopting it". The words "…*new to*…" emphasize the important aspect in this study, the SMEs' own active viewpoint as ICT adopting organizations. Information systems studies, especially the ones targeting the SME sector, have typically had a kind of an exterior viewpoint, where new information and communication technology are "blessings". The technology adopting organization has had quite a passive, mainly receiving role. In this study the aim is to respect the thoughts of the SMEs and to listen to their voice.

ICT is in this study conceived also to be re-invented (concept by Charters and Pellegrin 1972, Rogers 1995, pp. 175 to 180) by nature. As stated, adopting an ICTS innovation is not just a passive action of implementing a standard template of a new idea. ICT is generic, it offers applying frameworks to the adopter. The knowledge of how to apply it must be generated case-specific.

This research will explore and clarify a little known but significant topic - the production (manufacturing) SMEs as the adopters of ICT systems. That will give new elements to IS research and also to other related disciplines when they are debating the domains of information systems.

This study, as more general theory developing research which will explain specific ICTS innovations in an organizational context, is useful in at least three ways (Swanson 1994, p. 1089): It provides an understanding of the role ICTS can and will play in the organizational context. A good ICTS innovation theory also allows managers to shape their organizations better with respect to realistic expectations of ICTS innovation. Thirdly, it will give managers guidelines to consider when it is the appropriate time for the organization to adopt new ICTS innovations, in other words, when it is better to be among the first adopters, and when it is more reasonable to be among those who follow and learn from the accumulated experience of the predecessors.

1.5 Definition of the problem under study

After combining the previous aspects I am able to present the main research question and the research methods of this study.

> The main research question is:
> *What are the types of information and communication system innovations emphasized by a production SME when it adopts ICT?*

Järvinen (1999, 2001) has presented a qualified classification principle of classes of research methods, which is adopted in this study. In accordance with that classification the aim of the study is theory-creating. The iterative theory creating method of Eisenhardt (1989) is applied. Eisenhardt divides her original theory-building process to eight sequential and iterative steps. A specific feature of the method starts with neither a theory nor a hypothesis and compares the results with existing literature at the end of the research process.

This study can be placed also in the class of intensive case methods presented by Cunningham (1997). The intensive case methods develop a new theory exploratively. In this study comparisons between cases are made, but the new cases are used to supplement the conceptual view.

The main empirical data of this study consists of two sequential sets of interviews of production enterprise representatives. The SME cases presented in this study in more detail were mostly collected from a very SME rich area, South Ostrobothnia.

I argue that in this kind of research settings a case study can produce sensible results better than most other methods. This is because the case study method with interviewing is very sensitive; the researcher can interact with the interviewee(s) about the subject and the concepts used, and a common understanding can be created. A multiple case study method

(Cunningham 1997, Eisenhardt 1989) was required for extending knowledge among individual cases. Furthermore, results of a multiple case study are considered to be more convincing than those of a single case study (Yin 1994). I also aimed to describe various data gathering and analyzing phases in this study. According to Dubé and Paré (2003), to increase the reliability of the information presented in a case study, a key principle to be followed is the maintenance of a logical chain of evidence.

The first of the data sets consists of 17 cases, "ITEP interviews", which were collected totally from South Ostrobothnia within a regional development project frame called ITEP, **I**nformation **T**echnology in **E**telä-**P**ohjanmaa (i.e. South Ostrobothnia). Another set of data is based on "MET interviews". The data were collected nationwide from 40 metal and electrotechnical enterprises in cooperation with the Federation of Finnish Metal, Engineering and Electrotechnical Industries (MET) and the scope is their e-business innovations.

While the research unit of the dissertation is the enterprise, the production SME, the "idea of the information and communication system, ICTS" is the unit of the analysis. The "idea" refers to the utilization purposes ICTS is adopted for. Each enterprise builds its individual approach to what purposes and how it is adopting ICTS to achieve sustainable competitive advantage.

In the interviews the respondents discussed the information systems of their enterprises. I argue that they emphasized the systems most important to them. Because most of the respondents were owners of the enterprises, chief executives or other managers, a comprehensive view of the enterprises was achieved. The information systems mentioned during the interviews were the fundamental ones to the firms and to their sustainable competitive advantage creation. Thus these systems truly represent the ICTS innovations being adopted.

The a priori definition in this study will be the supporting functions always describing certain characters of the enterprises' ICTSs. The interviewed entrepreneurs have built their own visions on information systems they have adopted. In the interviews they said directly (when naming systems) or indirectly (when naming attribute(s), such as supporting function(s) of a system) what the ICTSs they emphasize are. Also, in this study an assumed a priori aim of an enterprise, and thus the aim of the ICTS innovation adoption roles, will be the financial success and sustainable competitive advantage to the enterprise. I had, however, to accommodate that picture in some of the theory-creating phases.

1.6 Results of the study

The main result of the study will be a new theory describing a taxonomy; a classification principle of information and communication technology system (ICTS) innovations adopted by small and medium sized production enterprises. I shall use my lived experience to analyze the data and aim to carefully interpret the interviews, preferring to respect the "voices" and views of the enterprises. The results will be formulated into a tree structure, in which the different types of ICTS innovations as separate categories will be presented (the core category

being on the "top", and the main categories having typically two subcategories each). An example of the emergent theory tree structure is presented below, in the Figure 1.1.

Organizations are typically examined as independent units with certain internal functions or processes. An organization is also seen having some external interfaces, but their role is becoming currently more important due to the networked cooperation with other organizations. To achieve sustainable competitive advantage organizations have various kinds of internal and external ICTSs.

I shall form the core category of the emergent theory, "ICTS roles", in the first place by using a dichotomy according to the enterprise context: "an independent entity"/"operating in a network". The ICTS innovation roles will be divided in two as seen from a SME's viewpoint: an "Internal systems" category to represent system innovations without external links (an SME as an entity), and an "External systems" category to represent system innovations with an external interface (an SME in a network). That dichotomy between Internal and External systems will be included in all the main categories of the emergent theory.

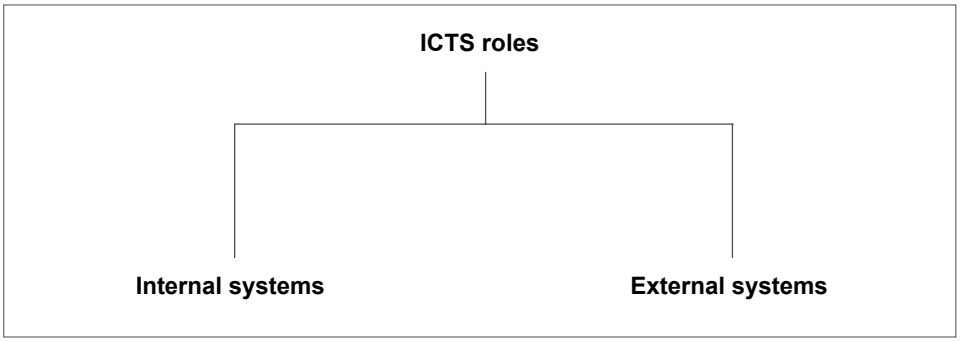

Figure 1.1: *An example of the emergent theory tree structure: The core category "ICTS roles".*

Correspondingly, four "Supporting systems" categories will be determined according to the four resources in the eight functions model to clarify and separate the differences in the emphasis of ICTS innovations – the categories of financial, human, physical/information technology, and informative supporting systems.

As I shall assume, the most important purpose of ICTS innovation adoption in production SMEs is the search for sustainable competitive advantage. Systems of this type are positioned under the category "Competitiveness-creating systems". However, the results will also point out some other remarkable ICTS innovation roles, systems not directly creating competitive advantage, which will be presented in a more detailed way in Chapter 8, "Discussion".

A traditional way of illustrating issues of competitive advantage-creating, and thus also illustrating information system innovations, is the Porterian (Porter 1985) value chain. It is based on a process view of an organization. A production or service organization is seen as a system which is made up of subsystems. Each of them is included in a chain with inputs, transformation processes and outputs which involve the acquisition and consumption of resources. This kind of organizational model produces system categories of the "Value

chain systems" type. They have a "one-way" external communication interface, like systems of acquisition (communication e.g. in the form of orders to suppliers) and "Sales and marketing systems" (e.g. marketing communication to customers). In this way of thinking production "Process systems" are situated independently in the middle of the production chain, within the individual enterprise.

If the enterprise operates within a real enterprise network, it means reciprocal, cooperative communication between the parties, and thus communication between the systems. More external interfaces are needed. Not only acquisition and sales/marketing systems have reciprocal external interfaces, but also production process activities and even the products of the enterprise may form their own networked information systems.

Advanced "Networked process systems" for production expect standardized data and processes between the partners. Accordingly, "Networked products" (seen as a separate system category) are not just simply produced and sold. The structure of the product is layered. The products may first be individually customized in cooperation with the customer. The product may also include long-period "After sales" services (systems) expecting continuous communication and consultation of how the product is most efficiently used by the customer.

I shall recognize also a category of "Outsourced systems", the networked counterpart of which is the category of "Application service providing network systems" (ASPs). It must also be noted that an enterprise may have both internal, chained and networked systems, as well as systems from "contradictory" categories, depending on e.g. customer priorities, nature of products, supplier partners, etc. Thus the ICT systems may be seen as "building blocks" for the enterprise.

1.7 Other chapters

The second chapter of this study specifies the conceptual background frameworks relevant for this study. Broad concepts related to information systems - the concept of the Information society and the concept of networking - are first combined for getting an extensive background to the actual research topic, a quite narrow scope of IS innovation adoption within production SMEs. At the end of the chapter the concept and the role of small and medium sized enterprises will be described. South Ostrobothnia is seen as a laboratory of the Information society, and my personal background will also be recounted briefly. I argue that a dissection of the broad concepts is necessary for describing the reality and environmental issues at the production SMEs. The environment affects the selecting of the type of innovations that are adopted by the enterprises.

The role of the third chapter is to present various aspects attached to the classification of innovation systems, which I shall synthesize at the end of the chapter. At the beginning of the chapter the definitions and connections between the concepts of information and communication systems (ICTS) and innovation will first be delineated. Some aspects concerning the systems theory and the nature of ICT systems will be discussed. I shall discuss various aspects of innovation conception, compare terms which describe phases of the innovation process, review briefly IS innovation literature and some innovation literature

from selected IS research related disciplines, as well as give some results of a previous survey-based study conducted in South Ostrobothnia. The model adopted for describing the activities and the structure of the enterprise will also be presented. It is the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003). The management function and the four supporting functions/resources will be looked at from an individual enterprise's point of view as prerequisites of ICTS innovations. At the end of the chapter these are synthesized into a "chart of four perspectives", a particular tool which I shall build to help the phase of the data analysis.

In Chapter 4 the philosophical and methodological assumptions behind this study will be presented. An important motivation for positioning the research issues philosophically is the scientific discourse. To me defining the philosophical "position" of this study is not to keep any special flag flying, but to describe my background motivation and views as a researcher. At the beginning of this chapter the research problem will be formulated into a form of research question and subquestions. The review of the research approaches and techniques applied will also be described. The aim of the study will be to characterize theory-creating in accordance with Järvinen (1999). The issues of qualitative research are characterized and the case study principles of the study will be evaluated based on the work by Yin (1994), Cunningham (1997) and Eisenhardt (1989).

In the fifth chapter the ITEP project frame and the phases of gathering and analyzing the data of the first case set with 17 interviews are presented briefly. I shall select the three most representative cases, which will be presented in a more detailed way. The preliminary theory is explored as a synthesis of the cases in the form of a taxonomy of ICT system innovations.

In Chapter 6 the theory will be supplemented and sharpened. I shall present the MET project set with 40 cases, from which again three shall be presented in detail way. In the 5th and 6th chapters the emergent theory will also be compared with extant literature.

In Chapter 7 the emergent theory will be tested, e.g. against the model of Stabell and Fjeldstad (1998). In the last chapter, Chapter 8, the contributions and the conclusions of this study will be presented. Finally, limitations and future research directions will be suggested briefly. The structure of this study is presented in Figure 1.2.

Chapter 1:	Introduction
Chapter 2:	The conceptual background frameworks of the study.
Chapter 3:	The definitions of the concepts and connections between them, with a review of innovation literature. A tool for analyzing the research data is also presented.
Chapter 4:	The philosophical and methodological assumptions behind the study.
Chapter 5:	The first empirical part of the study; forming the emergent theory.
Chapter 6:	The second empirical part of the study; supplementing the emergent theory.
Chapter 7:	Testing the emergent theory.
Chapter 8:	Discussion

Figure 1.2: *The structure of this study.*

2. Introducing the problem area

In this dissertation I address the issue of information systems adoption and contribute towards a new theory on the issue. The term theory should here be understood as a taxonomy, which describes a classification principle of information and communication technology system (ICTS) innovations adopted by production SMEs in the Information society context.

In this second chapter I shall present the environments and theoretical backgrounds this study evolves. To position the research and its results into the field of information systems I first apply the model of Ives, Hamilton and Davis (1980) in Section 2.1. They have presented a comprehensive model of management information systems (MIS) research, which is appropriate for the purposes of this research. The model and the different views accommodated into it work in this study as a "sensitizing device" (Giddens 1984, p. 326), giving background to the analyses and helping to observe the ways in which information and communication technology is adopted by the production SMEs.

The environment affects the selection of the types of innovations which are adopted by the enterprises. That is why broad concepts related to information systems - the concept of Information society (see Section 2.2) and the concept of networking (see Section 2.3) - are combined for getting an extensive background for the actual research topic, a quite narrow scope of IS innovations adoption within production SMEs. I argue that the dissection of these broad concepts is necessary, because the positioning of a single enterprise against the background views reveals the situation of a small enterprise in the cross-waves of globalization pressures and the possibilities of networking, new division of labor (e.g. Contu et al. 2003, Quinn et al. 1996, Engeström 2003).

A notable viewpoint of the emergent theory will be networking[4]. That kind of inter-organizational cooperation is a more concrete world to the production SMEs than the abstraction of the Information society. Various ways of explaining inter-organizational (i.e. interfirm) cooperation from different theoretical viewpoints have been proposed. I shall select a number of viewpoints when presenting this topic in Section 2.3, because none of the networking theories alone is suitable for studying the SME cooperation (Varamäki 2001a). Selected theories form the "organizational environment" and thus the views of the enterprises' new division of labor in this study, and they also reflect the eight main functions model (Kerola and Järvinen 1975) of a firm.

For emphasizing the relevance of the emergent theory, I shall next depict the important role of small and medium sized enterprises in the society and the business life (Section 2.4). Just as Finland is seen as a laboratory for the Information society, the Finnish region of South

4 In this study an enterprise is mostly looked at as an operative partner within a cooperative network. However, the idea is to keep the view of ICTS innovation adoption internal, as if seen through the eyes of an SME entrepreneur. To reach that aim the eight main functions model (Kerola and Järvinen 1975) of a firm, including a management function and four operational resources (financial, human, physical, and informative resources), will be adopted to describe the enterprise also as an entity. That issue will be presented in a more detailed way in the following Chapter 3.

Ostrobothnia is seen as a laboratory for small and medium sized enterprises which are oriented towards "traditional" production industry. For that reason the region of South Ostrobothnia and its industrial life is described briefly. Because I interpret the research data based on my own personal experiences, some aspects on my personal background will be presented at the end of Section 2.4.

2.1 Positioning the research setting into the information systems

To position the research and its results into the field of information systems I shall apply the framework of Ives, Hamilton and Davis (1980). The original framework was constructed over twenty years ago, and it has later been supplemented (e.g. Iivari 1992). There are other concurrent models, such as e.g. Benbasat and Zmud (2003) or Davis (1987), but for the purposes of this study the original framework is appropriate. It is also widely referred to and still very useful and expressive.

Ives, Hamilton and Davis presented a comprehensive model of management information systems (MIS) research, which was derived from a review of past research frameworks. In this study quite broad concepts - the concept of Information society and the concept of networking (inter-organizational, interfirm cooperation) are combined within the model for getting an extensive background to the research topic, a quite narrow scope of information systems adoption within SMEs.

The model and the different views accommodated into it are in this study used as a "sensitizing device", as put by Giddens (1984, p. 326), or a "practice lens" (Orlikowski 2000). They help me to analyze the empirical data and to see new ways of using information and communication technology.

In Figure 2.1 the model is presented in a modified form – the concepts of Information society, networking theories and organization are added. There is also an additional level, at which I positioned the term "organization". In the original model the organizational environment meant simply the organization itself, in this modified form also issues concerning enterprise networks are included. The original model consists of an information subsystem, three processes (use, development and operation) and five environments (use, development, operations, organizational and external). The supplemented model (Iivari 1992) includes also Impacts/Organizational effectiveness and relationships between the entities.

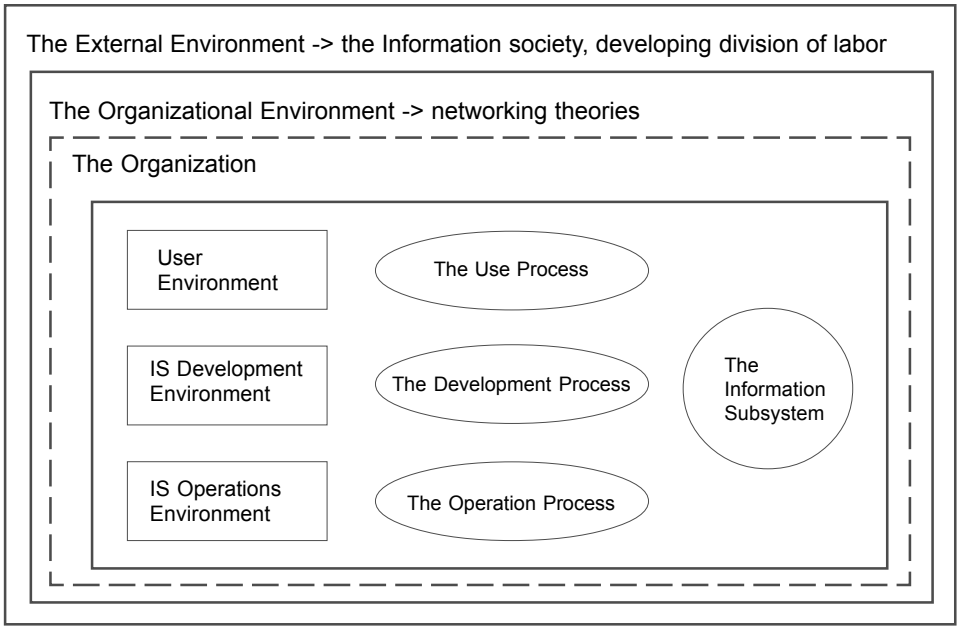

Figure 2.1: *A model of IS research according to Ives et al. (1980, p. 917), modified.*

In this study the external environment of an organization is formed by the Information society. Along with some other views the trilogy of Castells (1996, 1997,1998) is referred to, to give a macrotheoretical perspective on the Information society. Castells' "Informationalism" is in this study a macrolevel framework, in which large changes can be looked at. Different aspects can thus be matched to one "metacontext" and it is easier to characterize the multidisciplinary organizational environment.

The tension caused by the Information society for the organizational environment of the production SMEs is a dilemma in operating, in terms of both local and global markets. The globalization forces them to increase their cooperation with other enterprises and to operate as a part of a network. In that new context the SMEs must be able to maintain and develop their sustainable competitive advantage (term by e.g. Day 1984, Porter 1985, Barney 1991).

Traditionally the organizational environment of an SME has been local. In the local context SMEs may act more as single entities with traditional, independent ways. It is usually argued that physical networks, such as the Internet, create new global possibilities for local companies. I agree with that, but it must be noticed that the networked environment has made global markets local as well. By utilizing networks, globally operating enterprises have more efficient opportunities of intruding into smaller places where they did not earlier have agents or other representatives. Due to the rapid development of information technology and networks it is not any longer possible for the entrepreneurs to be lulled into operating purely at the local level. That brings about strategic issues, both threats and opportunities, but also creates a need for new kinds of information systems.

2.2 The external environment of the organization – the Information society context

Information and communication technology (ICT) plays an ever increasing role in today's society and industry, and it has changed the operational activities of the enterprises in many radical ways. The breakthrough in the steady development of ICT, which started definitively in the 1970's, has rapidly led for different theories of the Information society to take shape. The industry faces the growing challenges of efficiency and competitiveness, and concurrently the knowledge layer plays a more remarkable role in the products (see e.g. Ruggles 1998, Ruohonen and Salmela 1999).

Reflecting that change I shall in the following subsections discuss the emergence of the Information society (2.2.1), the new division of labor as a manifestation of the Information society (2.2.2) and some other characteristics of the Information society presented in the recent IS related literature (2.2.3).

2.2.1 Emergence of the concept of Information society

The concept of "Information society" entered public consciousness in the early 1970's particularly with Daniel Bell's visionary book (Bell 1973) and with professor Yoneji Masuda's work (Masuda 1980). Currently, there are various interpretations of the concept. Most of them are basically technical, but globalization is an established aspect in most of the Information society views.

In Bell's vision, the transition from industrial to post-industrial society includes the birth and growth of a knowledge class and a change from goods to services. These issues would be based upon an increasing dependence on science as a means of innovation, as a means of technical and social change (Bell 1973).

Masuda (1980) created his target program for the then future needs of Japan. According to him, information technology infrastructure with computer networks and databases will replace factories as a social symbol. In the 1980's Japan's society was the target of great interest due to its economical success.

The discussion on a network society took the form of "Information society" and became a subject of national and regional strategies all over the world in the early 1990's. The tendency was initiated in the US (e.g. Gore 1991) and soon forced itself into a global phenomenon. In the EU the process finally started when the so called White paper (1993) and Bangeman (1994) report were published. These papers put the focus on the growing competitiveness of production and service branches. Especially in the EU the context of the Information society has meant society where information is the key factor of economical and social activities.

One of the most comprehensive syntheses and best known social theoretical analyses of the societal transformation of our age is presented by Manuel Castells. Castells is one of the "sequel capitalism theorists" along with David Harvey, Peter F. Drucker and Krishan Kumar (see e.g. Harvey 1989, Drucker 1993, Kumar 1995). They emphasize that the information society is a straight protraction of modern capitalism (Mannermaa and Ahlqvist 1998). The view offered by the trilogy of Castells (1996, 1997,1998) is not beyond dispute, but it gives a rather suitable macrotheoretical perspective on the Information society.

The main purpose of Castells is to show how the Western societies are increasingly organized around networks. According to Castells, in the core of this transformation is a new mode of development known as *informationalism*, in which the source of productivity lies in the utilization of ICTs, information processing, and symbol communication and manipulation. In this study Castells' Informationalism forms a macrolevel framework, in which large changes are possible to be looked at. Different aspects can thus be matched to one "metacontext" and it is easier to characterize the multidisciplinary organizational environment.

Stressing the Information society, Castells has recognized two trends of organizational change, on the one hand the transition from mass production to flexible production (Castells 1996, p. 154 cit. Piore and Sabel(1984)) and on the other the crisis of the large corporations and the resilience of the SMEs as agents of innovation and sources of job creation (Castells 1996, p. 155 ref. Weiss(1988), Sengerberger et al. (1990) and Clegg(1990)).

Not only economic and sociological but also political perspectives are combined in Castell's views. Both a political perspective and the organizational environment are present when the terms of the SMEs' local development environment are discussed. For example, from the production SMEs' viewpoint an emergent change occurred when Finland joined the EU (1.1.1995)[5].

In Finland the first national strategy[6] was build in 1994 by so called TIKAS group, organized by the Ministry of Finance (Valtiovarainministeriö 1995a, 1995b). Later Castells and Himanen (2002) presented some aspects of the Finnish information society model and compared it with the two well known models of the US Silicon Valley and Singapore. When it comes to the technical aspects of the Information society, the Nordic countries - Finland among them - have been leaders in many ways: the highest number of Internet nodes per capita, the highest number of mobile telephones per capita, etc. The most successful Finnish firm recently, Nokia, raised rapidly to one of the leading companies in the world with its products such as mobile phones. Castells and Himanen argued that Finland can be seen as one of the laboratories for the Information society, with which I also agree in this study.

5 The EU changed the forms of development processes in the SMEs at least at the regional level. In a way the interaction of companies with local actors like city management, political decisions makers and researchers was put in a new situation. The focus moved to large development programs typically organized by separate development or educational organizations instead of the earlier direct support to individual enterprises. In this study the regional development organizations play a minor role, but it is important to notice that the development of an SME is currently heavily dependent also on the local development strategies and that e.g. the developing organizations are also the enterprises' network partners.

6 National technological activities have had strong traditions in Finland at least since 1954, when the so called "Matematiikkakonekomitea" was established (see e.g. Paju 1999).

In Finland the region of South Ostrobothnia represents the most SME intensive area with its 10.500 SMEs. Entrepreneurship and small businesses characterize the region, and I have regarded it in this study as a laboratory for production SMEs. In the South Ostrobothnia region the theme of the Information society has been largely raised in Paraddis, a regional information society project (1996 to1998) by the Western Finland Alliance WFA (see Kasvio et al. 1998, WFA 1998), its successor Hubnet project with various regional subprojects (see Hubnet 2003) and also in a so called ePohjanmaa project (electronic South Ostrobothnia, see ePohjanmaa 2004).

2.2.2 New division of labor

An important view reflected by the concept of Information society is the division of labor and its development. Engeström (2003) refers to a historical framework of Victor and Boynton (1998), for reintegration of organization, work and learning. In this view of the history of industrial production five types of work are identified: craft, mass production, process enhancement, mass customization and co-configuration (see Figure 2.2).

The reason for the need of different, developing types of work seems to be the *deep division of labor*. Since Weber, Taylor and Gilbreth at the beginning of the 1900's all the re-organization approaches to work have tried to eliminate the negative consequences of Taylorism (Järvinen 1980). The model presented by Engeström is more precise than that of Castells' at explaining some of the important aspects which have led to networked organizations models.

Engeström provisionally defines co-configuration as an emerging, historically new type of work that has the following characteristics: (1) adaptive 'customer-intelligent' products or services, or more typically integrated product/service combinations, (2) continuous relationships of mutual exchange between customers, producers, and the product/service combinations, (3) ongoing configuration and customization of the product/service combination over lengthy periods of time, (4) active customer involvement and input into the configuration, (5) multiple collaborating producers that need to operate in networks within or between organizations, (6) mutual learning from interactions between the parties involved in the configuration actions.

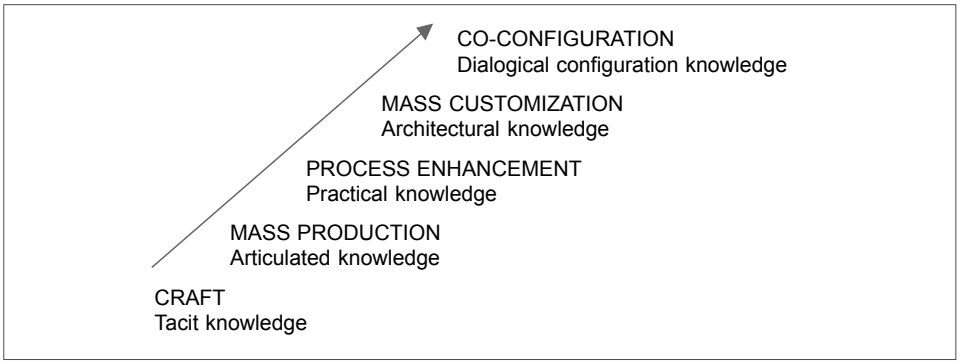

Figure 2.2: *Historical forms of work (adapted from Victor and Boynton 1998, pp. 6 and 233).*

In the course of time there has been much criticism against both Taylorism and Weber's bureaucracy. However, Quinn et al. (1996, pp. 1 to 19) combine the four models (the rational goal according to Taylor, the internal process of Weber, the human relations and the open systems models) into a single framework called the competing values framework. Quinn et al. argue that "…in any real organization all of these are, to some extent, necessary", and I agree with that. In my experience, real business life most commonly reflects different views, each model is utilized in the most appropriate situations.

2.2.3 Various views on the Information society

Many other perspectives describing the features suitable for the concepts of network economy/the Information society has been presented, for example:

a) From a technological viewpoint network economy is based on information and communication technology (e.g. Castells 1996). Knowledge is a factor in production, and new information and communication technology (and powerful processing capacity, see e.g. Tyllilä (1985)) raises the possibilities of communication to a new level.

b) The viewpoint of personal relationships is weighted on trust between the actors and chemistry between the key persons. The relationships between enterprises are reduced to personal relationships. Economical behavior is built on the relationship networks between persons (e.g. Johannisson 1987, Pfeffer and Salancik 1978).

c) From the viewpoint of regional economy, regional infrastructure - and physical communication networks as a part of it - is an essential competition factor. Also the regions are competing with each other under the pressure of global competition, so the regions are, and form, networks as well (e.g. Sotarauta and Viljamaa 2002, Sotarauta and Kosonen 2003).

d) The network economy can be seen as a group of enterprises which have strategically formed an optimal value chain. One of the most utilized models is by Porter (1985). Within the network an enterprise tries to reach a position which guarantees good market assets, in other words an access to the important resources and permanent selling (e.g. Johansson and Mattson 1988). More recently various kinds of new value adding concepts, for example value shop and value network (Stabell and Fjellstad 1998), have been presented.

e) Another viewpoint is changeability and dynamics. When the enterprises grow larger, they simultaneously diverge into units, which begin to grow or alternatively fade away. Malone, Yates and Benjamin (1987) concluded that by reducing the costs of coordination, IT may lead to an overall shift towards smaller firms and proportionately more use of the markets - rather than internal decisions within firms - to coordinate economic activity. Econometric overall analyses of large US firms in 1987 to 1991 appear to support this argument (Brynjolfsson and Hitt 1993). Gurbaxani and Whang (1991) have argued that IT leads to increasing centralization if it primarily reduces decision information costs, and to increasing decentralization if it primarily reduces agency costs. However, the small size of an enterprises is not a precondition to networking, but rather a consequence.

The conception of Information society can also be seen as an abstraction, build only in human minds. If considered critically, it may be seen as a fashionable issue, which strong actors in the society - such as developing organizations or the mass media - began to repeat. In my experience, however, visions like the ones mentioned above have gradually come true to the enterprises, and particularly to the production SMEs.

As a review of the external environment of the production SMEs, the Information society context is the multifaceted reality those enterprises currently meet. There is continuous interplay between the enterprises and both the external environment and the organizational environment. I will describe the latter in the following Section 2.3.

2.3 The organizational environment of the organization – networking theories

The organizational environment of the production SMEs is described in this study by considering selected networking theories. From a viewpoint of innovation classification the networking theories are important, because they give views on terms, according to which innovations are adopted between networked enterprises. The reasons and motivation for cooperating and at the same time for successful innovation adoption within enterprise networks will be revealed through the networking theories.

The overwhelming number of networking related theories with various viewpoints and emphasis does not make it easy to exploit them. A holistic view of inter-organizational cooperation is missing. According to Varamäki (2001a) none of the networking theories alone is perfectly suitable for studying the SME cooperation and its different nets.

I shall select the resource-based view as the starting point for my considerations of networking theory (see subsection 2.3.1), because it is compatible for the viewpoints utilized in this study.

Networking theories emphasizing the overall management perspective of an enterprise are described first (subsection 2.3.2). According to corresponding resources I shall then present networking theories stressing various resource views – financial (sub section 2.3.3), human (subsection 2.3.4), physical (limited to information and communication technology, subsection 2.3.5), and informative (subsection 2.3.6) view.

Networking theories described in the following subsections reveal the different roles of an individual enterprise as an actor within an enterprise network. The views of the enterprise and its resources are discussed later also from a more internal point of view.

2.3.1 Networking overview

Cooperation within networks, or in other words interfirm or inter-organizational cooperation, is not a new phenomenon. Research concerning factors of successful innovations as far back as in the 1970's illustrated the significance of external resources and knowledge to innovations (Freeman 1991). Various explanations have been presented for the growth of networking in many disciplines, e.g. sociology, organizational research and the economic sciences.

The growth of networking is attributed to reaction to changes in production, marketing and the competition environment, in other words to the new division of labor described earlier in Section 2.2. These changes have accelerated competition, increasing specialization in products and production processes, required more complicated technologies and knowledge in them and shortened the life-cycles of products (Biemans 1994).

Networks can vary according to their intensity, formality and objectives. In addition to inter-organizational cooperation, networking can mean a purely social connection between persons. Originally, the concept meant "a loosely coupled system" with "fuzzy" boundaries (Varamäki 2001a cit Weick 1969, Herbst 1976).

When exploring the field of networking theories, it is obvious there is a lack of meta-models, a need for better theoretical constructs to identify and to distinguish between different emphasis, and a need for a more exact characterization of types of networking theories. However, that kind of classification is beyond the focus of this study. Thus, basing partly on Varamäki, who has presented a synthesis of a holistic framework of inter-organizational cooperation (Varamäki 2001a), I shall in the following subsections (2.3.2 to 2.3.6) present some fundamental theories or theory types in short, concentrating on different angles of networking. Varamäki has studied the networking reality of the SMEs of South Ostrobothnia, which topic she has presented in her dissertation (Varamäki 2001).

From the viewpoint of an individual enterprise, there are also various conceptualizations of firm management. Seth and Thomas (1994) compared seven theories (Neoclassical microeconomics theory, Traditional industrial organization economics theory, New industrial organization economics theory, Behavioral economics theory, Managerial economics theory, Agency theory and Transaction cost economics theory), of which some are presented also here within the subsections of networking theories (subsections 2.3.2 to 2.3.6).

Another usually mentioned and networking-related management theory is the resource-based view (Wernerfelt 1984). It focuses on idiosyncratic, costly-to-copy resources controlled by the firm – resources which may give the firm a sustainable competitive advantage (Barney 1991, 1997). Because that view is compatible with the resource emphasis presented in this study, I select the resource-based view as a starting point to considerations of networking theory.

The idea of a firm's resource heterogeneity assumes (based on Penrose 1959) that firms can be thought of as bundles of productive resources and that different firms possess different bundles of these resources. Another fundamental assumption in the view is that the resources are either very costly to copy or inelastic to supply, i.e. the assumption of resource immobility.

If the resources of a firm enable it to exploit opportunities or to neutralize threats, if these resources are possessed by only a small number of competing firms, and if they are costly to copy or inelastic to supply, then they may be strengths for the firm and therefore potential sources of competitive advantage (Barney 1991, 1997).

The basic assumption of the particular resource dependence theory is that organizations use relationships in order to gain access to resources which are fundamental to their continuing existence. The lack of required resources reduces an organization's control over its own actions, which weakens the predictability of its future plans and thereby increases the organization's vulnerability to environmental changes. The alternative bases for control over a resource are: (1) possession (knowledge or ownership), (2) access to resource, (3) actual use and control, and (4) ability to make rules and regulate (Pfeffer and Salancik 1978).

The basic objective of reducing uncertainty is to achieve greater effectiveness. The effectiveness of an organization depends on how critical the following three factors are in determining the dependence of one organization on another: (1) the importance of the lacking resource, (2) the extent to which some other party can decide on the use of that resource, and (3) the alternatives. An asymmetry exists in the relationship when the exchange is not equally important to both organizations, and this causes dependence. Moreover, the resource dependency theory suggests that specialized firms have less autonomy in decision-making and a greater need to cooperate with their suppliers than general distributors (Pfeffer and Salancik 1978).

In IS-reserach field the resource-based view has been also applied. For example, Melville et al. (2004) derive an integrative model of IT business value that comprises three domains: Focal firm, Competitive environment, and Macro environment (cf. Section 2.1, Figure 2.1). Using the resource-based view as a primary theoretical lens, they presented a model describing how phenomena resident within each domain shape the relationship between IT and organizational performance.

Alike Barney (1997), several authors have generated lists of firm attributes that may be thought of as resources. Barney divides these resources into four categories: financial capital, physical capital, human capital and organizational capital. In addition to this, in this study also information is seen as a resource to a firm. The resource-based view of a firm can be reflected against other networking theories, emphasizing these five types of resources.

I refer to networking theories as reflecting the management function and four operational resources of the eight main functions model (Kerola and Järvinen 1975), which are later adopted in this study to form the emergent theory. I emphasize organization management aspects, financial aspects such as profit maximizing, human aspects, physical structures and knowledge management aspects.

It must be noted that the networking theories described in the following subsections 2.3.2 to 2.3.6 emphasize the different motives of an individual enterprise as an actor within an enterprise network. The views of the enterprise and its resources from a more internal point of view are discussed later, in Chapter 3, Section 3.4.

2.3.2 Networking theories emphasizing the management perspective

An important class of networking theories are the ones emphasizing the overall management of an enterprise when examining the forms of organization in relation to their alternatives (Varamäki 2001b, ref. Parkhe 1993, Johanson and Mattson 1987).

Within an individual organization the management function can be seen as the directing force of the enterprise. Decisions concerning e.g. cooperation and alliances are made, and they will affect the innovation adoption processes and thus the selection of the types of innovations which are adopted by the enterprises, and how successfully that is done.

Williamson's (1975, 1981) model, Transaction cost theory (TCT), is the traditional explanation of networking of managerial behavior in business administration and economics, even if he does not use the term network economy. Examining forms of organization in relation to their alternatives means decision-making between internalizing and externalizing, i.e. whether a firm makes a product itself or buys it from external markets.

Also the above mentioned resource dependence theory (Pfeffer and Salancik 1978) focuses on transactions between a firm and its environment, as does the transaction cost theory. Because organizations are not internally self-sufficient they require resources from the environment, and thus become interdependent. The resource dependence theory involves personal relationships and friendship, while in the transaction cost theory relationships exist only between firms.

The analyzed unit in the transaction cost analysis is the transfer of goods or services between technologically separate organizational entities. In the words of Varamäki (2001b)[7], "…in a perfect market, transactions would be carried out without transaction costs. Information would be freely available, decision-making would be rational and there would always be alternative suppliers and buyers." If these conditions do not prevail, transaction costs arise. The comparison concerns the costs of production and transaction, and in his original model Williamson omitted the mixed models some later authors have emphasized, e.g. franchising, joint ventures and networks.

The transaction cost theory also explains the heterogeneity of organizations. Transactions differ much and efficiency is realized only if governance structures are applied to the specific needs of each type of transaction (see Williamson 1981). In this theory a contract is a substitute for trust. According to the transaction cost theory, the lesser the trust, the more formal structures are required for interfirm cooperation. Lack of trust derives from the opportunistic behavior of firms and from imperfect information. Also the terms "power" and "control" are very closely linked to this theory.

Important concepts in the transaction cost theory, opportunism as a basic assumption, refer to a self–interest seeking individual with guile (Williamsson 1985, p. 47). Even if the theory does not suggest that all individuals are opportunistic, it claims some are. This means that a

7 The authors of the reference are E. Varamäki and T.Pihkala.

safeguard needs to be created. There is also a need for a distinction between opportunism and self–interest. Self–interest means that individuals seek to benefit themselves. The transaction cost theory has been criticized for describing the human being as an opportunist, or guile, meaning that an individual is willing to lie, steal and cheat in order to gain advantage to himself.

Williamson's model was expanded by David Teece. According to him the key function for networks is the complementary knowledge and advantage achieved when resources are in combined use. When the innovation is commercialized the reason for cooperation is the complementary resources or reserves of actors, e.g. having established marketing channels instead of creating a marketing organization of their own (Teece 1986).

Also the Uppsala school of thoughts, (see e.g. Johanson and Mattson 1987, 1988) is close to the transaction cost theory. The theory emphasizes different structures of inter-organizational cooperation. In it there are bonds of varying strength between firms. Weakly bonded nets are more volatile, while strongly bonded nets are more long-term in character. Having different kinds of resources, actors also have different power positions in the nets.

In the late 1980's Malone, Yates and Benjamin (1987) examined electronic markets and hierarchies. According to them in free market economies there can be distinguished two basic mechanisms for coordinating the flow of materials and services through adjacent steps in the value chain: markets and hierarchies. For the markets production costs are low and coordination (transaction) costs are high, for the hierarchies production costs are high and coordination (transaction) costs low. New technology increases the domain suitable for markets by allowing more complex descriptions of products and higher asset specificity. Malone et al. were among the first to link the Transaction cost theory to electronic communication and to illustrate how electronic networks can lower the costs of transactions and influence the formation of both electronic markets and electronic hierarchies.

The networking theories emphasizing the overall management of an enterprise stress decision-making, whether a firm makes a product itself or buys it from external markets. This selection guides also the different types of innovation adoption decisions. The theories describe basic terms of cooperation and the enterprises' basic ways of achieving sustainable competitive advantage. From the viewpoint of this study it means that the enterprises' choice is between staying as independent as possible or aiming at forming cooperative networked relationships with partners.

2.3.3 Networking theories emphasizing financial perspective

The aim of any business and business management is the financial success of the enterprise. The following networking theories stress financial resources, and there are some well-known theories explaining the inter-organization cooperation from the profit maximization viewpoint. However, it must be noted that in the model by Kerola and Järvinen (1975) the idea of financial resources is broad, including also financial administrational issues and

putting more emphasis on this kind of aspects. Despite of that, there is no contradiction, as long as the limited scope is kept in mind when comparing it to the networking theories emphasizing financial perspective.

The Strategic management theory

The Strategic management theory is often referred to, a broad discipline which was a response to the shortcomings of strategic planning and began to displace it (Ansoff, Declerck and Hayes 1976, Ansoff 1984). The strategic management theory emphasized the need to be adaptive to nonlinear changes in an organization's environment and to laying the groundwork for organizational change. Integrating the strategic planning theory with the organization development theory was also emphasized to create an ongoing learning process that is both participatory and anticipatory (Ackoff, 1981). Unlike the earlier strategic planning theory, the theory of strategic management has not been overthrown. The strategy-oriented literature for businesses today is mostly a refinement of the strategic management model.

The term "strategic alliance" is most commonly used in the strategic management theory, when discussing inter-organizational cooperation. Strategic alliances are "strategic weapons", used in a firm's long-term strategic plan context. Strategic alliances are aimed at securing, maintaining, improving or dramatically changing enterprises' profit, products or technologically competitive positions (Varamäki 2001a, Jarillo and Stevenson 1991).

The identification, acquisition and combination of the resources result in a unique identity and competitiveness for the enterprise. Objectives and resources required for supplementing the objectives are the core components of the strategic management theory. Thus the resource-based view (Wernerfelt 1984) of strategic management is applied also here.

The strategic management theory also began to recognize that business leaders face political constraints. Managers of an enterprises became strategists also in political environments, and the importance of identifying and understanding the various stakeholders of a business was also discovered (MacMillan 1978, Mitroff 1983).

According to Varamäki (2001a), strategic management alone does not explain the inter-organizational cooperation of the SMEs well enough, because it is focused mainly on cooperation between large firms. Instead of being a formal planning model, the strategy of a small firm is merely the personal vision or ambition of the entrepreneur or owner-manager, in which he is personally committed to pursuing particular objectives.

According to Ansoff, Declerck and Hayes (1976) there are two types of organizational behavior: competitive behavior and entrepreneurial behavior. Competitive behavior consists of resource uses, decision making and action in the existing domain. Entrepreneurial behavior changes the existing organization-environment relationship by re-allocating resources, for example, through product or market development. Entrepreneurial behavior creates new opportunities, whereas competitive behavior exploits and maintains the existing ones.

One of the specialization supporting strategies is Outsourcing, which assumes that external resources are easily applicable to the enterprise's processes. Thus considering the prerequisites for outsourcing strategy, the enterprise needs to be aware of the complementary and transferable nature of its core competencies (Varamäki 2001a).

Value chain and some extensions

Also Porter (1985) emphasizes the same view. According to him the combined efforts of all of the partners in a value chain must add up to a chain that can be more competitive and profitable.

The idea of the Porterian value chain is based on the process view of an organization. A production or service organization is seen as a system which is made up of subsystems. Each of them includes inputs, transformation processes and outputs, which involve the acquisition and consumption of resources – e.g. money, labor, data, materials, equipment, buildings and land. Activities of processing inputs to outputs can generally be classified as either primary or supportive, and all businesses have to have them in some form.

The Porterian value chain's five primary activities are labeled as follows: Inbound Logistics, Operations, Outbound Logistics, Marketing and Sales, and Service. There are also so called "Secondary activities": Procurement, Human Resource management, Technological Development, and Infrastructure.

Porter and Millar (1985) provide a value chain framework for analyzing the strategic significance of new information technology. According to Porter and Millar new IT is causing fundamental changes in management practices, philosophies, organizations and industrial structures. There is a continuous evolution going on in the enterprises' value chains, as the IT transforms not only the way activities are performed but also the nature of linkages between them. Porter and Millar show how and why the IT is changing the way companies operate internally as well as altering the relationships among companies and their suppliers, customers and competitors.

They also identify three specific ways in which the IT affects competition: it alters industry structures, it supports costs leadership and differentiation strategies, and it sets off entirely new businesses.

Porter's five competing forces are described in the following way (Porter and Millar 1985): "The structure of an industry is embodied in five competitive forces that collectively determine profitability: the power of buyers, the power of suppliers, the threat of new entrants, the threat of substitute products, and the rivalry among existing competitors."

Building on Thompson's (1967) typology of long-linked, intensive and mediating technologies, Stabell and Fjeldstad (1998) explore the value creation idea of the Value chain, the Value shop and the Value network. The model by Stabell and Fjeldstad is an extension of the value chain framework by Porter. They propose that there are three distinct

generic value configuration models required for understanding and analyzing the firm-level value creation logic across a broad range of industries and firms.

According to Stabell and Fjeldstad, while the long-linked technology delivers value by transforming inputs into products, the intensive technology delivers value by resolving unique customer problems, and the mediating technology delivers value by enabling direct and indirect exchanges between customers. With the identification of alternative value creation technologies, the value chain analysis both sharpened and generalized into what is proposed as a value configuration analysis approach to the diagnosis of competitive advantage.

Virtual organizations

Another branch of profit maximization applying new strategies is the trend of "Virtual organizations". The term was originally introduced to the wide public by Davidow and Malone (1992) and popularized by Byrne (1993). The term "Virtual organizations" may have various definitions. However, one of the most covering models is presented by Venkatraman and Henderson (1998), emphasizing the term virtual organizing instead of virtual organization. They view virtuality as a strategy that reflects three distinct yet interdependent vectors:

a) The *customer interaction* vector (virtual encounter) deals with the new challenges and opportunities for business-to-business interactions. The IT allows customers to experience products and services remotely, to participate actively in dynamic customization and to create mutually reinforcing customer communities.

b) The *asset configuration* vector (virtual sourcing) focuses on firms´ requirements to be virtually integrated in a business network, in sharp contrast to the vertically integrated model of the industrial economy. Firms using the Internet for business-to-business transactions can structure and manage a dynamic portfolio of relationships to assemble and coordinate the required assets for delivering value to customers.

c) The *knowledge leverage* vector (virtual expertise) is concerned with opportunities for leveraging diverse sources of expertise within and across organizational boundaries. The IT enables knowledge and expertise to become driving factors in value creation and organizational effectiveness.

Each vector in the model has three distinct stages. Stage one focuses on the task units (such as customer service, purchasing or new product development). Stage two focuses on the organizational level of coordinating activities for the creation of superior economic value. The third stage focuses on the inter-organizational network for designing and leveraging multiple interdependent communities for innovation and growth.

The above mentioned theories stress the financial resources in networking. Because financial success is the aim of any business, these theories describe some of the most motivating aspects in the field of creating competitive advantage, and also concern the innovation adoption aspects.

2.3.4 Networking theories emphasizing human perspective

Networking theories emphasizing the human perspective concentrate on the role of human resources when networks are formed. This is an important point because the fact is that in the end it is the individual human beings who adopt the different types of innovations. In the cooperative network environment individual characteristics and capabilities define greatly the success of the innovation adoption process.

According to the social network theory, the genuine unit of organized effort is the dyadic relationship between two persons (Johannisson 1987). These interrelated dyadic ties between the actors form a social network. He argues that the emerging network structure is loosely coupled (see Weick 1976), nonhierarchical, and open-ended. Johannisson (1987) regards a personal network as a major asset to entrepreneurs. In a dynamic environment it is difficult to estimate which resources will become crucial to the firm, and thus it would be wasteful trying to control all the resources through ownership (Pfeffer and Salancik 1978). A network is an effective way to control resources.

Also the personality of an entrepreneur has an impact on the type of his network. An artisan devotes himself to the local networks, while an opportunist searches for linkages also globally. It is possible to reach global markets by networking locally first.

Even if Johannisson (1987) emphasizes personal relationships, he also recognizes production networks and symbolic networks. According to him in production networks each transaction is carefully registered and balanced, and regularity is typically considered as an indicator of the strength of the tie. Symbolic network ties, meanwhile, often remain weak and latent. Personal networks which are based on true friendship can remain passive for long periods, but still do not lose their strength. An ideal personal network should contain both weak and strong ties.

Viewing social relationships from a more organizational level, the social exchange theory emphasizes the social relationship between actors involved in an independent series of transactions (Yli-Renko 1999 cit Emerson 1962, Homans 1961, Levine and White 1961). Emerson (1981, p. 33) notes actors engage in transactions “in honor of the social exchange relationships itself, that relationship being a series of reciprocating benefits extending into the experienced past and the anticipated future”.

According to Yli-Renko (1999), the social exchange theory has been applied at virtually all levels of analysis. Examples of inter-organizational relationships research can be found in Jacobs (1974), Provan et al. (1980), and Baker (1990). Correspondingly, examples concerning exchange networks can be found in Cook and Emerson (1984), and Marsden (1983).

Bourdieu (1985) and Coleman (1988) developed and introduced the social capital framework in modern sociology. The concept originated from community studies, where it was used to describe relational resources embedded in personal ties within the family and community (Yli-Renko 1999 cit Jacobs 1965, Putnam 1995). More recently the concept has been applied also in organizational studies. It has been used there in connection with the social context of

organizations and inter- and intra-organizational relationships (e.g. Nahapiet and Ghoshal 1998, Tsai and Ghoshal 1998).

Social capital is originally defined in the following way: "…the sum of the resources, actual or virtual, that accrue to an individual or a group by virtual of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu and Wacquant 1992, p. 119).

The concept of social capital has been applied in organizational studies at various levels, such as in the relationships between individuals and in management teams, among organizational units, in the market ties of an organization and in industry networks. Social capital can be conceptualized on a network level or applied to a single, dyadic relationship (Yli-Renko 1999).

Another viewpoint on the human perspective is the ways the human resources of an enterprise are organized. Vesalainen (1996) has presented five different inter-organizational cooperation basic models (development circle, loose cooperative circle, project group, joint venture, and joint unit), with six additional variations. Within all these models information and communication technology can be utilized in various ways.

Human resources are an essential part of almost any information system. The role of human beings and social aspects is fundamental also when discussing innovation types. If the innovations are adopted within a networked environment, the cooperation skills of the individuals are even more emphasized. Thus the networking theories stressing human perspective form in themselves an important view to the topic this study.

2.3.5 Networking theories emphasizing physical perspective

By utilizing physical networking, various types of organizational partners can currently be reached, for instance customers, suppliers, banks, state authorities, etc. Physical networks are enablers of cooperation and networked innovation adoption. Concurrently they themselves may also be technical innovations, targets which are adopted.

In the field of physical networking there is a need for theoretical models and taxonomies. Typically, there are no common standardized ways of communication between the ICT systems, and to ensure interoperability between their ICT systems networked partners may adopt each other's standards.

Maybe the most common current "surrogate" for a missing theory is the ISO Basic Reference Model for Open Systems Interconnection (ISO/OSI, see e.g. Stallings 1989). The OSI Model was developed by the International Organization for Standardization in 1984. Since then it has become the primary architectural tool for designing systems that can communicate across physical networks. The ISO/OSI model describes computer communication services and protocols, without making assumptions concerning programming language bindings, operating system bindings and applications or user interface issues. The ISO/OSI Reference

Model is a layered model in which each of the seven layers provides certain services and calls upon the services of other layers.

Most commonly, the world of physical networking is a battlefield of commercial ICT vendors with various, differing hardware equipments, software programs, interfaces and protocols supporting reciprocal communication. For example, Chellappa and Nilesh (2002) have studied the absence of standards in the enterprise software industries. They found that a payroll system that was programmed in COBOL and housed in a mainframe may now consist of components ranging from Oracle databases, Web servers by Apache, browsers from Netscape and an application component from an Enterprise Resource Application (ERP) vendor like the SAP. While there are some standards for low level communication, such as at the transport level and object stages, a uniform set of high level compatibility rules to enable a plug-n-play type of operation does not exist. (Chellappa and Nilesh 2002, cit Yang and Papazoglou 2000). It is also difficult to anticipate which of the many new technological innovations will be successful and advisable for early adoption (cf. e.g. the nature of disruptive innovation, Lyytinen and Rose 2003b).

The way in which the software industries work, which I shall present as an example, is not that far from the production industries, because also there the number of intelligent components and the role of services as a part of the products increase continuously. On the contrary, the reality at the production enterprises feels even more complicated due to their different focuses of production.

Benatallah et al. (2002) describe the patterns of connection between composite web-based services. According to them the specification of interactions among services must include descriptions about both control-flow and data-flow. The control-flow establishes the order in which the component services should be invoked, the timing constraints, the signals that may interrupt or cancel their execution, etc. The data-flow captures the flow of data between component services.

In their article Benatallah et al. classify differing levels of automating the connections between the networked partners. They argue that a natural way of describing the control flow and dataflow of services is to use an existing process-modelling language. They say there are some promising alternatives, but so far these efforts have had a very limited impact. According to them the current ways of operation are to define the component-based frameworks, cross-organizational workflows or document-based approaches.

Component-based frameworks (Dogac 1998, Brodie 2000) support the connection and coordination of data and operations among services. The description of a service is worked out and agreed to offline. After that, the global description of a service is spread through the implementation code of every component. Thus the composition of services in this approach is mainly ad-hoc.

Cross-organizational workflows (Yang and Papazoglou 2000) focus on the automation of business processes that interconnect and manage communication among disparate systems. In this approach the description of the service can be defined collaboratively among partners.

In document-based approaches such as EDI and XML-based frameworks (Dogac and Cingil 2001, Yang and Papazoglou 2000, Casati et al. 2000) the interactions among the components of a service are specified by the shared document definitions. The components are interconnected in terms agreed in documents. Interactions between components may be carried out according to a specific business-to-business standard (e.g. EDI, OBI, RosettaNet, cXML) or bilateral agreements.

Implementation of each of the above described applications has several alternatives and competing technologies of realization. Thus, to ensure communication between their complementary components network partners may adopt each other's standards. This requires agreements about technical cooperation between the partners.

Networked relationships between the enterprises focusing on physical resources can be created also e.g. by outsourcing certain physical technology. Typically, computers or servers are maintained by an external service providing company. The enterprises must consider carefully the limits of the ICT outsourcing, because, for example to production SMEs, the ICT in production may be a strategic resource and its management and maintenance an essential part of the whole core process of the enterprise.

As stated, physical networking resources can primarily be seen as an enabler of efficient communication between the parties of an enterprise network. In most of the cases physical networks are necessary but not a sufficient condition of networking. Physical networking resources may also be seen as targets of the innovation adoption.

2.3.6 Networking theories emphasizing informative perspective

At the networking level the informative perspective in this study means shared information resources and utilization of human knowledge. Issues concerning inter-organizational learning (e.g. Larsson et al. 1998) play a fundamental role. From the viewpoint of innovations knowledge can be seen as a resource, by which the lack of some other resources is possible to compensate. Knowledge issues are intertwined with other resources, particularly with human resources (human knowledge), and physical resources (e.g. computerized databases).

The knowledge-based view of a firm

The knowledge-based view of a firm developed from the resource-based view, and it is often considered as a part or an extension of the latter. Alternatively, the resource-based view can be considered as one of the several knowledge-based approaches (Yli-Renko 1999, Foss 1996). The evolutionary theory by Nelson and Winter (1982), Prahalad and Hamel's (1990) works on core competencies, while Teece, Pisano and Schuen's (1990) dynamic capabilities framework represents different examples or branches within the knowledge-based view.

In the resource-based approach knowledge and competencies are viewed as the key resources for the firms. Accordingly, an enterprise is conceptualized as a repository of knowledge (Nelson and Winter 1982, Spender 1996). The "organizational advantage" (Ghoshal and Moran 1996) or a firm's over market mechanisms arise from the firm's capabilities of creating and transferring knowledge (e.g. Teece and Pisano 1994).

Knowledge creation is currently argued to be the result of new combinations of existing knowledge elements and other resources (see e.g. Cohen and Levinthal 1990, Ghoshal and Moran 1996). Organizational learning has been viewed as a process through which existing intellectual capital is combined and exchanged to create new knowledge (e.g. Teece and Pisano 1994).

There are two main approaches to organizational learning which dominate the literature. Analyses focusing on learning within organizations are currently the most common unit of analysis. The other branch of literature concentrates on how organizations learn from each other through formal collaboration between them. In the literature such learning is referred to as inter-organizational learning (e.g. Child 2001, Ciborra 1991, Hamel 1991, Lane and Lubatkin 1998, Miner and Andersson 1999). The discussion has conceptualized how partners in a strategic alliance learn by producing sets of inter-organizational experiential rules that are partly separate from the rules of each of its members.

Three-level model for learning at work

A challenge for the organizational learning literature is to conceptualize how intra- and inter-organizational learning processes are related to each other. Not much attention has been paid to understanding the dynamics between the learning processes within organizations and those between them.

A. Järvinen and Poikela (2001) took three well-known, basic models to describe the learning at work and in a work organization. Their combined model is based on Kolb's (1984) model of the individual level, Nonaka and Takeuchi's (1995) model of the group level and Crossan et al.'s (1999) model (intuiting, interpreting, integrating, and institutionalizing) of the organization level. Järvinen and Poikela argue that the similarities between the models make it possible to construct an experiential process model of the learning at work.

This model (see Figure 2.3) consists of three learning models for the individual, group and organization levels. There are similar processes at the three levels, i.e. social, reflective, cognitive and operational processes. The context is taken into account in each process and at each level. The model of Järvinen and Poikela presents the key role of reflection[8] both at individual, group and organizational levels. They also refine the experiential learning in a work organization into a process description, in which social, reflective, cognitive and operational processes follow, influence and shape each other in a process of continuous learning.

8 Järvinen and Poikela refer to Mezirow (1991). According to him the core of adult learning is reflection, which is a precondition for the formation of meaning schemes and perspectives that will produce new activity.

Järvinen and Poikela stress the important role of the individual human being by referring to Boud and Garrick (1999): "the goal of learning is an improvement to the performance of the employee, the team and the whole organization, the development of the sense of community in the work organization and support for the employee's personal development, and mastery of her or his own life".

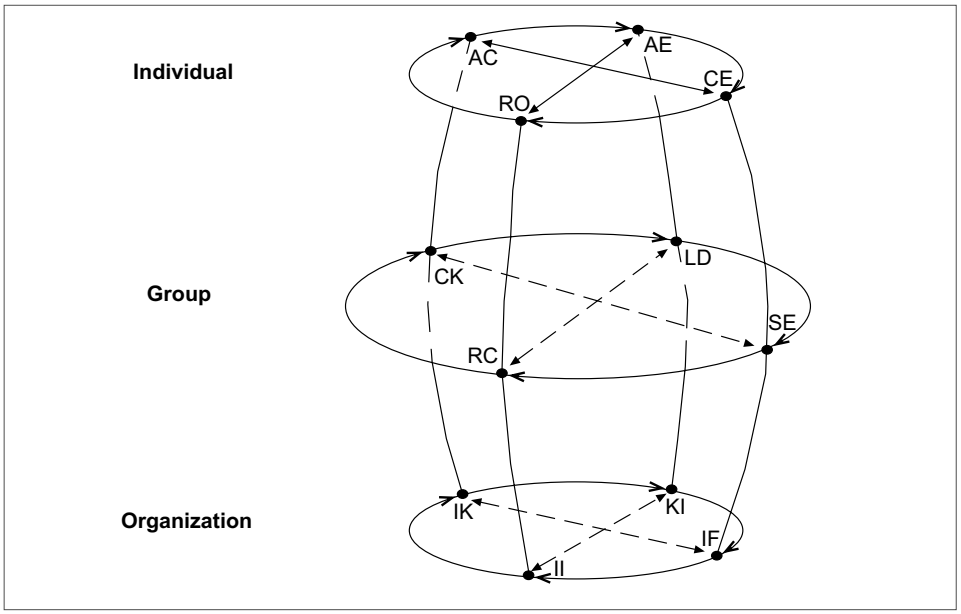

Figure 2.3: *The process model of learning at work (A. Järvinen and Poikela 2001).*

CE = Concrete Experience
RO = Reflective Observation
AC = Abstract Conceptualization
AE = Active Experimentation
SE = Sharing of Experience
RC = Reflecting Collectively
CK = Combining New Knowledge
LD = Learning by Doing

IF = Intuition Formation
II = Intuition Interpretation
IK = Integration of interpreted Knowledge
KI = Knowledge Institutionalization

In their model Järvinen and Poikela do not directly separate the learning between organizations, but their conception of organization implicitly includes also networks – in this model a network is just one form of organization, being represented e.g. through inter-organizational teams.

Layered model for learning at work

The premise for a model of the same type presented by Vesalainen and Strömmer (1999) is the concept of virtual organizing (Venkatraman and Henderson 1998). As they noted, Venkatraman and Henderson emphasize the term virtual organizing instead of virtual organization (see previous subsection 2.3.3). Vesalainen and Strömmer argue that in enterprise networks virtuality means operations crossing the borders of the enterprises and above all social relationships

and cooperation. Just as I in this study, they identify two different organizational environments: the context of an organization as an entity, and the networked context.

A crucial difference between a networking relationship and one that operates on the terms of the market is the obscuring of the boundaries of the enterprises. An enterprise can be described as layered. Each has a nucleus that is not open or transparent to outsiders (even to partners). The nucleus does accept and pass information. Any information that comes from inside to outside is distinctly limited. The nucleus is surrounded by a varying number of layers that are selectively open to the cooperative partners. The layer closest to the nucleus is open to strategically important cooperative partners, in which case the openness means transparency. The next layer is open to those cooperative enterprises which are not strategically important but with which a long working relationship is desirable. In their case reciprocity is of essence, so that a mutual ground can be found for the functions and learning at the companies. A third layer is formed by more traditional supplying companies, which provide the enterprise either with standard products or knowledge that can be replaced easily. These companies have no deep entry into the enterprise (Vesalainen and Strömmer 1999).

The conclusion by Vesalainen and Strömmer is a model of the same type as the one of A. Järvinen and Poikela. The model of Vesalainen and Strömmer is less aimed at considering the cycles of knowledge creation / learning processes at the different levels of the model (individual, group, organization), but in regard to the emphasis of this study they have highlighted three important additional elements in their model (see Figure 2.4): the level of networked enterprises, the shared vision(s), and the view of history at the different levels.

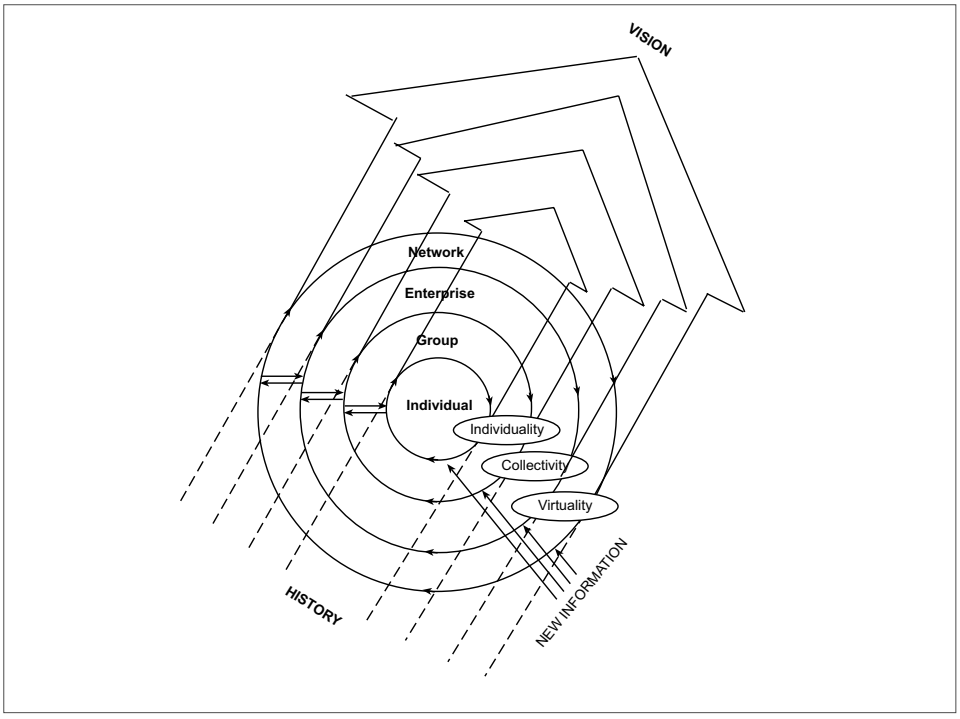

Figure 2.4: *Model of Vesalainen and Strömmer (1999).*

The essential points of the model of Vesalainen and Strömmer can be summarized as follows:

1) Alike in the model of Järvinen and Poikela, the central position in learning is held by individuals. Their learning and actions give birth to organizational structures, systems and processes and even to networking structures and processes, in which their acquired knowledge can be stored and in which it turns into profitable actions.

2) An efficient learning process is reflective and open to external information and knowledge.

3) At a group level learning is collective in every aspect of the cycle (planning, realizing and evaluating). The group is both a learner and a forum for learning for the individuals.

4) Learning at the organizational level means that the knowledge of the individuals is "stored" in the systems and processes of the enterprise. The enterprise both learns and is the forum for learning.

5) Accordingly, also networks can be seen as both learning entities and forums for learning. The precondition to learning is that the network is able to identify itself, in other words all parties have to share the view of the network and its strategic vision. It is also necessary that the network creates a process for evaluating, developing and realizing the needed operations.

6) Learning in the network is possible to organize by "middle-up-down" management[9] (e.g. Nonaka 1994) methods, in which cross-organizational teams form the mechanism for the integration of the learning processes in the network.

7) It is necessary to create a separate infrastructure for the learning processes.

8) Visions of different levels direct the development. At their best the actors became aware of the visions at individual, group, organizational and network levels and all the visions are parallel.

Summary of the Informative perspective

At the networking level the informative perspective means shared information resources and utilization of human knowledge. The knowledge-based view of a firm is often seen as an extension of the resource-based view. In any case issues concerning inter-organizational learning play a fundamental role. The two models presented above prove how multifaceted the issue really is.

Hence, from the viewpoint of innovations, knowledge can be seen as a resource, by which the lack of some other resources is possible to compensate. Knowledge issues are intertwined with other resources, especially with human but also with e.g. physical resources.

9 "Middle-up-down" was the term for the teams, led by the middle managers and having members also from top management (up) and employees (down).

2.3.7 Concluding the organizational environment of the production SMEs

In the previous subsections 2.3.2 to 2.3.6 I described the organizational environment of the production SMEs by considering the above mentioned networking theories and models.

I selected the resource-based view as the starting point for my considerations of networking theory, because it is compatible for the viewpoints utilized in this study.

Networking theories emphasizing the overall management perspective of an enterprise (subsection 2.3.2) were first described, and after that networking theories stressing various resource views were presented – financial (subsection 2.3.3), human (subsection 2.3.4), physical (limited to information and communication technology, subsection 2.3.5) and informative (subsection 2.3.6) view.

From the viewpoint of innovation classification the networking theories are important, because they give views on terms according to which innovations are adopted between the networked enterprises. Networking theories were presented in this study in a quite broad way, because none of the networking theories alone is perfectly suitable for studying the SME cooperation and its different nets (see e.g. Varamäki 2001a).

In the following Section 2.4 I will consider the view and the role of the production SMEs and their importance to the business life.

2.4 Organizations in the middle of change – production SMEs

In this Section 2.4 I shall present some central aspects of production SMEs and their important role in the business life.

I located the individual organization in the innermost circle in the modified model of Ives et al. (1980, see Figure 2.1). In this study an organization – a production SME - is seen in two contexts. On the one hand it is an independent entity, on the other it is seen as a part of an enterprise network. In the network context it operates in interactive relationship with other actors. From the innovation viewpoint a production SME emphasizes various of its resources when it is adopting ICTS innovations in cooperation with other enterprises to achieve competitive advantage, reflecting selected networking theories described in the previous subsections 2.3.2 to 2.3.6.

In the course of times there have been various classification principles for the SMEs. Although it is not all that relevant in practice to separate enterprises by using exactly defined criteria, the main lines are important to know. The SME classification principles are presented in the subsection 2.4.1. The SME criteria of the EU in its main points is adopted in this study, main criteria being the maximum number of employees. In this study the South Ostrobothnia region is seen as a laboratory for SMEs, and I go briefly into that in subsection 2.4.2.

The most important role of the SMEs in the society is attached to job creation. In fulfilling that role successfully the SMEs have various advantages but also restrictions due to their size. In a small enterprise the view of the individual entrepreneur is often important. The South Ostrobothnia region is rural, which gives cause for some additional challenges when the SMEs are striving for competitive advantage. The above mentioned issues are combined in the subsection 2.4.3.

My personal background is a noteworthy input into this dissertation. Living and working in the South Ostrobothnia region has given an opportunity to learn and understand the SMEs' ways of living. That is why I describe my background briefly in subsection 2.4.4.

2.4.1 SMEs as a part of an economy

In the course of times there have been various definitions of the SMEs, and the concepts are quite unestablished, e.g. in the US manufacturing branch they may include enterprises up to 500 employees and in Japan up to 300 employees, while in the EU the SMEs are enterprises employing 250 persons or less. In Russia they have their own definitions for small enterprises.

The key characteristics of a small firm were presented by the Bolton Committee in its 1971 Report of Small Firms (Bolton 1971). The report stated that a small firm is an independent business managed by its owner or part-owners and having a small market share. The Bolton Report also adopted a number of statistical definitions. It recognized that size is relative to the sector - i.e. a firm of a given size could be small in relation to one single sector where the market is large and there are many competitors, whereas a firm of similar proportions could be considered large in another sector with fewer players and/or generally smaller firms. Similarly, it recognized that it may be more appropriate to define size by the number of employees in some sectors but more appropriate to use turnover in others. It is most usual to measure the size according to the numbers of full-time employees or their equivalent (Bradford 2002). For the history of the determinants of capital structure see also Hutchinson et al. (1998).

The European Commission adopted in February 1996 a communication setting out a single definition of the SMEs (Bradford 2002). According to the exact criteria of the EU (EU_stat 2003), an SME must be a firm which:

- has fewer than 250 employees
- has an annual turnover of no more than 40 million euros or an annual balance sheet total of no more than 27 million euros
- meets the criterion of independence, in that no more than 25% of it is owned by one or more companies which are not themselves SMEs, except in the case of financial companies

The criterions of the various sized SMEs used in the EU are presented in Table 2.1.

Table 2.1: *Criteria of the SMEs in the EU, ref. (Bradford 2002, EU_stat 2003).*

Criterion	Micro sized	Small sized	Medium sized
Max. number of employees	10	50	250
Max. annual turnover	-	7 MEuros	40 MEuros
Max. annual balance sheet total	-	5 MEuros	27 MEuros
Max. % owned by one, or jointly by several, enterprise(s) not satisfying the same criteria	-	25%	25%

The SME criteria of the EU in its main points is adopted in this study, main criteria being the maximum number of employees. However, in practice it is very difficult to separate enterprises by using all the criteria exactly, due to the complicate and rapidly changing administrative structures of enterprises or their number of employees, but the basic lines can still be discerned by using these definitions.

2.4.2 The South Ostrobothnia region as a laboratory of SMEs

The region of South Ostrobothnia is Finland's most SME-intensive area with its 10.500 SMEs. Entrepreneurship and small businesses characterize the region. Agriculture and forestry still provide 11,5% (2002) of the jobs in the area, with significant sectors of mechanical engineering, furniture manufacturing and rug-weaving. On a national scale, a significant share of Finnish-produced food (bread, dairy and meat-products) originates in South Ostrobothnia. In 2001, the regional GDP remained at 74 (EU=100) reflecting the prominence of agriculture in the regional economy. In 2001, the population of South Ostrobothnia was 194.000 or about 3.7 % of the total in Finland[10].

The focus of the regional development in the South Ostrobothnia region has currently been on three branches of production industries; food industry, wood industry and metal industry. There are 160 enterprises in the food industry, 630 in the wood industry, including 355 enterprises in the furniture branch, and about 700 in the metal industry, including 50 enterprises in the electrotechnical branch. During the last few years also the importance of the IT branch has been noticed. With its great density of SMEs and its tradition of entrepreneurship South Ostrobothnia region can be seen as a laboratory for this kind of industry. This background forms a good basis for researching the classification of the ICTS innovation adoption at production SME's.

10 Information from Statistics Finland, Office of Seinäjoki/Ms. Leila Perälä, Feb. 2004.

"South Ostrobothnia in a nutshell"

- ⇨ 194.000 inhabitants (year 2002)
- ⇨ sub-regions, Seinäjoki 31.000 inhabitants (year 2002)
- ⇨ 27 municipalities (13 with less than 5000 inhabitants, year 2002)
- ⇨ 55 % level of basic education (FI 60 %, year 2001)
- ⇨ 18 % level of higher education (FI 24 %, year 2001)
- ⇨ 16 % of enterprises in agriculture and forestry branch (year 2002)
- ⇨ (in addition 8.500 farms, year 2002)
- ⇨ 35 % of enterprises in processing industry (year 2002)
- ⇨ 53 % of enterprises in services (year 2002)
- ⇨ Jobs in information sector: 2,9 % (FI 9,6%, year 2001)
- ⇨ GPD per capita (EU = 100): 74 (year 2001)

- ⇨ All municipalities have their own www-pages, quality varies greatly (problems: strategy, content, updating)

- ⇨ 25 of the 27 municipalities have established local networks, capacity ranging from 64 kbps to 2 Mbps. (95 % of population within reach of fiber optics network, "last mile" problem)

- ⇨ All public libraries are on-line with at least one free computer terminal for the customers

- ⇨ Common problem: lack of resources and skilled personnel

- ⇨ 10.600 companies + 8.500 farms (year 2002)

- ⇨ Three categories:
  - Companies not using Internet
  - Passive users (e-mail + passive homepage)
  - Active users (real e-business solutions)

- ⇨ Common problem: lack of skilled personnel at all levels of operation, difficult to make the leap from one category to another.

Based on the representation of Director Pertti Kinnunen, South Ostrobothnia Chamber of Commerce in "New Challenges in ICT Education" - seminar, April 27th 2001, Seinäjoki, Finland. Updated Feb. 2004 by Statistics Finland, Office of Seinäjoki/Ms. Leila Perälä.

The region of South Ostrobothnia was earlier a part of the county of Vaasa. In the mid-1990's the regional structure in Finland was renewed due to a structural policy of the EU. The county of Vaasa was divided into the three provinces, South Ostrobothnia, Middle Ostrobothnia and Ostrobothnia (the coastal region of Vasa). Currently the development organizations which support local enterprises follow mainly that regional structure. For the enterprises' business activities and from the cultural point of view regional borders such as that are quite irrelevant. For this study, too, some of the case data was collected within the former county of Vaasa.

Activities for increasing networking in the economy have recently grown strongly in South Ostrobothnia. The main development needs today are to increase export trade and to increase the forms of cooperation between the SMEs.

2.4.3 SMEs as an entity

The SMEs have various special features that distinguish them from large enterprises, which are usually studied in information systems for competitive advantage.

The most important role of the SMEs in the society is attached to the modern economy's competitive position and job creation (Dutta and Evrard 1999, Castells 1996, p. 155 ref. Weiss (1988), Sengerberger et al. (1990) and Clegg (1990)). The great number of SMEs in different economies makes them important with their big share in the total employment (Dutta and Evrard 1999). In Europe the SME's share of all enterprises is 98% and a majority of the employees (60%) in the EU work in the SMEs (EU_stat 2003). The role of the SMEs in various economics, according to RC Statistics, (1998) is presented in Table 2.2.

Table 2.2: *The role of the SMEs in various economics, according to RC Statistics (1998).*

Countries	N of SMEs (thousand)	N of SMEs per 1000 people	N of SME employees (thousand)	SME share in total employment (%)	SME share in GDP(%)
England	2630	46,0	13,6	49	50-53
Germany	2290	37,0	18,5	46	50-52
Italy	3920	68,0	16,8	73	57-60
France	1980	35,0	15,2	54	55-62
EU	15770	45,0	68,0	72	63-67
USA	19300	74,2	70,2	54	50-52
Japan	6450	49,6	39,5	78	52-55
Russia	844	5,7	8,3	13	10-11

The role of the SMEs is essential also in Finland. Over 60 % of all employees work in the SMEs and over 97% of the enterprises are SMEs. Classification of the enterprises in Finland in 2001 is presented in Table 2.3.

Table 2.3: *Classification of the enterprises in Finland in 2001 (FIN_stat 2003).*

Size	number of enterprises	enterprises %	employees persons	employees %	turnover mEur	turnover %
0 - 9	208 849	92,9	319.000	24,2	45 461	16,7
10 - 49	13 157	5,9	255.000	19,3	43 963	16,2
50 - 249	2 259	1,0	227.000	17,2	48 133	17,7
250 - 499	319	0,1	112.000	8,5	26 779	9,9
500 -	263	0,1	406.000	30,8	107 327	39,5

On the one hand the SMEs form a dynamic and flexible element of the economy (Crawford and Ibrahim 1985, Julian and Lafrance 1983, Plawgo and Chapman 1999), on the other they may be a slightly resourced, heterogeneous community which is confronted by many limitations (Noori 1987, Van Kirk and Noonan 1982, Thong and Yap 1997). In any case, in their societal role the SMEs are an important user group of information and communication technology.

Small and medium-size enterprises have specific advantages compared to large organizations because of their greater flexibility (Crawford and Ibrahim 1985), their rapidity in implementing decisions, and their capacity for adaptation and short-term orientation (Julian and Lafrance 1983). The organizational structures are most flexible in the smallest enterprises, but their lack of resources may in turn set limitations to flexibility.

SMEs may produce 'niche' products or services, which distinguishes them from larger firms offering standardized products. The client base of SMEs may also be limited. If small firms are able to cope with these constraints, they may be more innovative than larger firms (Auger and Gallaugher 1996).

In the region of South Ostrobothnia three traditional branches of productive industries - food industry, wood industry and metal industry - are very important. There are various kinds of innovations done by these enterprises in spite of their relatively small size. Perhaps the most common ones are just niche products provided by the metal industry. In my experience there are remarkable innovations adopted (processes, tools), such as the use of laser scanning and cutting technology or bending system for solid wood in the wood industry and functional food supplies or network-based ordering systems in the food industry.

The smallest firms employing a few or perhaps just a single person are a special group of small enterprises. However, I argue that the person of the entrepreneur and his or her entrepreneurship are fundamental in every case. That is the main reason why I use mostly the term "enterprise" in this study, instead of the term "firm".

Entrepreneurship is a social phenomenon, the characteristics of which are not very clear (Pihkala and Varamäki 1996): "The research on entrepreneurship has been accused of being scattered, unsystematic and even contradictory as regards knowledge about the entrepreneur. Despite the common background theory provided by Schumpeter, researchers have not really succeeded in accumulating knowledge and in introducing new better theories about entrepreneurship. The search for the typical entrepreneur is guided by the belief that entrepreneurial characteristics are the initial causes of the entrepreneurial effect"... …"Similarly, assuming entrepreneurial characteristics to be emergent and non-induced is widely shared. In academic papers, inducing entrepreneurship is considered an almost impossible task, nevertheless practitioners and teachers try to convince people that entrepreneurship can be learnt. Finally, seeing entrepreneurial characteristics as stable and continuous means treating entrepreneurship as a linear phenomenon. The presence of entrepreneurship is a finite state of affairs, and the studies do not identify unstable or periodical entrepreneurship."

In addition to personal features of the entrepreneur described above, also the location of the enterprise may be an important aspect. The region of South Ostrobothnia is a rural area, which brings about some additional challenges when striving for competitiveness. According to Plawgo and Chapman (1999) in peripheral regions the competitive advantages of small firms over large firms are traditionally as follows:

1) Production for the needs of the local market. Qualified local industry can be competitive in producing for the needs of small local markets. The advantage of small firms results from the fact that certain goods must be produced locally, and/or the transportation costs are high (like certain food products or construction materials). When producing goods of this kind, small firms are "naturally protected" from the competition of large companies.

   In this study that viewpoint is not accepted. It might be true in some cases, but more commonly so in local services, and in this study the focus is in production industries. The view of the SMEs and the entrepreneurs is naturally often local, but it is important to notice that it is no longer possible for entrepreneurs to operate purely at a local level. Even the rapidly perishable food products are more often imported from other countries. Networks of efficient packaging and logistic systems have turned markets which used to be global also local, and the automatic or "natural protection" continues to lessen.

2) Processing of dispersed raw materials. If the processing of dispersed raw materials gives significant reduction in weight and volume and limits the risk of damage, then in this field small companies can also be competitive.

   This kind of processing is quite suitable for the identification of the food industry in South Ostrobothnia. In other branches of the production industry the competitiveness attached to issues like this is more in relation to the knowledge concerning the raw materials, e.g. how to work the material or knowing its characteristics well.

3) Traditional manufacturing. The particular characteristics of manufactured (hand-made) goods can be obtained with the use of simple, traditional production technology. In this area, economies of scale are not present or, on the contrary, scale is associated with disadvantages.

   An good example is the furniture industry of Jurva with its traditionally valued models, made traditionally by handicraft. However, currently these processes are affected by the use of automation at the front end of the manufacturing process.

4) Production of niche goods. Large companies often consider certain market areas beyond their scope of interest, as too specialized or too small. By producing for small and selected market segments, small companies may avoid competition from large companies.

   In South Ostrobothnia this is most common for the metal industries, such as the logistics management of the material flows in Kauhajoki or agricultural machinery in the region of Härmä. Also in the food industries the fact that large enterprises concentrate on mass-volume products offers new possibilities to the small enterprises of the branch.

5) Vertical integration. Many technological processes can be divided into several stages. Small firms can be competitive in the production of sub-assembly parts, finishing products, or offering services.

   This is an essential factor reflecting the networking issues. This kind of vertically integrated activities are most common among the metal industries. Many enterprises in South Ostrobothnia produce large, specialized sub-systems to other enterprises.

6) Many SMEs are a means of utilizing limited capital, in a way that provides work for the surrounding family; the motivations for hard work are clear. Large industry is usually very capital-consuming, and the accumulation of capital requires time; therefore, small companies can be competitive during the transformation period.

   This aspect is the most common in South Ostrobothnia. However, limited capital means also disadvantages, e.g. limited resources to invest or to buy expert consulting services. For a small family business the eagerness for growth is often very small.

7) Among the social elements the SMEs are often owner-managed, by highly entrepreneurial people, driven by the desire for self-betterment, with direct access to the rewards of their activity.

   This is the factor which more reflection of the human perspective. However, an old culture of entrepreneurship characterizes the region of South Ostrobothnia, and enterprises like these are the most common in the area.

2.4.4 A brief personal history

A noteworthy input into this dissertation is my personal background. In addition to theoretical views, this kind of study requires solid practical experience. I have worked for years with SMEs in regional ICT development and research, operating as a managing director in a small network firm, being a member of board in two other small firms, and living most of my life in the very SME-rich area of South Ostrobothnia. All this have given me a basis for understanding the SMEs' lifelines and also the personal motivation for this study. My personal background guarantees experience and competence for finding and estimating the important viewpoints of the research topics.

The main data for this study were gathered from the very SME-rich area, South Ostrobothnia. For this kind of study close familiarity with the culture of entrepreneurship is essential. Living and working in this area has given an opportunity to learn and understand the SMEs' ways of living. This study was not conducted as an action research. However, working and having cooperated with some of enterprises involved in this study may have some effect on the data, for example by giving a deeper understanding of the answers while I analyzed the interviews.

In the mid-1980's I worked at Tampere University, which has its Institute for Extension Studies (acronym TYT) and a special "Information technology development unit" in the town of Seinäjoki. I worked at the unit for almost seven years. Our main activities were different kinds of educational services directed to enterprises and to individual grown-ups,

and also information technology services directed mainly to the local SMEs. It can be estimated that hundreds of people from different enterprises attended the courses we organized and we were involved in dozens of consultation cases during the seven years. Most of these consultations were for production SMEs.

The period gave me experience in ICT innovation adoption in production SMEs, because many of the technologies about which we gave consultation were new innovations back then, such as email or some other network services. As a curiosity I remember that at the beginning of the period we took part in a tour during which we demonstrated the possibilities of a new technical innovation – the telefax.

During my time there the TYT also composed the ideas for Seinäjoen Tietoraitti Oy (Ltd, acronym STR). The STR was established in 1989 as an expert organization in the field of data communication and networks. I had two different roles in the STR. During the first years (1989 to 1994) I was a consultative, non-voting member of its board, and in1994 to1998 I worked as its managing director.

From the very beginning the STR carried a dual role. On the one hand it was a normal business unit with normal economical commitments, on the other it was also a regional development organization. These roles did not always go well together, but personally that time gave me an experience of both sides.

During my period there the projects of the STR were directed for the local enterprises to develop their networking activities. In comparison to the common technologies of that time, most of the projects which we realized included very innovative network products and services, for example a web marketplace for local furniture enterprises (MööpeliNet) in 1995, a gopher-, and later web- based wood-marketing site "PuuMa" at the beginning of 1995, and a large educational project with twelve enterprise groups aimed at the creation of inter-organizational web-based network services in 1995 to 1998. Most of the enterprises were production SMEs.

The last important enterprise project during my time in the STR was the 1998 plan for Ruokaraitti, an Internet-based system for order processing between small food-producing enterprises and stores.

Those years in the STR taught me many new aspects of enterprise networking, both financial, human, physical and informative, as well as challenges and possibilities of the ICT innovation adoption, and also the management and real business life of an enterprise. I argue that all that experience from the STR gave knowledge and skills for the analyzing and interpreting of the research data in this study.

2.5 Summary of the problem area

In this dissertation I address the issue of adopting information systems and contribute towards a new theory in the issue. In this chapter 2 I presented the theoretical backgrounds for this study. The main result of the study will be described as a taxonomy; a classification principle

for the information and communication technology (ICT) system innovations adopted by production SMEs in the context of the Information society.

At the beginning of this Chapter 2 I explored the literature about the Information society and networking (inter-organizational cooperation), both of which were selected as basic views for the study. To position the research setting into the field of information sciences I first apply the model of Ives, Hamilton and Davis (1980) in the Section 2.1. The model and the different views accommodated into it work in this study as a "sensitizing device" giving background to the analyses and helping to note the ways in which information and communication technology is adopted by the SMEs.

In this Chapter 2 the concepts related to broad information systems – such as the concept of Information society and the concept of networking - were combined for getting an extensive background to the actual research topic, a quite narrow scope of information system adoption within production SMEs.

Some networking theories emphasizing the management of an organization, financial aspects - such as profit maximizing - human aspects, physical structures and knowledge management were referred to as a reflection of the management function and the four operational resources of the eight main functions model of a firm, (Kerola and Järvinen 1975), the role of which will be presented in a more detailed way in the following Chapter 3.

I presented also the important role of small and medium sized enterprises in the society and the business life in Section 2.4. Just as Finland is in this study seen as a laboratory for the Information society, the Finnish region of South Ostrobothnia is seen as a laboratory for small and medium sized enterprises oriented at traditional production industry. For that reason the region of South Ostrobothnia and its industrial life was also briefly described in this chapter.

Because I reflect on my personal experiences while analyzing the research data, I presented also some aspects on my personal background at the end of this chapter.

In the following Chapter 3 I will delineate the definitions and connections between the concepts of information and communication systems (ICTS) and innovation, preparing for the empirical part of this study.

3. Introducing information and communication technology system as an innovation

In this chapter I delineate the definitions and connections between the concepts of information and communication systems (ICTS) and innovation, relevant for forming the emergent theory. While the research unit of the dissertation is an enterprise, a production SME, the unit of analysis is "the idea of the information and communication system, ICTS". The "idea" refers to the utilization purposes ICTS is adopted for. Each enterprise builds its individual approach to what purposes and in what ways it adopts ICTS to achieve sustainable competitive advantage. This is how the concept of innovation is combined with information and communication systems in this study.

At the beginning of Chapter 3 the nature of ICTS and some aspects concerning systems theory will be described (Section 3.1). In Section 3.2 the model to describe the activities and the structure of an enterprise is presented. It is the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003).

In the following Section 3.3 the various aspects of the conception of innovation are discussed and a number of terms which describe the phases of the innovation process are compared. I review briefly IS innovation literature and some other innovation literature from selected IS-research-related disciplines. Some results of the late survey-based study I conducted in South Ostrobothnia are also presented.

Classifying innovations is significant because earlier research findings suggest that facilitation factors vary among innovation types, and that adoption sequence and timing may also vary systemically between the types. The emergent theory presented later in this study aims to improve the categorization of ICTS innovations especially from the viewpoint of networking. One of the most fundamental and most referred works categorizing IS (ICTS) innovations so far is by Swanson (1994). Swanson's model is described at the end of Section 3.3, and some restrictions in its ways of demonstrating inter-organizational, networking innovations between organizations are pointed out.

Next I concentrate in Section 3.4 on the an enterprise's achieving sustainable competitive advantage. A way to this is the efficient utilization of the enterprise's resources and its (ICTS) innovation adoption. After an overall discussion of management I go through the four resource types of the organization from the viewpoint of innovation adoption.

With my eye on the upcoming phase of data analysis, I combine in Section 3.5 the overall management view and the four resource types by building a particular tool to help the data analysis. This tool is a chart emphasizing the SMEs' differing roles in differing organizational environments (as acting organizational entities versus actors in a network). The preliminary model is presented at the end of Section 3.5.

3.1 Information and communication technology systems, ICTS

While the research unit of the dissertation is an enterprise, a production SME, the unit of analysis is "the idea of the information and communication system, ICTS".

"The idea" refers to the utilization purposes for which ICTS is adopted. Each enterprise builds its individual approach to what purposes and how it is adopting ICTS to achieve sustainable competitive advantage, so every information and communication technological invention is re-invented (concept by Charters and Pellegrin 1972, Rogers 1995, pp. 175 to 180) by adopters who implement them in a wide variety of ways. The idea of the ICTS reflects the entrepreneur's knowledge and trust in the adopted technical (or organizational or other) invention around which the ICTS innovation is forming. On the one hand "the idea of the ICTS" is a rather abstract unit of analysis, but on the other that abstract nature makes it possible to generalize the results.

3.1.1 General systems theory and systems logic

According to Higgs (1995) one of the most important theories of systematic approach to knowledge is the general systems theory. Its origin is in the discipline of biology, and therefore it is focused on a system as an organic whole. The original theory was expanded during the 1960's into a general theory, which could be applied to any system. This general theory was needed, because the various disciplines had come to include similar general viewpoints and conceptions.

According to Higgs the general systems theory argues that systems (i.e. organized wholes) are found everywhere and they are not simply to be regarded as organic entities (as found in nature) or social entities (as found in human society). Virtually anything could be a system: physics, engineering, life-insurance statistics. All these examples consist of data that could be arranged into a systematic whole, i.e. into a system.

The general systems theory studies the properties of systems in general, rather than investigating specific systems. The general systems theory is based on the notion that there is a general ideal form which is common to all systems. Traditional scientific theories have focused on the logic of relationships in terms of the relationships between entities, that is, the correlative and causal relation between phenomena. That was why there was a need to develop a similar study for the logic of systems.

The logic of systems concentrates on organizational patterns in the systems, while the aim of the general systems theory is to look at the multiplicity of systems and at the patterns of organizations common in these systems. In other words, the general systems theory tries to reveal the nature of organizational patterns comprising systems.

In the general systems theory the components of systems interact with each other in a system which forms a whole entity. The theory sees a system as having specific goals. The system

needs to be controlled in a hierarchical way ensuring that inputs can be transformed into outputs, thereby achieving the goal of the system.

3.1.2 Determination and definition of ICTS

Due to multidisciplinary background literature the term "information system", IS, is used in many different forms. In this dissertation the terms IS (information system), ISS (information subsystem, included e.g. in the model of Ives, Hamilton and Davis 1980), IT (information technology, an expression emphasizing technical aspects), ICT (information and communication technology, emphasizing technological and communication combination) and ICTS (information and communication technology system, emphasizing the systems nature) are used, maybe not always as equals but still with the same function, to describe a system-natured, information and communication technology-related entity.

In her dissertation Tiainen (2002) referred to two meanings: "First, IS is used to refer to a system that includes information and the rules governing how the information is handled, e.g. governing a bookkeeping IS... …In addition, IS is used to refer to a specific organizational function and the staff doing them. The function includes acquiring (or developing and purchasing) and maintaining information and communication technology… …that is needed for information processing."

From the viewpoint of innovations Swanson (1994) described information systems as follows: "…IS innovation may involve a new IS product or service, a new IS work technology, or a new IS administrative arrangement. Each of these reshapes the content, extent and organization of the IS task." Swanson, referring to Zmud (1982), includes both products and processes into information systems.

The above mentioned also means that IS may also refer to non-physical artifacts, in other words, to certain kind of information products or information services and their delivery (see e.g. Meyer and Zack 1996), or information technology hidden in embedded systems.

Furthermore, abstract IS could be formed around human knowledge, for example, in the case of taking advantage of business intelligence systems handling either customer, supplier or business relationship in knowledge networks (see Ruggles 1998, Ruohonen and Salmela 1999).

Basing on the structuration theory Walsham (1993, p. 200) draws up IS conceptualisation, in which he argues: "A theoretical view of computer-based information systems in contemporary organizations which arises from structuration theory is that they embody interpretative schemes, provide co-ordination and control facilities, and encapsulate norms. They are thus deeply implicated in the modalities that link social action and structure, and are drawn on in interaction, thus reinforcing or changing social structures…"

Also Lyytinen and Damsgaard (2001) suggest that complex IT solutions should be understood as socially-constructed and learning-intensive artifacts, which can be adopted for varying reasons within different situations. The complex, networked, and learning-intensive features of technology should be recognized. Also the role of institutional regimes should be understood.

The above mentioned kinds of views on socially constructed information systems and the role of human beings (Hargadon and Sutton 1997, Bharadwaj et al. 1999) as a part of them is very important. It is exactly the human role which guides me to use the concept "system" instead the bare "technology" in this study. System units including ICT are seen here as a combination of resources, such as financial aspects, people, technology and information, so even at the first sight quite simple technological solutions are recognized in this study to be information and communication systems, ICTSs.

3.2 The model of an enterprise

As stated in the previous chapter (see subsection 2.3.1), research on various management and economic disciplines has been brought together to develop a rigorous model that can be used to analyze an enterprise's strengths and weaknesses, a resource-based view of a firm (Barney 1997, Wernerfelt 1984). It focuses on idiosyncratic, costly-to-copy resources controlled by the enterprise – resources the exploitation of which may give a firm a competitive advantage.

The resource-based view rests on two fundamental assumptions. First, based on Penrose (1959), firms can be thought of as bundles of productive resources, and different firms possess different bundles of these. This is the assumption of the heterogeneity of a firm's resources. The second fundamental assumption of the view (e.g. Selznick 1957) is that some resources are either very costly to copy or inelastic to supply, i.e. the assumption of resource immobility. If the resources which a firm possesses enable it to exploit opportunities or neutralize threats, if these resources are possessed by only a small number of competing firms and if they are costly to copy or inelastic in supply, they then may be the strengths of the firm and thus potential sources of competitive advantage (Barney 1991, 1997, see also Melville et al. 2004).

There are many proposals of what attributes of a firm may be thought of as resources. Barney (1997) divides resources into four categories: financial capital, physical capital, human capital and organizational capital.

The model adopted to describe the activities and the structure of an enterprise in this study is the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003). The four supporting functions of the model originally represent the internal systems of an organization, due to the intra-organizational view of the model. The four supporting functions can also be seen as the corresponding resources of a firm (e.g. Järvinen 2003, p.19).

In the model according to Kerola and Järvinen γ is the management function and φ, ε, λ, and ι are the supporting functions, while α, π and μ, are the operational functions. The framework of the eight main functions of a firm according to Kerola and Järvinen (1975) is described in Figure 3.1, and the original definitions of the functions are presented in the following framed box.

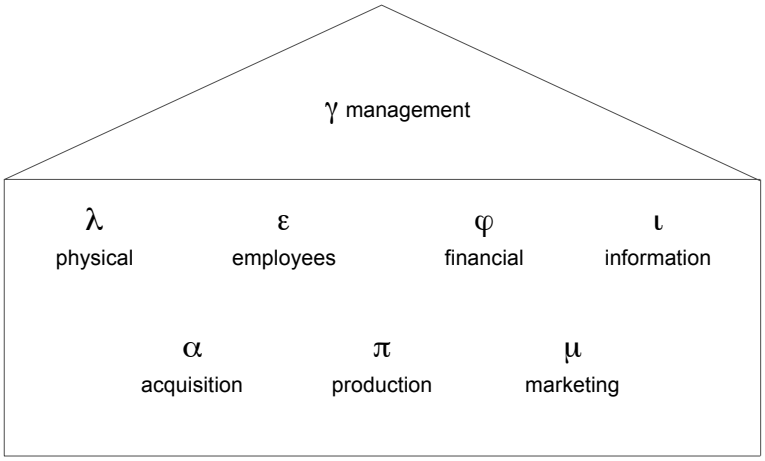

Figure 3.1: *The eight main functions of a firm according to Kerola and Järvinen (1975).*

The original definitions of the functions according to Kerola and Järvinen (1975):

γ function: set of management activities for the system as a whole; takes care of the maintenance and development of itself.

φ function: set of activities for the acquirement, attendance, maintenance and development of financial resources needed by the system.

ε function: set of activities for the acquirement, attendance, maintenance and development of man power resources needed by the system.

ι function: set of activities for the acquirement, attendance, maintenance and development of data, information and communication systems (information resources) needed by the system.

λ function: set of activities for the acquirement, attendance, maintenance and development of long term physical resources needed by the system.

α function: set of activities which from the system environment produces necessary raw material, components and other proper facilities required for the production of final outcomes. Takes care of maintenance and development of itself.

π function: set of activities which produces the final outcomes and takes care of the maintenance and development of itself.

μ function: set of activities which produces triggers from the system environment. Takes care of maintenance and development of itself.

In this study the assumed a priori aim of the management function γ is the financial success and competitiveness of the enterprise. To reach that aim enterprises must e.g. have skillful employees and adequate technical resources, such as ICT systems. Despite some differences and limitations, an analogy can be brawn between the role of the management function and the organizational capital resource by Barney (1997). For example, the management function γ has a broader view in Kerola and Järvinen's model. However, organizational capital according to Barney is an attribute of collections of individuals. It includes the organization's administrative framework (Penrose 1959), its formal and informal planning, controlling, and coordinating systems, its culture and reputation, and also informal relations among groups within the firm, between firms and those in its environment (Barney 1997 cit Tomer 1987).

The four supporting (resource) functions according to Kerola and Järvinen are used later in this study for analyzing the enterprise cases and transforming them into a theoretical model. Like the model of Ives et al. (1980) with a background view, presented in Chapter 2, the supporting functions work as a kind of "sensitizing device" (Giddens 1984) or a "practice lens" (Orlikowski 2000). They help me to see new ways of using information and communication technology, to analyze my cases and to anchor and classify the information systems which the respondents emphasized in the interview data. The four supporting (resource) functions can be described and combined with the resource view of Barney (1997) in a following way:

The financial function is seen fulfilled when the activities of an enterprise are made in an economic way, leaning on the basic management rule that financial success is the aim of the enterprise. That financial success may be achieved or not, as long as it is intended. In proportion, the financial capital resource by Barney (1997) includes all the different money resources the firms can use to conceive of and implement strategies[11]: Capital from entrepreneurs, from equity holders, from bond holders and from banks is financial capital, not forgetting retained earnings.

The function of the employees represents the social/human viewpoint within the enterprise. In most of the information systems the human role is fundamental, even though it is often forgotten. Enterprise networks are in many cases based just on human relationships, and many-sided human cooperation is needed between the enterprises to reach competitiveness. The human capital resource by Barney includes the training, experience, judgment, intelligence, relationships and insights of individual managers and workers in a firm (Barney 1997 cit Becker 1964).

When considering the information aspect there is some serious discrepancy between the views. The model according to Kerola and Järvinen stresses the importance of information as a separate resource. The fourth supporting function, information function, is attached to various kinds of information reserves, and also to the lifecycle of knowledge (such as knowledge creation, use, storing and demolishing). Barney does not regard information and knowledge as a separate resource, but in this study Kerola and Järvinen's way of thinking is adopted.

11 In addition to the monetary resources, the term "capital" can refer to other kinds of resources, e.g. "intellectual capital", "social capital" or land and environment (Järvinen 2003).

The physical function covers the physical, long-term resources of an enterprise. In this study the focus is on ICT issues – the acquirement, attendance, maintenance and development of computers and computer networks. Software components might be also included in that resource type. However, in many cases it is matter of opinion whether software should be seen as a part of the information function. The physical capital resource by Barney (1997) includes the physical technology used in a firm, a firm's plant and equipment, and also its geographic location and its access to raw materials. In this Barney refers to Williamsson (1975). The resource view is broader than the one adopted in this study.

Kerola and Järvinen's model with the management and the supporting resources of an organization is used as a basis for outlining the overall management perspective and the four supporting resource perspectives. This is done to enlarge the narrow concept of ICT indicating technological determinism into a broader concept of ICTS:

- the management (γ) function is the basis for an overall management perspective (achieving competitiveness in the context of the global information society)

- the financial (φ) function is the basis for a financial perspective (financial assets, capital from different sources, retained earnings)

- the employees' function (ε) is the basis for a human perspective (staff, organizational structures, human resources management, social networks, co-operation between organizations)

- the physical function (λ) is the basis for a technology perspective (the acquirement, attendance, maintenance and development of information and communication technology), and

- the information function (ι) is the basis for an informative perspective (ICT-resources management, some software, databases, information and knowledge issues)

The rest of the eight main functions of the organization according to Kerola and Järvinen are operational functions (α= acquisition, π= production and μ= marketing), which are not seen as actual resources in the model, and that is why they are here excluded. Corresponding issues are called, for example, primary activities by Porter (1985). The production or service main function π is firm-specific while all the other main functions are not. The same applies also for the information systems of those functions, respectively.

The main target group of this study are production SMEs. From that viewpoint the three primary functions of a firm are very important. SMEs often have minor resources, and their production activities must be prioritized. From the cooperation and thus from the networking viewpoint the acquisition and marketing functions are significant, because they form the main external interface of the firm to other enterprises.

As stated by its name, the nature of Kerola and Järvinen's model is functional. That creates some restrictions and limitations. For example, relations and logistics between the functions cannot be presented, and it is possible that some resources are not emphasized sufficiently

enough. Another possibility would be to describe the activities of a firm by using processes, which is the common way of outlining innovations in most cases, also in the IS research field (for information system process innovations see e.g. Mustonen-Ollila and Lyytinen 2004, Friedman and Cornford 1989).

However, I considered the advantages of the model a cogent reason for choosing it, compared to the alternatives. First, in spite of some restrictions, the main function classification of Kerola and Järvinen is exhaustive (Bunge 1967)[12] enough for the purposes of this study, and it can be applied even to the smallest firms with few employees. Second, the functional manner of representation does not exclude the use of a process model, because functions can be seen as systems, with their internal dynamics, processes and interfaces to the external world - the systems can be seen as "building blocks" of an enterprise. An adopting process kind of view would be more necessary in future research when the emergent theory is sharpened from taxonomy into e.g. conceptual frameworks. Third, as stated earlier, the resource categories can be adjoined to various networking theories, emphasizing respective resources. Thus the view of a single enterprise entity is quite easily enlarged into inter-firm cooperation, the networking view. Fourth, the eight main functions model also includes the idea that functions describing the systems are recursive, which increases the model's power of expression.

Functional analysis also helps to distinguish system entities. The functions help to anchor and classify the information systems which the respondents were emphasizing in the interview data. Adoption and diffusion are longitudinal events and every "adoption story" is unique and includes various choices of the enterprises. By using functional analysis those long-lasting events can be frozen into "snapshots" and separated from the organization.

The resources of any organization are the power which guides it through existing or anticipated problems. The production SMEs must also use their resources in the most effective way to resolve the new challenges of the Information society.

3.3 IS research and innovations

In this section I first review some central concepts concerning innovation. Various definitions of the term "innovation" are also compared to give a comprehensive view of the topic.

Several of the presented definitions are relevant from the point of view of this study, and they may overlap and intertwine with each other. However, because in this study it is an enterprise that is the innovation adopting unit, emphasizing organizational innovation is obvious, and thus the definitions of Swanson (1994) and Daft (1978) are selected to be the most suitable.

When comparing various terms which delineate the phases of the innovation process, I selected a basic term "innovation adoption". Hence, in this study it should be understood in a broader meaning, including all the (early) phases of the innovation process. That is because

12 The model of Kerola and Järvinen satisfies the requirements of the classification (Bunge 1967, p. 75). A good classification is a) remaining permanent, b) exhaustive, c) pairwise disjoint and d) natural (Järvinen 1999).

I build up a classification of information systems innovations, and being based on broad empirical data from enterprises findings will inevitable represent innovations at a number of phases in the enterprises' innovation adoption processes. Other significant concepts for this study are the re-invention of an innovation (Charters and Pellegrin 1972, Rogers 1995, pp. 175 to 180) and technology clusters (Rogers 1995, p. 235).

Next I review briefly IS innovation literature and some other innovation literature from selected IS-research-related disciplines. Some results of the late survey-based study I conducted in South Ostrobothnia are also presented. The results of the survey have been one of the starting points to this dissertation.

Classification of innovations is important because earlier research findings suggest that facilitation factors vary among innovation types, and that adoption sequence and timing may also vary systemically between the types. The emergent theory presented later in this study aims to improve the categorization of innovations especially from the viewpoint of networking. One of the most fundamental and most referred works categorizing IS innovations so far was presented by Swanson (1994). Swanson's model is described here, and some restrictions in the ways of demonstrating inter-organizational, networking innovations between the organizations are recognized.

After presenting Swanson's classification I concentrate on the enterprises' achieving sustainable competitive advantage. A way to this is the efficient utilization of the enterprises' resources and innovation adoption. After an overall management discussion I go through the four resource types of an organization from the viewpoint of innovation adoption.

3.3.1 Innovation overview

The studies of Everett Rogers are recognized as pioneering in the innovation-diffusion literature. Although they were originally based on the study of agricultural innovations (Rogers 1958), they have been the inspirer for research within various disciplines. Also in this study one of the background theories is the work of Rogers. He defines (and thus separates) the concepts of innovation, innovation-decision process, adoption and diffusion.

Rogers defines an innovation as "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers 1995, p. 11).

It must be remembered that Rogers' focus is on an individual rather than an organization. Rogers also takes quite a narrow view on the innovator. He reserves the term "innovator" to be synonymous with the first adopters of an innovation, which covers just the first 2.5 % of all adopters. It is generally presumed that the decision of adopting diffusion models is guided by two separate forces, internal interaction (i.e. imitation) and external interaction. Basing on Bass (1969) Majahan defines (Majahan et al. 1990) innovators as users whose decisions of adoption are guided by external factors, while imitators are users whose decisions are guided by internal interaction. It means that innovators do not necessarily have to be the first adopters but innovation takes place during the whole diffusion process.

In his narrower definition of organizational innovation Daft (1978) quotes Becker and Whisler (1967). According to them an innovation is defined as "the first or early use of an idea by one of a set of organizations with similar goals". At its broadest an organizational innovation refers to "the adoption of an idea or behavior that is new to the organization adopting it" (Daft 1978, p. 197).

Another broad definition is presented by Biemans (1992), basing on Zaltman et al. (1973). The adopting unit can be an individual, a business or any other organization. According to them, the term "innovation" usually refers to one of three different variations of the concept:

1) The process of developing a new item, which refers to the creative or development process with something new as a result. In this class an innovation is defined from the perspective of a development unit. It concerns the stages of the development process and the characteristics of the development unit.

2) The process of adopting a new item. An innovation is viewed as the process whereby a new item is adopted, and thus implemented, by an adopter. In this view an innovation is defined by the directions of the adopting unit, and it relates to the stages of the adoption process and the characteristics of the adopting unit. The definition Biemans selects here (cit Knight 1967) is: "the adoption of a change which is new to an organization and to the relevant environment".

3) The new item itself, a class which refers to the item that has been invented and is regarded as new. From that perspective innovations are usually defined as being new to the unit of adoption.

Focusing on information systems innovations, one of the fundamental definitions is by Swanson (1994): "Information systems (IS) innovation may be broadly defined as innovation in the organizational application of digital computer and communication technologies (now commonly known as information technology, or IT). It is fundamentally organizational innovation, whether it is analyzed from the vantage point of the entire organization, or from a lower level, that of one or more of the organizations adopting subunits, or even at the individual level among a subunit's secondary adopters".

Lyytinen (2001, see also Lyytinen and Rose 2003a, 2003b) defines an ICT innovation (interpreting also Swanson) in the following way: "An ICT innovation is a subclass of innovations which embed computational solutions and artifacts into the innovation space. [It] can cover a series product, incubative, adoption, and use innovations over time (path creation, innovations, diffusion). [Following interpreting Swanson 1994] A subclass of those is IS innovation which is innovation in the application of digital and communications technologies".

From the angle of this study most of the above presented concepts are relevant. I do not make any synthesis of definitions, even if the presented ones may overlap and intertwine with each other. In this study an enterprise, a production SME, is the adopting unit. Thus the organizational innovation emphasis is obvious, and the definitions of Swanson (1994) and Daft (1978) are the most suitable. Production SMEs can be also be seen as "a set of

organizations with similar goals" (Daft 1978). However, in the SMEs the role of an individual entrepreneur is often significant, and Rogers' individually focused model is applicable, when reservations about the term "innovator" (Bass 1969, Majahan et al. 1990) are kept in mind. Adopting information and communication technology offers new kinds of possibilities to define unique, customer-based products and services in cooperation with customers. Concurrently the whole developing and producing process within the supply-chain/network in which the enterprise is involved may change, as well as the administrational structures, due to the new communication possibilities. All the above mentioned applies also to Bieman's (1992) depiction.

Yet, quite contrary to Lyytinen (2001), IS innovation is understood in this study as a main concept, not as a subclass of information and communication technology innovations. It must also be noted that Swanson in his original definition stresses organizational aspects ("…defined as innovation in the organizational application of digital computer and communication technologies…"), and this is also in the focus of this study.

3.3.2 Innovation adoption and important early phases

The traditional model of an innovation process consists of initiation, adoption decision and implementation (Rogers 1995). According to Rogers the innovation-decision process is the "process through which an individual (or other decision-making unit) passes from first knowledge of an innovation to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision" (Rogers 1995, p. 20).

The innovation-decision process leads either to adopting or rejecting the innovation. Adoption is "the decision to make full use of an innovation as the best course of action available". Rejection is naturally the decision not to adopt an innovation (Rogers 1995, p. 21).

Implementation is another term sometimes used in the field of innovation-related IS research. However, it usually means constructing new administrational information system, and that is not in the focus of this study.

Kautz and Nielsen (2000) stress the term adaptation, using it in accordance with Veryard (1995). Veryard, as well as Damsgaard et al. (1994), have used the notion of penetration, the latter to describe the process of information technology uptake through and in organizations. Veryard criticizes that penetration, like transfer, just describes one-way influence: either the organization accommodates itself to the technology or the organization assimilates and transforms the technology. According to him the concept of adaptation comprises a two-way process.

The phase after adoption decision, "diffusion", is a communication process, an activity of information seeking and processing. Innovation diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995, p. 10).

However, in this study I have selected the term "innovation adoption". Hence, in this study it should be understood in a somewhat broader meaning than that of Rogers, i.e. including the early phases of his innovation process. I build up a classification of information systems innovations, and being based on broad empirical data from enterprises my findings will inevitable represent innovations at various phases in the enterprises' innovation adoption processes.

Adaptation would also be quite a suitable choice, but the term "adaptation", even thought it is reciprocal, expresses a more passive, reactive attitude when compared with the term "adoption", which has uncompelled, proactive connotations. I argue that adoption may also be a reciprocal, cooperative process, especially when it occurs in the context of an enterprise network.

Parallel to the other terms, "implementation" in the context of IS research emphasizes a more software oriented, building or "running-in" process. Also the notion of penetration is inadequate for describing the complex nature of ICTS innovation, and it should be used very carefully. For example, in the recent years the growing use of the Internet has been evaluated mostly according to penetration estimates, which easily gives a distorted view of the actual utilization.

From the viewpoint of IS innovation research an important additional note is that interactive communication technologies follow a diffusion pattern and create a social impact which is quite different from the diffusion and impact of mass communication technologies. An interactive innovation is of little use to an adopting unit unless another units with which the adopter wishes to communicate also adopt it. With each additional adopter the usefulness of an interactive communication technology innovation increases for all of the adopters. A critical mass of units must adopt an interactive communication technology innovation before it of use for an average unit in the system (Rogers 1995, pp. 313 to 317). To enterprises striving for networking, that critical mass is the community they are working with, i.e. the network of their (business) partners.

3.3.3 Re-invention of the innovation

As discussed in the subsection 3.3.1, compared to Rogers' definition of innovation Daft (1978, p. 197) has used a slightly different form: "…an idea or behavior that is new to the organization adopting it".

The words "…new to…" underline the important aspect in this study, the production SMEs' own active viewpoint as ICT adopting organizations. In my experience the developers and studies of information systems, especially the ones targeting the SME sector, have mostly had a kind of an exterior viewpoint, according to which adopting new information and communication technology is inevitability. Technology brings only good things to the adopting organization, it is a "blessing". The technology adopting organizations are given quite a passive, mainly receiving role. If an SME has not been immediately interested in new inventions, it is doomed as laggard (term by Rogers 1995). However, e.g. in our research

(Mäki and Riihimaa 1995), when the enterprises invested in communication technology they did it quite rationally, according to direct utility value.

As stated earlier, the diffusion after the adoption decision is a process of communication, an information seeking and processing activity. Innovations may appear not just individually, but as closely interrelated, yet distinguishable elements of technology. The boundaries around any given innovation are often not clear-cut or distinct. In the minds of its adopters an innovation may be perceived as closely related to another new idea. This is what Rogers calls technology clusters (Rogers 1995, p. 235). I argue that it is another significant and potential way to adopt ICTS at the SMEs; finding and transforming the ways of appliance, and by those means achieve competition advantage.

The concept of re-inventing an innovation (Charters and Pellegrin 1972, Rogers 1995, pp. 175 to 180) is also significant to this study. According to Rogers, certain innovations are more flexible in nature, and they are re-invented by many adopters who implement them in a wide variety of ways.

In the 1970's, diffusion scholars began to study the concept of re-invention. It was defined as the degree to which innovation is changed or modified by the user in a process of its adoption and implementation (Rogers 1995, pp. 175 to 180). Charters and Pellegrin (1972) were the first of the scholars to recognize the occurrence of re-innovation. When the concept of re-invention became known, it began to be measured, and a considerable degree of re-invention of many innovations were found.

Rogers argues that some of the reasons for re-innovation lie in the innovation itself, while others involve the individual or organization adopting a new idea. Further, according to him some features make innovations more easily re-invented:

1) Innovations that are relatively more complex and difficult to understand are more likely to be re-invented.

2) Re-invention can occur because of an adopter's lack of full knowledge about the innovation.

3) An innovation that is an abstract concept or that is tool with many possible applications is more likely to be re-invented. A computer software program is one of Rogers' example of this.

4) When an innovation is implemented in order to solve a wide range of users' problems, re-invention is more likely to occur.

5) Local pride of ownership of an innovation may also be a cause of re-invention. The innovation is in that case often modified in certain rather cosmetic or minor ways so that it appears to be a local product.

6) Re-invention may also occur because the change agency encourages his clients to modify an innovation.

Most of the features which Rogers mentions fit quite well the ICTS innovations and the SMEs. The complex and most often abstract nature of ICT and the lack of full knowledge about rapidly changing applications are evident from an entrepreneur's point of view. I argue that they are at least a part of the reason for ICT re-invention in practice. Adopting an ICTS innovation is not just a passive action of implementing a standard template of a new idea. ICT is generic technology and it offers applicable frameworks to the adopters. The knowledge how to apply them must be generated case-specifically by the adopter. Like Hargadon and Sutton (1997) said, a firm's capability are not its resources as such but the ways it uses them.

Also Pinch and Bijker (1987) and Orlikowski (1992) noted that particular technologies can be adapted and used in different ways, and thus organizations may retain a degree of "interpretive flexibility".

3.3.4 IS research field and innovations

In this subsection 3.3.4 I first briefly review IS innovation literature. Within the IS research field the interest for innovation theories has increased since there has been seen similarities in the processes of IS implementation and innovation diffusion. The view of the innovation literature in the IS research field is voluminous and fragmented, with a wide variety of viewpoints and focuses. However, some criticism e.g. against the limited scope has been presented and more holistic adoption models have been demanded. When focusing particularly on the IS innovation literature about networked, inter-organizational production enterprise systems, previous research seems to be even more limited in number and some parts of it are out of date due to the rapidly changing situations.

Relating to earlier IS innovation literature some results of the late survey-based study I conducted in South Ostrobothnia are also presented. The survey and its results have also been one of the starting points for this dissertation, because the research process and its results made me to see not only the threats but also the opportunities for the production SMEs in the context of the Information society.

Some innovation literature from other IS-research-related disciplines is presented next. The topic of innovation is widely discussed also in many disciplines related to the IS research field and it is addressed by a broad range of literature, such as the economic and organizational sciences, sociology, education sciences, or technology policies.

At the end of this subsection I present some aspects of classifying innovations. Differences between innovations are important to identify, because earlier research findings suggest that facilitation factors vary among innovation types, and that adoption sequence and timing may also vary systematically between the types. In the course of time there have been a wide variety of innovation classifications, but one of the most fundamental and most referred works categorizing IS innovations so far was presented by Swanson (1994). His context is organizational innovations, focusing on information systems. However, the model of Swanson

has some weaknesses, restrictions in the ways it demonstrates inter-organizational, networking innovations between organizations. Especially from the networking viewpoint the emergent theory presented later in this study aims to improve the categorization of innovations.

IS innovation research

In the IS research field there is an increasing interest in innovation theories since there seems to be similarities in the processes of IS implementation and innovation diffusion. Especially the innovation diffusion theory has been widely applied to the study of IT innovations during the past years (Prescott 1995). Lyytinen and Rose (2003a) distinguish one of the main streams, the theories concerning industrial innovation. Another branch is formed by various diffusion models (e.g. Jaakkola 1991, Baskerville and Pries-Heje 1997).

Rogers' (1995) model is the most widely accepted in identifying the characteristics of innovations in IS research in general, and particularly in the research concerning SMEs (Al-Qirim 2003, Iacovou et al. 1995, Karahanna et al. 1999, McGowan and Madey 1998, Moore and Benbasat 1991, Moore and Benbasat 1996, Premkumar and Roberts 1999, Thong 1999).

However, the view of the innovation literature in the field of IS research is voluminous and fragmented, with a wide variety of viewpoints and focuses. Criticism against the limited scope has been presented and more holistic adoption models have been demanded (e.g. Attewell 1992, Moore and Benbasat 1991, 1996). In his extensive article Iivari (1993) suggests a framework for micro innovation theory of IS adoption to complement the dominant macro innovation focus of research. The IS innovation research is also criticized for its mixed results (Prescott and Conger 1995) and its limited and fragmentary scope (Swanson 1994). Lyytinen and Rose (2003a) argue that the past IS innovation research has primarily described and explained the volume of technological and organizational change associated with IT innovation, instead of trying to identify the types of changes in system development and their outcomes. IS innovation research focusing on process innovations is also seen important but too rare (Mustonen-Ollila and Lyytinen 2003). Veryard's (1995) criticism against the emphasis on penetration research is another example of distortion in the research orientation. Most commonly it seems that any coherent research lines are difficult to find. Every author typically emphasizes the importance of a narrow gap in the IS innovation research field he or she has identified.

One of the recognizable lines of research literature has identified various emphasized characteristics of IS adoption as an organizational innovation. When conceptualizing the determinants of organizational innovation adoption, it is advisable to look at different contexts (Thong 1999). In addition to the innovation attributes suggested by Rogers (1995)[13], many other possible perspectives have been identified, and technological innovation research has determined several variables for studying organizational adoption, e.g. Kwon and Zmud (1987), Tornatzky and Fleischer (1990), Damanpour (1991), Grover (1993), and Thong (1999). As a representative example, Kwon and Zmud (1987) identified five influencing

13 Rogers (1995) identifies five innovation attributes determining the adoption of innovations. These five attributes include relative advantage, compatibility, complexity, observability, and trialability, which have been extensively utilized by many researchers in order to explain the adoption and diffusion of IS innovations.

contexts: the innovational, organizational, environmental, individual and task factors. Within the contexts there are various factors identified that would influence IT adoption. Even if they are not much focused on in this study, I present some of them briefly because of their evident relevance.

Kwon and Zmud (1987) named several factors influencing IT adoption: top management support, the size of the enterprise, quality of IS, user involvement, product champion and resources. According to Al-Qirim (2003) these findings are supported by other recent IS-related innovation literature concerning SMEs (e.g. Premkumar and Roberts 1999, Thong 1999, Thong and Yap 1997, Thong and Yap 1996). Of the factors presented by Kwon and Zmud (1987) resources are considered more carefully later in this study. However, at least two of the remaining factors need some attention. Top management support is important, because in an SME the CEO, who is usually the owner of the firm, is the central authority and the decision maker investing resources in the IS adoption (e.g. Blili and Raymond 1993, Thong 1999, Thong and Yap 1996).

There is also always the question whether information technology should be pushed or pulled. In the 1960's and 1970's the dominant viewpoint of the innovation models was whether the success of innovations was explained better by the science push or the market pull. In the 1970's and 1980's simple innovation models were abandoned and models including many interactive factors were created instead (Miettinen et al. 1999, pp. 4 to 5). In their article Lyytinen and Rose (2003b) suggest that technological characteristics need to be included as important antecedents in the IT innovation analyses. They argue that the IS scholars need to move beyond the pull-driven analysis of managerial choice and the resulting purely social explanations of IT innovation. They think that a careful examination of the changes in computing capability should form an important ingredient in the IT innovation analyses. The true needs of an enterprises should be the primary motivations for ICTS innovation adoption. However, I agree that sometimes it may be necessary also to push new technology, but that must be done very carefully and in responsible ways.

Another important aspect is the size of the organization. The literature about an SME's ability to adopt innovation is quite contradictory. Ussman et al. (1999) have studied the discussion of the relation between a firms' size and its innovative capability. According to them, two opposing positions exist. On the one hand, there are authors who follow the arguments of Schumpeter (1934), who concluded that large companies were the ones with more innovative behavior. On the other hand there are those who insisted that due to their characteristics the SMEs would be more inclined to the introduction of organizational changes and therefore to innovative activities. Ussman et al. (1999) refer to some researchers (e.g. Gonzalez et al. 1997) who argue that larger companies are more dynamic in innovation activities. Contrary to that, according e.g. to Harrison and Watson (1998) the SMEs are generally more flexible, adapt themselves better and are better located to develop new ideas and to implement them. Thus these authors claim that an SME, due to its specific features, can more easily generate changes inside the organization. In addition, according to Ussman et al. (1999), some empirical studies also insist that there is no relation between the size and the innovative capability.

I also found that the size of an enterprise is one of the important factors when IS innovations are discussed. In 1995 I conducted a survey based study (Mäki and Riihimaa 1995) to define the profiles and special features of SMEs and their adoption of ICT. The study is presented later in more detail.

When finally focusing on the IS innovation literature about particularly networked, inter-organizational systems of production enterprises, previous research seems to be even more limited in number. Some parts of it are also out of date due to the rapidly changing business world of applying ICT and the resulting increased adoption by the SMEs. Various industry branches do have research from the new e-business viewpoint (see e.g. Tuunainen 1999). However, inter-organizational IS innovation literature is mostly technologically oriented. The exceptions that prove the rule are e.g. Caldeira and Ward (2003), who concentrate on a resource-based theory and the SMEs' IT adoption, Peterson and Fairchild (2003), who concentrate on the ASP services at SMEs, Riihimaa and Ruohonen (2002), who concentrate on the knowledge management business premises, and Brown (2002), who concentrate on the knowledge networks between SMEs.

A summary of the survey by Mäki and Riihimaa, 1995, and other local results

In 1995 I conducted a survey-based study, "Small enterprises as pedestrians on information super highways" (Mäki and Riihimaa 1995, orig. title in Finnish). The survey was organized in cooperation with Statistics Finland, with its local office in Seinäjoki. Three different kinds of data were combined there. By using all of them it was possible to define profiles and special features of the SMEs in rural areas and their adoption of ICT. The results include e.g. the effect of the size of an enterprise on the adoption process, the effect of geographical placement, differences between industrial branches and early SME experiences of adopting and utilizing telematic[14] (= the Internet) services.

As a conclusion the most important results were as follows:

- The adoption of primal information technology (such as PCs and modems) was a continuous, but slow process at the production SMEs.

- The then existing forerunner applications of information technology were in short quite simple, profitable, administration-reductive software, such as billing, monetary transactions and word-processing applications.

- The smaller the enterprise was, the more clearly the adoption was emphasized on one single function or process.

- In the enterprises of over nine employees there was a much richer variety of information systems than in the smallest firms.

14 In survey we used the term "telematics", which did not become established in the end. Telematics means the combination of telecommunication and information technology, e.g. PCs, and currently the term ICT covers it.

- In the enterprises located in rural areas information systems were simpler and more conventional, and there were fewer applications than in the enterprises located in towns and municipalities.

- When the enterprises invested in (communication) technology they did it quite rationally, according to its direct utility value. The then existing line of adoption was: telephone – mobile phone – telefax – (PC) computer – communication facilities.

- The SMEs adopted new applications quite rapidly if they were well motivated by e.g. the utility value.

We illustrated the ICT adopting curves of various branches. The figures indicated that in South Ostrobothnia the service industries were the first to adopt information technology. They were soon followed by the local government sector. Production SMEs, on the other hand, were extremely cautious in adopting information technology (such as PCs). According to our data it seemed obvious that different business branches have different kinds of adoption processes and the production industries adopt ICT systems differently from the enterprises in the service branch.

Figure 3.2 illustrates how each of the branches adopted information technology in relation to the adoption process in the whole province. If the intensity of the adoption process in a certain sector is the same as the average value for the whole province, the s-quotient value is 1. If the value is over 1, the adopting process is more active in this sector than in the province as a whole (Mäki and Riihimaa 1995, p. 19).

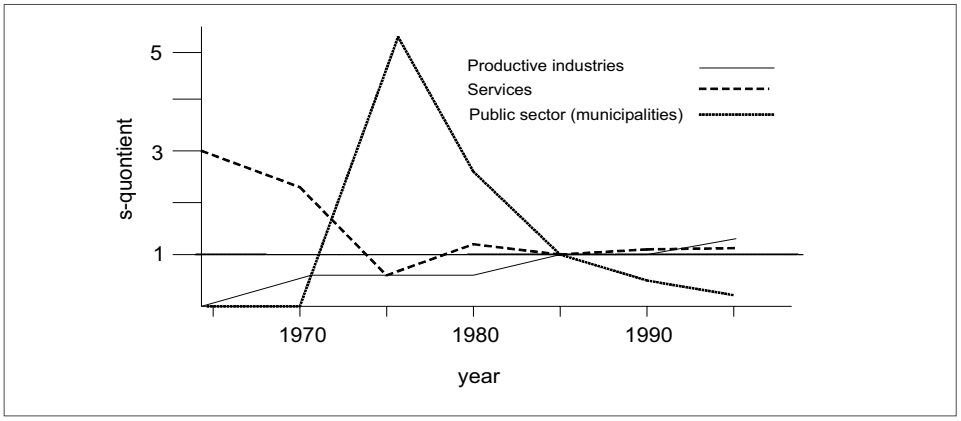

Figure 3.2: *Intensity of adopting information and communication technology by SMEs and some other types of organizations in South Ostrobothnia 1965 – 1995 (Mäki and Riihimaa 1995, p.19). The higher the value, the more intensive the ICT adopting process.*

After our survey several regional reports concerning the "laboratory for the Information society", South Ostrobothnia, were published, e.g. Puistosalo (1996a), Puistosalo (1996b), Palm (1997), Rintaluoma (1998), Kortelahti and Nevanperä (1999) and Taipalus and Varamäki (2000). Some of them are based on the same or partially the same questionnaire as our survey.

A remarkable source of research reports concerning South Ostrobothnia was a regional development project called ITEP, Information Technology in Etelä-Pohjanmaa (ie. South Ostrobothnia). The project published about 20 different research reports, e.g. Petäjä (2000), Riihimaa and Vuori (2000), Linnamaa et al. (2000), and Taipalus and Varamäki (2000)[15]. The first set of data of this dissertation study was also gathered under the ITEP project.

As a summary of above mentioned local reports it seems that the small enterprises in South Ostrobothnia are deliberate when it comes to the ICT technology. However, the adoption potential of new technology and the practical use of the existing technology are at an average level when compared nationally or to some other areas in Finland (e.g. Berg and Karttunen 1998, Berg et al. 1999, Karttunen et al. 2000, Granholm 2001, Helsinki Chamber of Commerce (2001), Lahtinen and Roose (2003)).

The survey and its results have been one of the starting points also to this dissertation, because the research process and its results made me see not only the pressures but also the possibilities for the production SMEs in the context of the Information society. The results raise many questions, in which I have tried to answer during my professional career. Conducting the survey also taught me for its part to respect and appreciate the entrepreneurs' viewpoints.

Other IS-related innovation disciplines

The topic of innovation is widely discussed also in many disciplines related to the IS research field and it is addressed by a broad range of literature, such as economic and organizational sciences, sociology, education sciences, or technology policies.

In the economics and business administration the focus of innovation research has been on management and on aspects of innovation organization. Networking has been an important viewpoint. None of the current organizations is able to manage such a number of skills and resources that it could create an innovation alone, so a network of actors has became the birthplace of innovations (Powell et al. 1996).

The concept of innovation network arose strongly at the beginning of the 1990's among the disciplines of economics, business administration and organizational science, which were economically oriented. After the model of linear innovation chain was replaced with more complicated interactive innovation models, the issues of interdependencies, co-operation of different actors and learning in the process of interaction have become the focus. Significant viewpoints are how interaction is build, which kind of forms and contents it has and which are the terms of success in interaction. Research of innovation networks aims to answer these questions (Miettinen et al. 1999).

15 The documentation of the project was published on a www page http://www.sjoki.uta.fi/tyt/itep/osaraportit.html, among documentation were also most of the reports mentioned.

Powell et al. (1996) have summarized the reasons for networking as five main aspects: aiming at sharing the risks, access to new markets, the need to adopt new technologies, shortening the time of accessing the markets and combining the complementary skills.

Miettinen et al. (1999) defined the innovation network as a network(s) of actors which are involved in the developing process of an artefact or a process, and the aspects of innovation network as follows:

1. An innovation network is a network formed by institutional actors, which are involved in developing a new product or process. The resources and knowledge of the actors are in a complementary relationship to the product or process under development.

2. The need for co-operation between the actors of an innovation network is based on their former activities. They resolve the problems in their activities, try to enlarge their activities and use their previously formed resources and knowledge in new ways.

3. An innovation is a polyphonic process, where every actor has an interest and point of view of his own to the innovation under development.

4. Networks and the structures of networks change during the innovation process.

5. Synergy and uniqueness which is bundled up by the innovation network explains the success of the innovation.

Sociological research became interested in the innovations in the mid-1980's. The actor-network theory and the theory of social shaping of technology are examples of the interests the social sciences have in the development of technology and the research of technical innovations (Miettinen et al. 1999).

The actor-network theory was developed by French researchers Latour and Callon (Callon 1986, Latour 1987). The theory looks at the innovation process from the viewpoint of an artefact (which may be a product or a process) and the networks needed concurrently when the artefact is created and delivered. According to them these are two inseparable aspects of the same process. Latour says there is not such a thing as a technical artefact. At the beginning there is a project to create a product. If it is successful, an institution is made up, which includes the established practices to produce and use the artefact. If the project is not successful, the artefact will disappear (Miettinen 1999, p. 9).

Latour and Callon use a metaphor from politics. When a network is created, it is a process of mobilization, organization and persuasion. The key position is held by an innovator, who succeeds in directing, mobilizing or changing the interest of other actors according to his own visions. The metaphor has many limitations, because such things as the complementing of knowledge and information, learning, the reciprocity in the co-operation of independent actors and the content of technological information are excluded.

The theory of the social shaping of technology has a broader scope. The innovation process does not have any single key person nor any single possibility of development. The interests, inputs and actions of different social groups, including the users, affect the process of the

developed product or process during the innovation. (Miettinen 1999, p. 10, Pinch and Bijker 1987, Bijker 1993).

The evolutionary innovation economic science has had clear effect on the political thinking and decision making of technology. It uses a metaphor from the biological evolution theory while examining the development of innovations. Anderson and Tushman (1990) have pursued this idea by proposing a dichotomy of competence-enhancing and competence-destroying technological discontinuities (innovations). When technologies are created, markets and organizations choose the ones capable of surviving. Those surviving technologies establish their position by becoming dominant designs and industrial standards. (Miettinen et al. 1999, p. 8, Anderson and Tushman 1990, Lotz 1998).

Van de Ven and Poole (1995) propose that four basic theories may serve as building blocks for explaining the processes of change in organizations: life cycle, teleology, dialectics, and evolution. According to them these four theories represent the different sequences of events of change that are driven by different conceptual motors and operate at different organizational levels.

The identification of innovations that may cause disturbance is tried within a related research strategy. That is in line with a long-standing tradition which has come up with such dichotomies as "radical" versus "incremental" innovations (Freeman 1987, Freeman and Perez 1988, Lotz 1998, Henderson and Clark 1990).

Research oriented to economics, business administration and technological policy has also emphasized analyzing and identifying large and stable consortiums or systems, which may enable innovations Miettinen et al. (1999). Miettinen et al. classify these as the following five categories (Miettinen at al. 1999, pp. 22 to 23):

1) The entities of technological and production knowledge of a single enterprise, which are described by using the concept of core-competence. It also includes the strategic alliances of enterprises and consortiums based on agreements. According to Cohen and Levinthal (1990) the ability of an enterprise to absorb new technologies is based on a strong culture of knowledge, which makes it possible for the enterprise to exchange knowledge and communicate with the community of science and technology.

2) Regionally located technology and science parks and hatcheries. These try to advance networking by gathering enterprises around common services or the same location, which is assumed to help co-operation, synergy and innovation.

3) Networks of small specialized enterprises, which are regionally formed (such as Emilio Romagna in North Italy or South Ostrobothnia in Finland) or networks between enterprises and research organizations (such as Silicon Valley). The perspective is cultural and historical, the networks are based on local specialties and local needs.

4) Economical blocks or clusters, where the basis of formed by enterprises which complement and support each other.

5) National innovation systems of all the national actors which effect the innovation development.

Miettinen et al. (1999) bring in some new aspects, when they combine different views on networking in the disciplines related with the IS research field. Those aspects may be more related to the external and environmental environment of the enterprise, but they remind us of the multifaceted reality of the enterprises, when the topic of innovation is discussed.

IS innovation classification model of Swanson

Innovations may themselves be classified. Innovation types are significant because research findings suggest that facilitation factors vary among them, and that adoption sequence and timing may also vary systemically (Swanson 1994).

In his presentation Lyytinen (2001) demands better definition taxonomies of ICT innovation, more exact characterization of innovation types and modalities, better theoretical constructions for identifying and distinguishing between different innovations and better alignment with organizational theory.

In the course of time there has been a wide variety of innovation classifications. For example, Robey (1986) distinguishes between new products/services, administrative innovations and technical innovations. Zmud (1982) distinguishes between product and process innovations. Lyytinen (2001) separates several types of innovations, such as having vs. using an innovation (ref. Zaltman et al. 1973), product and incubative in-house innovations or inventions (ref. Damanpour and Gopalakrishnan 1998) and imitative innovations with subclasses of adoption innovations and use innovations.

However, one of the most fundamental and most referred works categorizing IS innovations is by Swanson (1994). His context is organizational innovations, focusing on information systems. The basis for Swanson's model was from Daft (1978), who proposed a dual-core model for explaining the differing characteristics of administrative and technical innovations.

Swanson claims there is a lack of theoretical models: "While organizational innovation theory has been selectively applied in IS contexts, it has not been significantly elaborated upon or extended. No theory of IS innovation in its particulars is distinguishable from organizational innovation in general. There exists no useful typology of IS innovations, which in consequence are differentiated neither among each other, nor from other, non-IS innovations. Nor is IS-innovation typically viewed in the larger organizational context in which innovation takes place. For these reasons, surprisingly little about the contribution of IS innovation to the business ostensibly supported can be said. This fails to serve not only IS theory, but organization theory in the long run."

In his model, "in a straightforward extension of Daft's (1978) dual core model of organizational innovation", Swanson separates three main types of IS innovations: innovations confined to the IS task (administration and technological, types Ia and Ib), innovations supporting the administration of the business (type II) and innovations related to or imbedded in the core technology of the business (production process, product itself and integration innovation, types IIIa, IIIb, and IIIc, respectively). Swanson names three kinds of innovations: process innovation, product innovation and integration innovation.

In the following table 3.1 the innovation types, innovation descriptions and some illustrative examples of categorized innovations according to Swanson (1994) are presented.

Table 3.1: *Main categories of information systems innovations in organizations (Swanson 1994).*

Innovation types	Description	Illustrations
Type I a	IS Administrative	Maintenance Departmentalization (1970s and 1980s) Process Innovation Chief Information Officer (1990s)
Type I b	IS Technological Process Innovation	Systems Programming (1960s) Chief Programmer Team (1970s) Data Administration (1970s and 1980s) Application Prototyping (1980s)
Type II	IS Product and Business Administrative Process innovation	Accounting systems (1950s) Information Centers (1970s and 1980s) Executive Information systems (1980s and 1990s)
Type III a	IS Product and Business Technological Process Innovation	Material Requirement Planning (1950s and 1960s) Airline Reservation systems (1960s) Computer Integrated Manufacturing (1980s and 1990s)
Type III b	IS Product and Business Product Innovation	Airline Reservation systems (1970s and 1980s) Remote Customer Order Entry and Follow on Customer Service Systems (1980s)
Type III c	IS Product and Business Integration Innovation	Inter-organizational Information Systems (1980s) Electronic Data Interchange (1980s and 1990s)

Swanson's classification is based on the concept of organizational innovation. Thus the typology is capable of recognizing innovations which are aimed for competitive advantage and differentiating whether the purpose of the IT innovation is e.g. to achieve cost-leadership, differentiation or niche (=Porter's generic strategies; Porter 1985, Porter and Millar 1985):

- the information function, types Ia and Ib of IT innovations strive for efficiency in IS development and use, and hence for cost-leadership

- administration, type II for rationalization with diminishing costs, and hence for cost-leadership

- Type IIIa for better quality, and hence for supporting some aspects of differentiation

- Type IIIb for novel products and services, and hence for niche or differentiation

- Type IIIc for better co-operation and partnership, and hence both for diminishing negative effects of division of labor and for differentiated products and services.

Swanson's (1994) innovation types are also related to the eight main functions of Kerola and Järvinen (1975) as follows:

- Types Ia and Ib to the ι-function
- Type II to all the other functions but to the π-function, i.e. γ, λ, ε, φ, and minor parts of α and μ.
- Types IIIa and IIIb to the π-function
- Type IIIc to the relations to the bodies outside the firm, mainly functions α and μ.

Swanson's typology is currently a bit outdated. It reflects the reality at large enterprises with their own IS units, and - which must be noted - it was created before the powerful penetration of the Internet and decentralized computing ("…today's centralized mainframe-based IS unit…"). Thus type IIIc innovations have to cover all inter-organizational issues, even though Swanson has also admitted the importance of inter-organizational relationships (e.g. Ramiller and Swanson 1997).

Later the model has been expanded, e.g. by Grover (1997, strategic and technological moderators) and Lyytinen (2001, base technology core). The latest revision was presented by Lyytinen and Rose (2003a, 2003b), based just on the technology core. However, these studies emphasize technology, and they do not touch to the most essential weakness of Swanson's model, the restrictions in the ways of demonstrating inter-organizational, networking innovations between organizations. In Swanson's original model the interfaces between organizations, and thus important reciprocal communication channels, are left with minor attention.

3.4 Management and resources as prerequisites of ICTS innovations

In this section 3.4 I shall present the management function and the four supporting resources from an individual enterprise's point of view as prerequisites for ICTS innovations. Long-term success is essential to the enterprises, and they should achieve sustainable competitive advantage. Also in this study the financial success, the competitiveness of the enterprise and a sustainable competitive advantage are the assumed a priori aims of an enterprise's management function. A way to this is the efficient utilization of the enterprise's resources.

The overall management function of managing the resources (Kerola and Järvinen 1975, Barney 1997) is presented first in subsection 3.4.1. Later that management function will be used in two contexts, managing the enterprise on the one hand as an individual entity and on the other as an actor in an enterprise network (see Section 3.5).

In the following subsections the resources corresponding functions φ (financial, see subsection 3.4.2), ε (employees, see subsection 3.4.3), λ (physical, see subsection 3.4.5),

and ι (information, see subsection 3.4.6) based on combination of Kerola and Järvinen's (1975) model and that of Barney's (1997) are presented.

3.4.1 Overall management

Long-term success is essential to an enterprises and a body of literature has emerged addressing the content of sustainable competitive advantage, its sources, and different types of strategies that may be used to achieve it (Hoffman 2000). As remembered, in this study the assumed a priori aim of the enterprise's management function γ is the financial success and competitiveness of the enterprise and its sustainable competitive advantage.

The idea of a sustainable competitive advantage surfaced in 1984, when Day (1984, p.32) suggested types of strategies that may help to "sustain the competitive advantage". The actual term emerged in 1985, when Porter discussed the two basic types of competitive strategies firms can possess (low-cost or differentiation) to achieve sustainable competitive advantage. However, he did not present any formal conceptual definition in his discussion. Barney (1991, p. 102) has come closest to a formal definition: "A firm is said to have a sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these other firms are unable to duplicate the benefits of this strategy".

There has been some terminological discussion concerning the organizational attributes which can be used for gaining sustainable competitive advantage in single businesses or industries. Distinctions between the terms "resource", "capability" and "competence" can be drawn in theory. In practice, however, they will become badly blurred (Barney 1997).

According to Barney one of the earliest strategic management references to these organizational attributes was presented by Wernerfelt (1984), who called them "resources". While Prahalad and Bettis (1986) analyzed the implications of these kinds of organizational attributes for diversification strategies, they called them a firm's "dominant logic". Later Prahalad and Hamel (1990) named these (internal) attributes a firm's "core competencies". In some closely related works they are also called "capabilities" (Stalk, Evans and Shulman 1992).

It has been suggested that a firm's "resources" include its fundamental financial, physical, individual and organizational capital (and in this study information resource/capital as well) attributes. In contrast "capabilities" should include those internal attributes that enable a firm to coordinate and exploit its other resources, while "core competencies" refer to attributes that enable managers to conceive of and implement certain corporate diversification strategies (Barney 1997 cit Hill and Jones 1992, Stalk, Evans and Shulman 1992, Prahalad and Hamel 1990).

Bharadwaj, Sambamurthy and Zmud (1999) make a distinction between resources and capabilities: "…capabilities reflect the ability of firms to combine resources in ways that promote superior performance. While firm resources are copied relatively easily by

competition, capabilities are more difficult to replicate because they are tightly connected to the history, culture, and experience of the firm."

They also emphasize a more holistic view in the field of IS research: "…while a substantial body of IS literature has focused on identifying the competitive advantages resulting from specific IT applications, we feel that it is more important for firms to move away from focusing too narrowly on singular applications whose competitive advantage is at best short-lived, but instead focus on creating a firm-wide IT capability that provides a substantive basis for sustained IT innovation."

According to Hargadon and Sutton (1997) a firm's capability are not its resources as such but the ways it uses them. Crucial factors are e.g. distributing knowledge to staff, combining ad hoc teams and organizing brainstorming meetings. They argue that data and knowledge are stored in three types of organizational memory: in physical artefacts (such as products and prototypes), in human resources (such as staff and organizational structures) and in informational resources (such as knowledge and data bases).

Cohen and Levithal (1990) argued that the ability of a firm to recognize the value of new, external information coming from outside of the firm, to assimilate it and to apply it to commercial ends is critical to the firm's innovative capabilities. They label this capability its "absorptive capacity" and suggest that it is largely a function of the firm's level of prior knowledge. Rogers has a same type of concept, "organizational innovativeness" (Rogers 1995, pp. 376 to 381) with three independent variables (individual leader characteristics, internal characteristics of organizational structure and external characteristics of the organization).

According to Cohen and Levithal (1990) the development of absorptive capacity, and, in turn, innovative performance are history- or path-dependent. They claim that a lack of investment in an area of expertise early on may foreclose the future development of a technical capability in that area.

Another view of the resources of an organization is the model adopted to describe the activities and structure of an enterprise in this study. It is the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003). The functions of the model are used in this study for analyzing the enterprise cases and transforming them into a theoretical model.

The functions φ (financial), ε (employees), λ (physical), and ι (information) of the eight main functions of an organization according to Kerola and Järvinen are supporting (resource) functions. The four supporting functions can also be seen as the corresponding resources of a firm (e.g. Järvinen 2003, p.19).

For the purposes of this study, the sharpness of the concepts is satisfactory without making any refined sorting between "resource", "capability", or "competence". There do exist differences between these terms, and they should be remembered. Hence, the idea in this study is to apply the different types of resources (capabilities/competencies) to recognize ICTS innovations. I shall build on the assumptions that each information system of an organization includes the resources described in Kerola and Järvinen's model, and that

each of the supporting functions/resources (financial, employees, physical, and information) of the model represents some way the information system it is included in. Based on this, the supporting functions/resources are later used as indicators on ICTSs innovations while the empirical data is analyzed.

In the following I scan briefly the supporting functions/resources from the viewpoint of ICTS innovation.

3.4.2 Financial viewpoint

The financial (φ) function is the basis for the financial perspective. The financial function includes activities for the acquirement, attendance, maintenance and development of financial resources needed by the system. As stated earlier in subsection 2.3.3, in the model of Kerola and Järvinen (1975) the view to financial resources is broad, including also issues of financial administration and emphasizing more this type of aspects. Noting that limitation, in this study the financial function is seen fulfilled when the activities of an enterprise are done in an economic way, leaning on the management's basic rule that financial success is the aim of the enterprise. Thus issues like the efficient utilization of an innovation and a short repayment period are assumed to be included, when this resource type is emphasized.

Based on my earlier experiences I argue that adopting innovations in their very early phase is not very common, if that viewpoint is emphasized. This is due to several risks in early adoption. It must be also noted that financial assets, i.e. money, as a resource has a particular feature: other resources can generally be bought by using it.

The network theories stressing the inter-organizational cooperation between firms from the profit maximization viewpoint reflect the financial viewpoint at least indirectly. These are for example the four specific ways affecting the competition environment when using IT, according to Porter and Millar (1985) - altering industry structures, supporting costs leadership and differentiation strategies, and setting off entirely new businesses – as well as the explored ideas of the value chain, the value shop, and the value network by Stabell and Fjeldstad (1998), and some other new possible added value creation models.

The term "financial innovation", on the contrary, is not that relevant for this study. Financial innovations, such as Internet banking or various e-business activities, may naturally be relevant in some cases, but they play a minor role.

3.4.3 Human viewpoint

In must be noted that an information system does not necessarily need any technical component at all. If it does, the social subsystem plays in any case an important role in determining the way in which the technology is used. The production and appliance of information and knowledge within a certain social setting is a complex network of human relations. The network theories stressing the social and psychological issues reflect that resource type, but some also emphasize the informative perspective.

The employees' (ε) function, i.e. the human resources in this study, are the basis to the human perspective. The employees' function includes activities for the acquirement, attendance, maintenance and development of the resources of manpower needed by the system. In the end, the enterprise networks are based on human relationships, and many-sided human cooperation is needed between the enterprises. Systems do include social networks, and thus there is multiform cooperation between the organizations.

Also the issues concerning learning and knowledge inevitably touch human resources, e.g. much of the knowledge for potential solutions resides in the minds of the individual designers as products they have seen or used before, projects they have worked on, or technologies they have read, heard or talked about (Hargadon and Sutton 1997).

The variety of different learning theories is wide. Some of them emphasizing a networked informative perspective were discussed earlier in Chapter 2 (see subsection 2.3.6). However, Rogers (1995) argues that the social psychological theory with direct applicability to diffusion networks is a social learning theory, despite some differences. The basic perspective of the social learning theory is that an individual can learn from observating other people's activities, and nonverbal communication is important in behavior change. Nonaka (1994) has this type of concept of Socialization (from tacit knowledge to tacit knowledge), and Rogers argues such social modeling frequently occurs through diffusion networks (Rogers 1995, pp. 330 to 334).

Another model attached to innovations in the field of sociology is the developed concept of co-evolution and co-evolutionary learning (see e.g. Sklar, Blair and Pollack 1998). In co-evolution as well technical solution, social network of actors, learning which is attached on processes, economic possibilities (competitiveness of price) and possibilities of the markets develop simultaneously and interact with each other. Any of these alone does not explain the innovation process or its success, but the interaction between them does.

Some innovation theories also highlight the important roles of individuals, such as Rogers (1995), when he discussed people called innovators, change agents or opinion leaders. Another example is by Eric von Hippel, who stressed the role of the users in his studies of high technology branches, when the original idea is refined to a product. According his lead user method the creation of an idea and the development work is done in cooperation with skilled users, who have experience of the use of the product in demanding situations and therefore a view of its limitations. Hippel also stressed methods of learning by doing and adaptive learning (Tyre and von Hippel 1997, von Hippel and Tyre 1995, Herstatt and von Hippel 1992).

It has been shown in research looking at knowledge networks between SMEs, that even when there was adoption of networked technologies to allow connectivity between the companies, the potential for knowledge exchange was highly dependent on the level of trust. Similarly in other works on SME collaboration, information sharing and learning was shown to be based on the prior existence of trust and an atmosphere of continued trust-building. There is the SMEs' fear for opportunistic behaviour from competitors. Human

beings need confidence, either through trust or thorough formal legal mechanisms, such as agreements, that other firms will be cooperative and do not opportunistically take competitive advantage (Braun 2002).

There are also situations where coordination can take place neither through a market nor through a hierarchically organized firm: products and services are so complex, transactions so ambiguous that the parties involved in the exchanges have to trust each other and give up any attempt at a short-sighted calculation of the reciprocal costs and benefits accruing from the exchange. The "invisible" and "visible" hands are replaced by the "invisible handshaking" (Ciborra 1987)[16]. Establishing this kind of culture between organizations described in the examples involves investments in building social capital[17] (e.g. Nahapiet and Ghoshal 1998, Adler and Kwon 2002)

Based on Leavitt (1965), the employees' function ε can be seen from two different viewpoints – employees as actors or the structures formed by employees. Another, similar division is individual vs. community/collective. For example, Cohen and Levithal (1990) demonstrate that their concept "absorptive capacity" does not only exist at the individual level but also at the organizational level. Examples of the structures are hierarchies and teams or social networks. The division of the concept is presented in Figure 3.3.

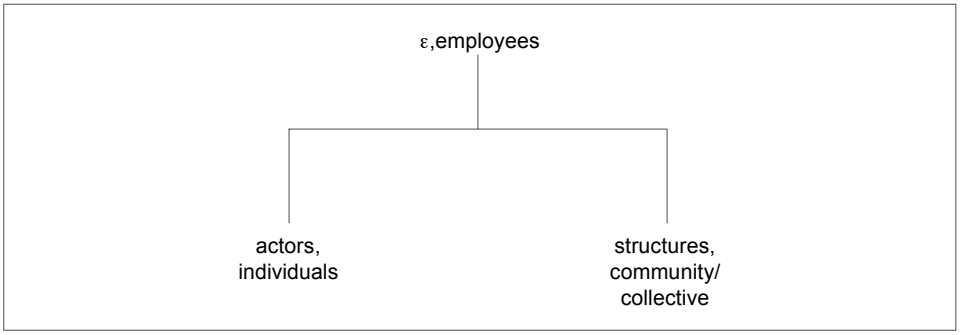

Figure 3.3: *The employees' function ε.*

3.4.4 Information technology (physical) viewpoint

The physical function (λ) is the basis for the information technology perspective (information and communication technology). Physical function includes activities for the acquirement, attendance, maintenance and development of long term physical resources which are needed by the system.

16 The organizational arrangement whereby networks of exchanges are governed in a stable manner by informal relationships of trust is called a clan by Ciborra (1987).

17 There are other similar terms, e.g. "human capital", or discussion of social capital versus intellectual capital (Nahapiet and Ghoskal 1998).

Also function λ can be seen from at least two different viewpoints – ICT technologies and other physical resources. In this study the focus is in ICT resources – computers, networks, pieces of software and their acquirement, attendance, maintenance and development. The division of the concept is presented in Figure 3.4.

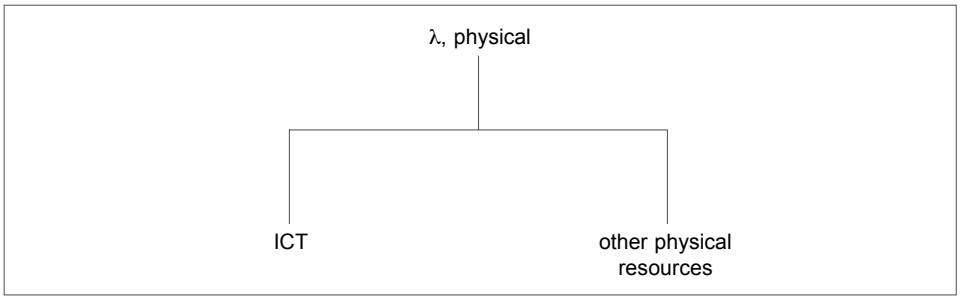

Figure 3.4: *The physical function λ, divided into ICT and other physical resources.*

As stated in the previous Chapter 2 (see subsection 2.3.5), there are typically no common standardized ways of communication between the ICT systems, and to ensure technical interoperability between their ICT systems networked partners may adopt each other's technical standards. Most commonly, the world of physical networking is a battlefield of commercial ICT vendors with various, differing hardware equipments, software programs, interfaces and protocols supporting reciprocal communication.

Physical networks can form the technical base for inter-organizational cooperation. However, what was said about technology clusters in subsection 3.3.3 (Rogers 1995), is very true of physical networks too. Innovations based on physical networks may appear not just individually, but as closely interrelated - I argue also cumulative - yet distinguishable elements of technology. In the minds of its adopters an innovation may be perceived as closely related to another new idea. This reflects also the learning process of the adopters. In the context of the Information society enterprises face an uninterrupted flow of new information technologies appropriate to be adopted as a network basis. Despite of their relatively small resources production SMEs must continuously choose which of those technologies they will take in use and which are wise to abandon. That is why I do not feel that the innovation research concentrating on single technologies or IS penetration is very valuable.

In her dissertation Tuunainen (1999) separated three basic strands of existing inter-organizational technologies concerning electronic commerce, which reflect the technical communication alternatives quite well: proprietary systems, electronic data interchange (EDI) and Internet-based networking technologies.

The proprietary inter-organizational information system (IOS) that crosses organizational boundaries is the first of the strands. An example of these kinds of IS innovations are (proprietary) electronic links between suppliers and customers (e.g. Malone et al. 1987, 1989).

IS innovation studies focusing on inter-organizational relationships between SMEs have so far concentrated mostly on Electronic Data Interchange (EDI) systems (see e.g. O'Callaghan et al. 1992, Saunders and Clark 1992, Ojala and Suomi 1994, Suomi 1994, Iacovou et al.

1995, Hart and Saunders 1997, Tuunainen 1998, Ramamurthy et al. 1999). EDI systems are used for standards-based computer-to-computer exchange of inter-organizational business documents and information (Swatman and Swatman 1991). The adoption rate of this technology has not been as high as was predicted some time ago (Bergeron and Raymond 1997). It is quite expensive and inflexible for the SMEs' purposes.

Diffusion of the Internet to business-to-business activities and the availability of advantageous computer equipment have recently created a new kind, more standardized base to inter-organizational information systems, most suitable also to the SMEs (see e.g. Riihimaa and Ruohonen 2002). Lyytinen and Rose (2003a, 2003b) see this "Internet computing" having a nature of "disruptive IT innovation". They define it as an architectural innovation originating in the information technology base that has subsequent pervasive and radical impacts on (development) processes and their outcomes.

Another viewpoint to physical resources is to produce so called embedded systems - products including ICT components (for example, Swanson's innovation type IIIb) and abilities to communicate. This kind of a product may by a totally new invention, or more typically, a long improvement process which enlarges the practical application domain as needed, when the best targets for using the technologies are developed (Rosenberg 1995). These technologies have typically come into being when they are still unsophisticated. Especially at the very beginning it is very difficult to envision the innovation diffusion of the technology. The example Rosenberg gives is a computer, the development from the ENIAC to current computer technologies, but from a production enterprise's viewpoint it is currently possible to embed ICT technology into a wide variety of physical products.

3.4.5 Informative viewpoint

The information function (ι) is the basis for the informative perspective, i.e. information and knowledge issues. The information function includes activities for the acquirement, attendance, maintenance and development of the data, information and communication systems (information resources) needed by the system. The information function includes also knowledge and knowledge-based assets which are an increasingly important source of competitive advantage. Empirical evidence from the capital markets and organizational research has shown that the main source of economic and social value is no longer the capacity to produce material goods alone, but it lies more and more in the creation and exploitation of knowledge-based assets.

The strategies of an enterprises' involve increasingly knowledge and learning processes (e.g. Ruohonen and Higgins 1998). Current ICT systems and infrastructures are growingly networked, supply-chain based entities with electronic and mobile business services. Therefore it is an inter-organizational innovation process, the parties of which handle distributed knowledge.

Within the literature of organizational studies a variety of approaches to knowledge can be identified, and the whole lifecycle of knowledge (knowledge creation, use, storing and demolishing) and the interaction of knowledge processes are discussed.

Concerning knowledge creation there are differing views. For example, Nonaka (1994) argues that the dialogue between tacit and explicit knowledge might postulate four different modes of knowledge conversion: (1) from tacit knowledge to tacit knowledge (socialisation), (2) from explicit knowledge to explicit knowledge (combination), (3) from tacit knowledge to explicit knowledge (externalisation), and (4) from explicit knowledge to tacit knowledge (internalisation).

From the viewpoint on an production SME, externalisation as the most important mode is triggered by successive rounds of meaningful dialogue within a team, and a sophisticated use of 'metaphors' can enable the team members to articulate their own perspectives, and thereby reveal hidden tacit knowledge that is otherwise hard to communicate. In opposite, according to Cook and Brown (1999) organizations are better understood if explicit, tacit, individual and group knowledge are treated as four distinct and coequal forms of knowledge (each doing work the others cannot). They claimed that "it is important not to mistake using one form of knowledge as an aid in acquiring the other with one form being 'converted' into the other. Tacit knowledge cannot be turned into explicit, nor can explicit knowledge be turned into tacit". Thus, Cook and Brown's view is entirely different from that of Nonaka.

However, various models of knowledge creation reflect the (inter-organizational) learning theories discussed earlier, such as the network theories emphasizing an informative perspective (cf. e.g. Nonaka 1994 and Kolb 1984). In these cases knowledge creation can be seen as a learning process. For example, innovation researcher and marketing expert Wim Biemans has analyzed how the cross-functional teams of enterprises can be networked with externals. A cross-functional team is composed of people with varied levels of skills and experience brought together to accomplish a task. These teams may use action learning as a process to solve problems (Biemans 1992).

In addition to knowledge creation, also the importance of shared spaces, ("ba's") has been appraised by Nonaka (e.g. Nonaka 1994, Nonaka and Takeuchi 1995, Nonaka and Konno 1998, Nonaka et al. 2000). Knowledge is said to be embedded in shared spaces, and the separation of knowledge from ba turns it into information. Inter-organizational groups should find ba's appropriate to them to get knowledge in shared use. More commonly, the group dynamics and the processes of knowledge are the most essential issues in the studies of learning, practicing or knowing communities. That discussion is fundamental when creating professional and organizational competence or developing knowledge-intensive work organization (i.a. Brown and Duguid 2001, Boland and Tenkasi 1995, Crossan and Lane and White 1999, Cook and Brown 1999).

Knowledge can be stored or situated in the organization in various forms. For example, Blackler (1995) identifies five images of knowledge and classifies them in the following way:

1.) Embrained knowledge; "knowledge that", which is dependent on conceptual skills and cognitive abilities.

2.) Embodied knowledge; "knowledge how", which is action oriented, partly tacit and explicit.

3.) Encultured knowledge; which is process of achieving shared understandings, and is socially constructed.

4.) Embedded knowledge; which is within technologies, roles, formal procedures and emergent routines.

5.) Encoded knowledge; which is conveyed by signs and symbols (books, manuals, codes of practice).

It must be noted that for the first four knowledge types of Blackler a human being is necessarily required to process knowledge. The encoded knowledge only is in such a form that a computer can process it. This observation strengthens the previously presented view of the importance of human beings as a part of the information systems.

At the end of the life-cycle of knowledge there is the demolishing process. That means processes like e.g. eliminating outdated information or unlearning (e.g. Hedberg 1981) outmoded working skills.

3.4.6 Summary of the management function and the four supporting resources

In this Section 3.4 I presented the management function and the four supporting resources from an individual enterprise's point of view and as prerequisites of ICTS innovations. Long-term success is essential to the enterprises and they should achieve sustainable competitive advantage by utilizing their resources efficiently. The resources of the enterprise set the internal limits also for its innovation adoption and the types of innovations.

In the following Section 3.5, while preparing the phase of data analysis, the management function and the four emphasized resources will be used in two contexts, seeing the enterprise on the one hand as an individual entity, and on the other as an actor in an enterprise network. A particular tool is created to help data analysis by utilizing the above mentioned management function and resource views.

3.5 Synthesis – a tool for analyzing research data

Having my eye on the upcoming phase of data analysis, I next combine the overall management view and the four resource types.

I will use the functions of Kerola and Järvinen's (1975) model to help the analysis of the enterprise cases and their transformation into an emergent theory. The functions φ (financial), ε (employees), λ (physical), and ι (information) are supporting functions, which can also be seen as the corresponding resources of a firm (e.g. Järvinen 2003, p.19). In the following Figure 3.5 the supporting functions of the model are tied together. In the figure also the exclusions of the employees and physical resources – as discussed in earlier (see subsections 3.4.3 and 3.4.4) - are presented.

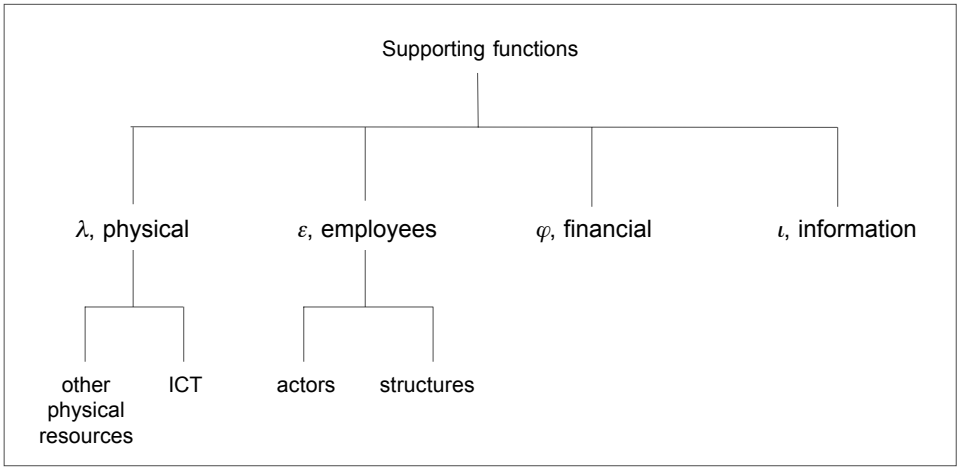

Figure 3.5: *The supporting functions model, modified from Kerola and Järvinen's model.*

To help the data analysis I build a particular tool for the phase of analysis. The tool (see Figure 3.6) is a chart emphasizing SMEs differing roles in differing organizational environments (as an acting organizational entity versus as an actor in a network). The assumed a priori aim of the enterprise's management function is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage and thus the efficient utilization of the enterprise's resources. The management function is therefore represented in both columns in the chart.

In addition to this, building on assumptions that each information system of an organization includes the functions described in the model, and each of the supporting functions/resources (financial, employees/human, physical/information technology, and information/informative) is represented some way in the information system it is included in, the supporting functions are used as indicators of ICTSs innovations, while the empirical data is being analyzed. Thus the supporting resources are represented by the four rows of the chart.

When the basic elements of the research unit - a production **SME** as an entity and a SME working in a **network** - were combined with the four supporting resource perspectives, I was able to form the chart presented in Figure 3.6. The chart is used in the following chapters in analyzing the data of the enterprise cases and in transforming it into the emergent theory model.

	Organizational entity (SME)	Organizational structure (Networks)
Financial perspective	ICTSs emphasizing SMEs' financial aims	ICTSs emphasizing SMEs' financial aims in network environment
Human perspective	ICTSs emphasizing social/ human aspects	ICTSs emphasizing social/human aspects in network environment
Information technology perspective	ICTSs emphasizing technological aspects	ICTSs emphasizing technological aspects in network environment
Informative perspective	ICTSs emphasizing informative aspects	ICTSs emphasizing informative aspects in network environment

Figure 3.6: *Chart of the four perspectives.*

Seeing supporting functions as mentioned below, I argue that they describe certain characteristics of the enterprises' ICTSs. The interviewed entrepreneurs have built their own visions on information systems they have adopted. In the interviews they tell directly (when naming a system) or indirectly (when naming attribute(s), in other words supporting function(s) of a system) what ICTSs they emphasize.

The management function combined with supporting resource functions works also as a kind of a "sensitizing device" (Giddens 1984) or a "practice lens" (Orlikowski 2000). They help me to see new ways of using information and communication technology, to analyze my findings and to anchor and classify the information systems emphasized by the respondents in the interview data. I will present these analyses in more detail later, in Chapters 5 and 6.

3.6 Summary of information and communication technology systems as innovations

In this chapter 3 I delineated the definitions and connections between the concepts of information and communication systems (ICTS) and innovation.

At the beginning of the chapter I described the nature of ICTS. While the research unit of the dissertation is an enterprise, a production SME, the unit of analysis is "the idea of the information and communication system, ICTS". The "idea" refers to the utilization purposes ICTS is adopted for. Each enterprise builds its individual approach to what purposes and in what ways it adopts ICTS to achieve sustainable competitive advantage.

Next I presented the eight main functions model of an organization according to Kerola and Järvinen (1975), Järvinen (1985, 2003). The management function and the four supporting functions/resources were described from an individual enterprise's point of view as prerequisites for ICTS innovations. A way to long term success is the efficient utilization of the enterprise's resources. Later the supporting functions of the model are used for analyzing the enterprise cases and transforming the data into the theoretical model of an emergent theory.

I also discussed various innovation concepts and compared various terms which describe the phases of innovation process. Then I briefly reviewed IS innovation literature and some innovation literature from selected IS-research-related disciplines.

Classifying innovations is significant because earlier research findings suggest that facilitation factors vary among innovation types, and that adoption sequence and timing may also vary systemically between the types. One of the most fundamental works categorizing IS innovations so far was presented by Swanson (1994). Swanson's model was described in more detail, because it is a base-line model for IS innovations and thus to the results of this study.

After these issues I concentrated on an enterprise's achieving sustainable competitive advantage. Having my eye on the upcoming phase of data analysis, I combined the overall management view and the four resource types by building a particular tool to help the data analysis. This tool, which I presented in Section 3.5, is a chart emphasizing the SMEs' differing roles in differing organizational environments.

In Figure 3.7 I summarize the theoretical views and models which are the most important to this study, as presented in previous Chapters 2 and 3.

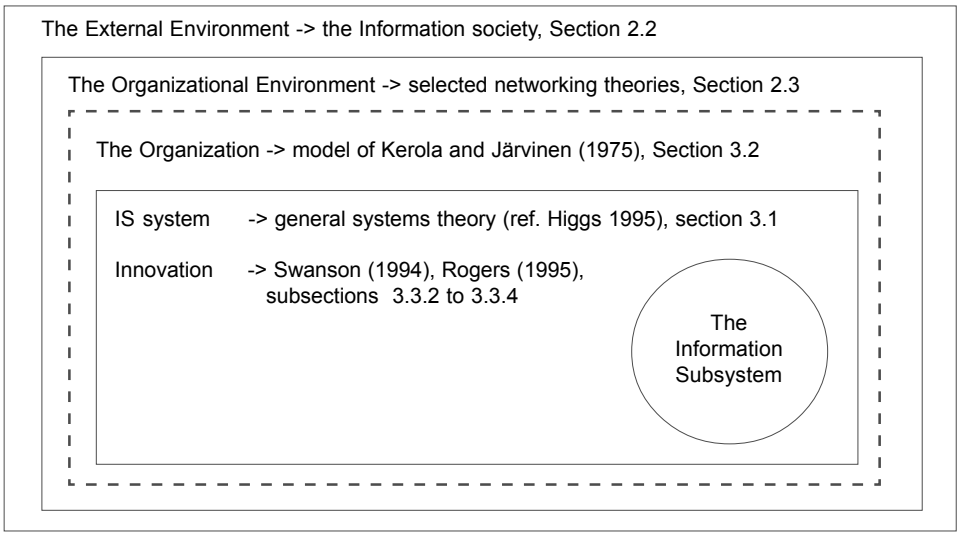

Figure 3.7: *Model of selected theoretical views in this study.*

In the following chapter 4 I will present the philosophical and methodological assumptions behind this study and review the research approaches and techniques adopted. At the beginning of the chapter 4 I will also present the main research question and the subquestions.

4. Philosophical and methodological assumptions

In this chapter I shall present the philosophical and methodological assumptions behind this study and a review of the research approaches and techniques adopted. In the first section I repeat the main research question and present the subquestions.

According to a typical categorization of research purposes, this study utilizing so much of my experiences is characterized as phenomenological (Section 4.2), but (Deetz 1995) as it emphasizes interactive discussion between the researcher and the members of the organizations he is studying, results transform in the research process and concepts are developed with the members of the organizations. Phenomenology is not a method of empirical scientific investigation, but rather a trend in philosophy that has been adapted to promote an understanding of the relationship between states of individual consciousness and social life (Järvinen 2001, p. 169).

The described categorization of philosophical assumptions of this study (see Section 4.3) are based on Järvinen (2001), Deetz (1995), and Iivari (1991). The aspects of ontology, epistemological assumptions and the ethics of research are based on Iivari (cit Burrell and Morgan 1979), but the methodology is based on Järvinen's categorization.

The aim of this study is characterized theory-creating (according to Järvinen 2001). Theory-creating studies are very appropriate for exploratory investigations, when no prior knowledge exists of a part of reality or a phenomenon. Qualitative methods, such as case studies, are included to the theory-creating approach (see Section 4.4).

The issues of qualitative research are characterized first, and the principles of this case study are evaluated, based on the works of Yin (1994), Cunningham (1997) and Eisenhardt (1989), which are widely applied within the science of information systems[18]. Eisenhardt's (1989) model is applied in this study, and I shall present it in more detail in Section 4.5.

4.1 Research goals

In this study the purpose is to refine the data of practical experiences in production enterprises to a theoretical construction that could provide valuable for both the academic research community and the practice in different branches of industry. This is achieved by combining empirical data with theoretical perspectives, by looking at the data through "sensitizing devices" (Giddens 1984) or "practice lenses" (Orlikowski 2000), in a way that leads to a new theory. The final result of this study is a taxonomy - a classification principle of information and communication technology (ICT) system innovations.

18 For qualitative research methods in some other relevant disciplines, see e.g. Bogdan and Taylor (1975), Gummesson (2000) and T. Lee (1999).

The main research question is formulated as a "what" question: *What are the types of information and communication system innovations emphasized by a production SME when it adopts ICT?*

Subquestions are formulated as "how" questions in a following way:
- *How are the financial aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the social aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the technical aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the informational aspects emphasized, when an SME adopts ICT-based innovations?*

4.2 Research philosophies

In this section I aim to introduce the approaches of the research philosophy of my study. An important motivation for positioning the research setting philosophically is the scientific discourse. To me, defining the philosophical "position" of this study is not to keep any special flag flying or to try to find a proper pigeonhole for the results, but to describe the background motivation and views of the researcher.

One of the most referred research paradigm models is by Burrell and Morgan (1979). Against it there has currently been criticism, some of the most comprehensive of which is in an article by Deetz (1996). The most important philosophical aspects of this study are presented, after they are first recognized from the basis of Deetz's model.

4.2.1 The background for the philosophy of this study

Various different theoretical frameworks, called metatheories, have been presented to guide the research effort (Higgs 1995). These views determine the problems that are analyzed as well as the adequacy of proposed solutions to the problems. An important motivation for positioning the research setting philosophically is the scientific discourse. As Deetz (1996) has stated, the work of researchers carries assumptions and responsibilities which are central to understanding and evaluating their work, but they are rarely explicit in study reports.

The background for the research philosophy selected for this study leans on my personal experiences, described in earlier chapters, and on the research purposes I am interested in. One of the key words is my personal experience, more than fifteen years of living and working with entrepreneurs and SMEs, most of them representing the production branch. It is nationally well-known that in South-Ostrobothnia the tradition and culture of entrepreneurship are dominant, and local entrepreneurs are known as individuals and independent people.

I have acted in various positions and operated at different levels with the enterprises the representatives of which were interviewed for this study. To some of the enterprises I have been a "legate" of the pressures of the Information society (= external environment) – a

developer, teacher or consultant, aiming to help them to see the possibilities of ICT in business life (= organizational environment). To some of the enterprises I have been a node in their network, a cooperative business partner aiming to maximize the profits of business operations in real working life. To some I have been the CEO of a firm providing networking services, an essential part of their ICT systems. In a couple of the enterprises I have been the CEO and a member of the board, and thus a part of their internal world and history. To most of the interviewed enterprises I have been an external researcher showing an interest in their business activities and ICT systems, trying to get the message they communicate to me in the interviews. However, all that has meant interactive discussions with the members of the organizations being studied.

All those premises have guided me to anti-positivistic tendencies, because I have to agree with the criticism that says that one of the worst effects of positivism is that it reduces human beings to quantifiable and measurable objects of investigation (e.g. Higgs 1995).

4.2.2 Two research paradigm models

To me defining the philosophical "position" of this study is not to keep any special flag flying or to try to find a proper pigeonhole for the results, but to describe the background motivation and views of the researcher. To identify the proper theoretical settings and metatheory I first briefly present and compare two research paradigm models.

One of the most referred research paradigm models is the one of Burrell and Morgan (1979, see Figure 4.1). The four paradigms by Burrell and Morgan are the four combinations of the opposite ends of two dimensions. The first dimension is of the nature of social sciences, which is divided into two approaches, subjectivist and objectivist. The second dimension is borrowed from the macro level of society. The theories are allocated within a dichotomy of the sociology of regulation and the sociology of radical change. The combination of these two dimensions leads to four paradigms (according to Nurminen 1997).

	Subjective	**Objective**
Radical change	Radical humanist	Radical structuralist
Regulation	Interpretive	Functionalist

Figure 4.1: *The four paradigms by Burrell and Morgan.*

There has currently been criticism against the model of Burrell and Morgan (by e.g. Nurminen 1988, Iivari 1991, Nurminen 1997). One of the most comprehensive critical articles is by Deetz (1996). He is concerned about the dimensions of the contrast, a kind of juxtaposition of black/white or on/off, which is easily made if the model of Burrell and Morgan is followed. Deetz especially criticises the perpetuation of the subjective-objective controversy.

Deetz has presented a substitutive model (see Figure 4.2.), which includes a grid describing two "sliding" dimensions of contrast. The first dimension focuses on the origin of concepts and problem statements as a part of the constitutive process in research. Differences between research orientations can be shown by contrasting "local/emergent" research conceptions with "elite/ a priori" ones. The key questions, which this dimension addresses, is where and how research concepts arise. In the two extremes, concepts are either developed in relation with organizational members and transformed in the research process or they are brought to the research by the researcher and held static through the research process – concepts can be developed with or applied to the organizational members being studied.

The second dimension focuses on the relation of the research practices to the dominant social discourses within the organization studied, the research community and/or the wider community. The consensus pole draws attention to the way research seeks order and treats order production as the dominant feature of natural and social systems. The primary goal of a research is to display a discovered order with a high degree of fidelity and verisimilitude. The descriptions hope to "mirror" entities and relations that exist out-there in a relative fixed state reflecting their "real" character. The dissensus pole draws attention to research styles which consider struggle, conflict and tensions to be the natural state.

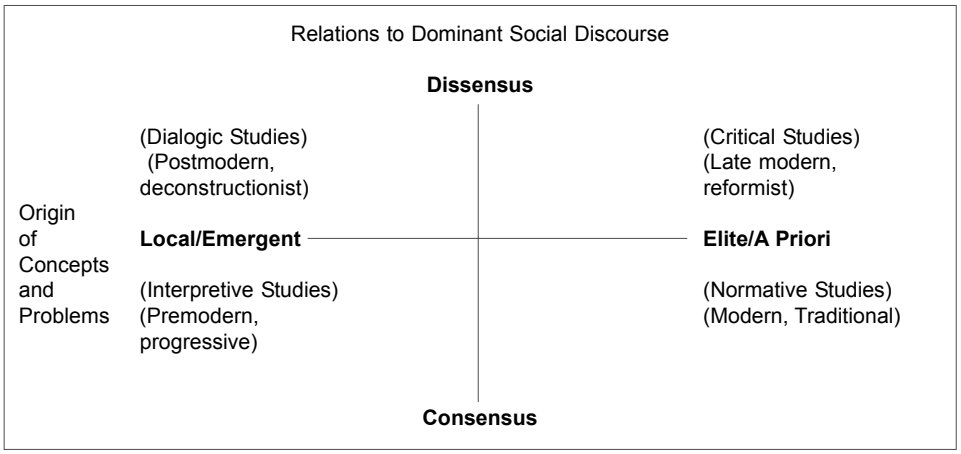

Figure 4.2: *Contrasting dimensions from metatheory of representational practices (Deetz 1996).*

To me the model of Deetz is much more natural to adopt, due to the relative freedom it gives for positioning my own view and practices of research philosophy into the grid.

I argue that the concepts of the results of this research results are developed in relation with the organizational members and transformed in the research process. Thus the local/emergent dimension of Deetz's model is emphasized. I also use background concepts from existing literarure of IS and organizational research (see the summary at the end of the previous chapter, Figure 3.7), and the aim of this study is to present an emergent theory from that basis. Thus the consensus dimension of Deetz's model is emphasized. From that it follows that the nature of this study is leading towards the interpretative studies, and thus towards the phenomenologist research philosophy and metatheory.

However, the "sliding" dimensions of contrast in Deetz's model make it flexible for following my own view and experience when, for example, the philosophical assumptions are later defined.

4.2.3 Applying the phenomenological research view

Phenomenology is not a method of empirical scientific investigation, but rather a trend in philosophy that has been adapted to promote an understanding of the relationship between states of individual consciousness and social life. Phenomenology strengthens certain anti-positivistic tendencies in the human sciences, and in the process gives these human sciences a foundation from which they can operate with confidence. As an approach within sociology, phenomenology seeks to reveal how human awareness is implicated in the production of social action, social situations and social worlds (Higgs 1995, Järvinen 2001, pp. 169 to 170, Orleans 2001 cit Natanson 1970).

As a philosophical tradition, modern phenomenology is younger that hermeneutic, but both have the same philosophical base, and hermeneutics has later been assimilated to phenomenology. According to hermeneutic thinking a phenomenon is abstract, and conceptual until it is understood comprehensive as a part of certain context. Hermeneutic thinking also respects the claims of cultural tradition (Anttila 2000).

The search of essence is the search for meaning, and phenomenology is therefore concerned with the structures of meaning that give sense and significance to our immediate experience. Thus, the problem of translation and interpretation of texts (called hermeneutic problem) is a central problem of phenomenology (Boland 1985).

In modern scholarship, the term hermeneutics is associated with historical and literary texts (Higgs 1995). However, that should not be seen as in textual interpretations only. For example, according to Boland (1985) in the IS research discipline the design and use of information systems is a kind of a "text" that we must to try to understand.

Neither is there a reason to mystify the phenomenologist concept of essence. The term should be simply understood as a linguistic description. A good description that reflects the phenomenon is such that the structure of our lived experience is shown to us in a way that helps us to see the nature and significance of this experience in a way not seen before. The linguistic description, that is both holistic and analytical, evocative and accurate, unique and universal, powerful and perceptive, is the aim of all phenomenological endeavour (Higgs 1995).

In this study I will use my lived experience mostly to analyze the data I gathered, not that much as data itself or even as findings, which might be possible as well. I will aim to carefully interpret the interviews I did, preferring to respect the "voices" and views of the enterprises.

In designing an information system, the designer reads the organization and its intended users as a text in order to make an interpretation that will provide the basis for a system design (Boland 1985, p.196). Analogously, I have read the organizations from different positions and made my interpretation based on my experience, observations and analysis.

According to Boland (1985), if "the text to be read" is the information system in use (in this study ICTS innovation under adoption process), the "hermeneutic task" is an interpretation by the researcher of system design and use. Analogously, in this study the tasks of formulating and identifying the system innovation correspond to the task of system design. It is through a hermeneutic process that it is possible to approach the task and to develop an interpretative description of information systems. However, there has been discussion if Boland really does recognize and understand the view of system building, alike e.g. March and Smith (1995)[19]. I must note that I do not see "linguistic IS design", literally just reading texts and then designing and building ISs, a successful method. To me it is the interpretation of the whole real life context and also living in it that counts. That is just one of the reasons why I saw it important to present the broad environmental views of the SMEs (see Sections 2.2 and 2.3).

It must also be noted that the hermeneutic process is sometimes seen as quite a rigorous research method with its set of terminology and techniques. In this study the hermeneutic model is not followed slavishly. For example, I do not use the term "hermeneutic circle", despite the iterative nature of the data analysis.

Hence, there is no fixed or final meaning for the interpretation of a text. Interpretation requires that we interact with the text as if we were engaged in an interpersonal dialogue. Meaning is constructed when people open to each other, expanding their horizons toward that of others. When a phenomenologist studies a person, he does not look at them, but with them in a dialogue searching for understanding. Understanding comes from step to step, layer by layer, as preconceptions, prejudices, and assumptions are recognized and seen through (Boland 1985). Our sessions of interviews were a good example of this kind of research, especially the ones of the latter case set. Both of us interviewers noticed the saturation points within most of the cases, after which no new information was got. Respectively, we found the same kind of a saturation point between the cases. When it was reached, new enterprise cases did not reveal any issues new to us.

By "intentionality" phenomenology means the intentional or direct nature of our mental focus on the world "out there". This does not imply a subject-object relationship, but rather focuses on the world as it appears in, and as constituted by, human consciousness. The word "phenomenon", which literally means "that which appears", refers to that which appears in human consciousness (Higgs 1995).

In phenomenology the situation and phenomenon under research is opening to the researcher authentically, richly and in polymorphous ways. The experience of the researcher is important

19 March and Smith (1995) present a two-dimensional framework for research of information technology. The first dimension is based on broad types of design and research activities in natural sciences: building, evaluating, theorizing and justifying. The second dimension is based on broad types of outputs produced by design research: representational constructs, models, methods and instantiations.

and the experiences must open to the researcher as living reality, not as passive images. Thus phenomenology emphasizes the researcher's analysis and observation-making of "texts" (Anttila 2000).

Intentionality maintains that there is a relationship between us and the world "out there", which becomes "our world" because of mutual encounter with the world. This mutual encounter takes place as a result of the inter-subjective and reciprocal nature of our relationship with the world "out there", in which, phenomenology asserts, we are free to constitute our own world (Higgs 1995).

More commonly, this kind of shift towards interpretivism has been recognized in the IS research field in recent years. This is evidenced by a shift in the editorial policy of some of the main IS journals (Mingers 2001, ref. Lee 1999, Walsham 1995b). Further, Nandhakumar and Jones (1997) found that 16% of the papers used a broadly interpretive methodology.

However, there has also been criticism against interpretative research. One branch reflects the social scientists' controversy between the school of thought, positivism and interpretivism (see e.g. Schutz 1962-1966, p. 48, Lee and Baskerville 2003). Weber (2003) argues quite sarcastically:"…I find many of the debates about realism versus social constructivism tedious and misplaced. In my view, some sort of reality exists independently of our senses. For instance, I have been unable to persuade any of my colleagues (even those who subscribe to extreme postmodernism) to step off the ledge outside the window of my office (which is on the third floor of my building). They seen reluctant to accept that the phenomena that will occur once they take the step (they will fall to the ground!) are socially constructed".

The interpretative view is the most relevant way of conducting research, but the above kind of criticism is justifiable, if the researcher after jumping out of the window is left floating in the air. The interpretative view is a relevant way of research if the researcher knows the research topics and thus has capability for interpretation. However, in the interpretation the realities and - in that sense - the positivist view of the world must be remembered. For this the experience of the researcher is necessary. An experienced, wise researcher does not jump out of the window himself, but does an interpretation of the feelings of the possible jumper.

Also Weber admits:" Of course, the theories we use to describe the stable pattern of phenomena that seem to arise if we step off the ledge are socially constructed. In this regard, witness the ways in which the theories we have used to account for the phenomena have changed over time (Newton's versus Einstein's view on gravity)… …Nonetheless, in my view whether we are a realist or social constructionist is irrelevant. We build theories about phenomena we believe are stable in some sense if only in the ways we construe them in our minds". An example of this kind of phenomena can be found e.g. from Contu et al. (2003) and their critique of the "learning discourse".

Phenomenology also emphasizes the value of science that does first make clear what it is talking about. The things are found out through a methodical process of description. The process of description is phenomenological when it is focused on that which is immediately

presented to consciousness, and when it employs reductions to search for truly objective knowledge in pre-reflective consciousness. Phenomenology does not assert the existence of an absolute knowledge. Phenomenological study cannot claim to have a proof of its findings, but a reliance on its method and hope that others will "see" its descriptions as true and accurate (Boland 1985).

Phenomenological concerns are frequently studied by using qualitative methods. Researchers frequently undertake analyses of small groups, social situations, and organizations by involving face-to-face techniques of participant observation. The one of the focuses in social phenomenology is to demonstrate the reciprocal interactions among the processes of human action (Orleans 2001).

According to Boland (1985) our every day experience of the social world is a hermeneutic. In the world we encounter a text of meaning already made and being made. All around us, mutually validated ways of seeing the world are being actualized through multiple language games.

Preferably than contending that any aspect is a causal factor, phenomenology views all dimensions as constitutive of all others. Phenomenologist use the term reflexivity to characterize the way in which constituent dimensions serve as both foundation and consequence of all human projects (Orleans 2001).

In the end the aim of this study is theory-creating. Phenomenology and hermeneutics are related to the theory-creating approach. Theory-creating studies are also very suitable for exploratory investigations, when there is no prior knowledge of a part of reality or a phenomenon (Järvinen 2001, pp. 8 to 9).

4.3 Philosophical assumptions

As mentioned in previous section, philosophical assumptions are in many disciplines categorized according to Burrell and Morgan (1979), whose model has been criticized (see previous subsection 4.2.2). In the IS research field e.g. Iivari (1991) and Nurminen (1988, 1997) have elaborated the categorization.

The first dimension of the four paradigms by Burrell and Morgan is of the nature of social sciences. It is divided into two approaches, subjectivist and objectivist[20]. Based on Burrell and Morgan, four underlying subdimensions or philosophical assumptions can be recognized (see e.g. Nurminen 1997): ontology, epistemology, human nature and methodology.

Iivari (1991) has presented another kind of differentiation. He argues that human nature is rather an ontological attribute or concept than a separate aspect or subdimension (of subjectivism-objectivism scope). That is why he suggests four attributes differing from Burrell and Morgan: ontology, epistemology, methodology, and ethics.

20 That means whether the empirical world is assumed to be objective and hence independent of humans, or subjective and hence having existence only through the action of humans in creating and reacting it.

In the following I consider the underlying philosophical assumptions of this study partly based on Iivari (1991), because it is important to describe the subdimensions of ontology, epistemology, and methodology. However, I shall not make it through a subjectivist/objectivist dimension, but just by describing some dominant aspects of the background.

I do not here consider the ethical issues (value etc.) as recommendes by Iivari (1991) separately, because the values of the SME managers, or more commonly of the organizational management, are closely integrated in my analysis of raw data.

4.3.1 Ontological assumptions

Ontology says out what we are assuming about the research subject. Holsapple and Joshi (2002) adopted Gruber's (1995) view that ontology is an explicit specification of an abstract, simplified view of a world researcher desires to represent. It specifies both the concepts inherent in this view and their interrelationships. For example, as database-oriented researchers Holsapple and Josh argue that a typical reason for constructing ontology is to give a common language (concept structure) for sharing and reusing knowledge about phenomena in the world of interest.

Iivari demonstrates ontology with five attributes: information/data, information system, human image, technology, and organization and society. In the following I shall picture the ontological assumptions leaning on these five attributes. Iivari also gives two alternative assumptions on every construct, but I shall not position the ontological assumptions of this study in that way, only show the points I see the most important to know.

The assumption of the nature of the data

The assumption of the nature of the data in this study can be seen as an indicator of (entrepreneurs' / SMEs') motives, attitudes and competencies of the ICT system innovations they have adopted. The research data was compiled mainly by interviewing representatives of the enterprises and from secondary data material (presented later in more details), such as brochures or www pages, and also via my personal experiences.

The assumption of the nature of the Information and communication systems

Information and communication systems are characterized in this study as innovations having strong organizational and social emphasis. The background of the contemplation of systems is the general systems theory. ICT related innovations are seen as systems, combinations of information/knowledge, technology, and people, also including the (internal) relations between them, so even at the first sight quite simple technological solutions are recognized here to be information and communication system innovations, including a large human

proportion. There is also always the question whether ICTS innovations should be pushed or pulled. In my experience it may sometimes be necessary to push new technology, but that must be done very carefully and in responsible ways.

The assumption of the nature of human image (conception of human being)

In his article Iivari used the term "human image" to describe what the human being is. Isomäki (2002) has used a different, possibly more appropriate term "conception of human being". However, the baseline of human image (or conception of human being) is here defined as voluntaristic, and assumed to be homing. It must be noted that due to many requirements and commitments of the Information society and global competition that positioning is not inevitably clear.

The assumption of the nature of technology

The same consideration concerns technology. This is one of the most fundamental issues, because within the rapid development of new technologies the entrepreneurs are easily branded as old-fashioned by various constituent groups, e.g. the development organizations, if they do not take new proposed technical innovations in use immediately. So the idealistic view here is human choice without technological determinism, but that ideal is hard to achieve.

The assumption of the nature of organizations and society

The assumption of the nature of organizations and society is multifaceted in this study. The Information society, division of labor and networking in various forms are some of the contexts. The main aim of an organization is to achieve sustainable competitive advantage by adopting ICTS innovations. The entrepreneurs and SMEs certainly have their own kinds of working cultures, which also forms one of the contexts they are working within.

Adopting ICTS innovations is seen as continuous, developing interpretation by the entrepreneur, because the utility value and applicability of the current technology is continually changing. In this study it is additionally assumed that in every case there are individual human beings and their interpretations behind the networks. Networks between organizations are mostly created on the basis of connections between human beings.

4.3.2 Epistemological assumptions

Epistemological assumptions concern the criteria by which valid knowledge about a phenomenon may be constructed and evaluated (Järvinen 2001). As was clarified above, the anti-positivistic tradition is significant here. That is because the world is here understood from the viewpoint of the individuals (the entrepreneurs or the representatives of SMEs)

who are directly involved in the activities that are studied (adoption of ICTS innovations for various purposes).

In this study an interpretive emphasis has been adopted with a way of thinking that no individual description of reality can be proven as more correct than any other. It would be impossible to compare them against any objective knowledge of a 'true' reality.

The philosophical base of interpretive research is just hermeneutics and phenomenology. Interpretive research has built-in the assumption that access to reality, given or socially constructed, is only through social constructions such as language, consciousness and shared meanings (Boland 1985).

Interpretive research methods aim "...at producing an understanding of the context of IS together with the process whereby the IS influences and is influenced by such context… … [Consequently] there are no correct and incorrect theories but there are interesting and less interesting ways to view the world." (Walsham 1993 pp. 4 to 5).

Alike Deetz (1996), discussed in earlier sections, also Myers (2001) warns that the classifications above are not that clear in practice:

- "It should be clear … that the word 'qualitative' is not a synonym for 'interpretive' - qualitative research may or may not be interpretive, depending upon the underlying philosophical assumptions of the researcher. Qualitative research can be positivist, interpretive, or critical ... It follows from this that the choice of a specific qualitative research method (such as the case study method) is independent of the underlying philosophical position adopted." (by which he means case study research can be positivist, interpretive, or critical, just as action research can be positivist, interpretive or critical), and

- "However it needs to be said that, while these three research epistemologies[21] are philosophically distinct (as ideal types), in the practice of social research these distinctions are not always so clear cut."… …"There is considerable disagreement as to whether these research "paradigms" or underlying epistemologies are necessarily opposed or can be accommodated within the one study."

4.3.3 Methodological assumptions

Concerning **methodology** Iivari separates constructive, nomothetic and idiographic approaches of research methods. Iivari's nomothetic and idiographic categories are based on Burrell and Morgan's (1979) analysis (see Järvinen 2001, p. 9). The nomothetic approach lays emphasis on the importance of basing research upon systematic protocol and technique as in natural sciences. The idiographic approach is based on the view that one can only understand the social world by obtaining first-hand knowledge of the subject under the study. Third category, the constructive methods, is based on the special character of IS and computer science as applied sciences (see Simon 1981).

21 remembering that e.g. Deetz (1996) has four views.

Järvinen presents a different and more qualified categorization of research methods, which is adopted in this study. The structure of Järvinen's categories is based on the classification principles presented in Figure 4.3.

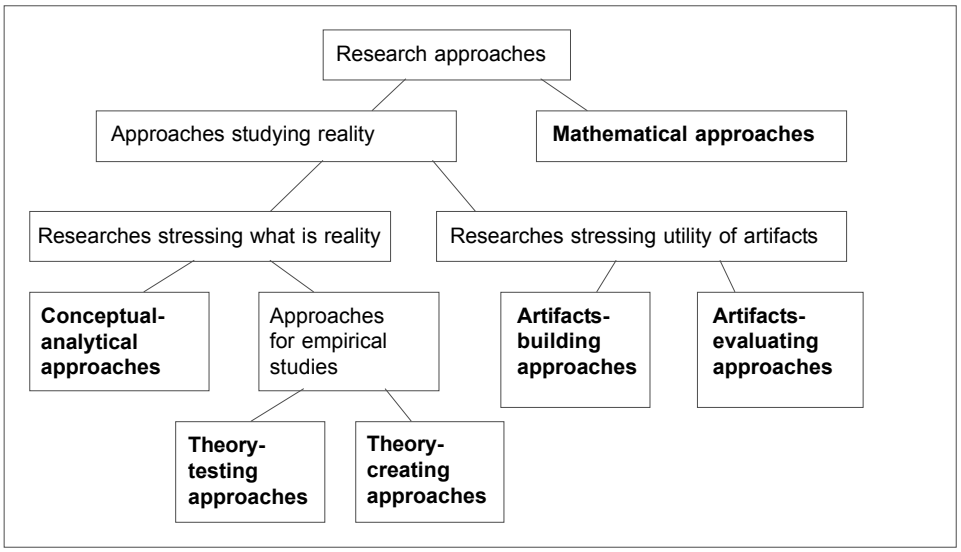

Figure 4.3: *Classification principles of classes of research methods (Järvinen 2001, p. 10).*

In the classification mathematical methods are differentiated from other methods, for these concern formal languages, and other symbol systems not having any direct reference to objects in reality. The other methods concerning reality are differentiated by the research question. Two classes are based on whether the research question concerns what is a (part of) reality or stress the utility of an artifact. In the former category methods for theoretical development (i.e. conceptual-analytical approaches) are separated from empirical research approaches. According to Järvinen, when the past and present are studied, theory-testing or theory creating methods can be used, depending on whether there is a theory, model or framework guiding the research or if there is a developing process of a new theory grounded on the gathered raw data. Concerning artifacts, they can either be built or evaluated (Järvinen 1999, p. 8).

The aim of this study is theory-creating. Theory-creating studies are very suitable for exploratory investigations, when there is no prior knowledge of a part of reality or a phenomenon. In the theory-creating approach there are included e.g. case studies, ethnographic method, grounded theory, phenomenography, contextualism, discource analysis, longitudinal study, phenomenological study and hermeneutics (Järvinen 2001, pp. 11, 62).

4.4 Research methods

In this Section 4.4. I shall present the research methods applied in this study. The aim of this study is theory-creating, which issue is considered in subsection 4.4.1.

One of the general and most common distinctions of research methods is the classification between qualitative and quantitative methods. When applying the framework of research methods by Järvinen (2001) that classification is not efficient, because both the theory-testing and the theory-creating classes may include qualitative and quantitative methods. The role of qualitative methods in this study is described in subsection 4.4.2.

Case studies are also applied in this study. Because the aim of this study is theory-creating it can be placed in the class of intensive case methods. Intensive case methods develop new theory exploratively. Case studies are discussed in subsection 4.4.3.

4.4.1 Theory creating approach

Phenomenology and hermeneutics are applied in the theory-creating approaches with some general features. The raw data is often originally in text format or it is transcribed into text. As stated, in the IS research discipline the design and use of information systems can be seen as the text that we must to try to understand. Analogously in this study tasks of formulating and identifying the system innovation corresponds to the task of system design. Through reduction essential data is separated from non-essential. The purified data is then presented as structures to extract the most essential relationships and themes. Qualitative methods like case study, grounded theory and phenomenography are characteristic. (Järvinen 2001, Miles and Huberman 1984).

The aim of this study is theory-creating. The term theory should here be understood as a taxonomy. According to Webster and Watson (2002), theories can be placed on a hierarchy from ad hoc classification systems (in which categories are used to summarize empirical observations), to taxonomies (in which the relationships between the categories can be described), to conceptual frameworks (in which propositions summarize explanations and predictions) and to theoretical systems (in which laws are contained within axiomatic or formal theories). Respectively, the final product of creating theory from case studies may, according to Eisenhardt (1989), be concepts, a conceptual framework, or propositions or possible mid-range theory.

One of the viewpoints for forming the new theory is the duality of “process theory” vs. “variance theory”, which has been described e.g. by Markus and Robey (1988), Soh and Markus (1995), and Langley (1999). Process theory attempts to explain the phenomena in terms of the sequence of events leading to an outcome. Variance theory explains phenomena in terms of relationships between dependent and independent variables.

The differences between the two models can be described as follows (Markus and Robey 1988): Variance theories are concerned with predicting levels of outcome from levels of

contemporaneous predictor variables, and process theories are concerned with explaining how outcomes develop over time. In variance theories, the precursor ("cause") is posited as a necessary and sufficient condition for the outcome. In process theories, the precursor is assumed insufficient to "cause" the outcome, but is held to be merely necessary for it to occur. In other words, outcomes are (partially) predictable from a knowledge of process, not from the level of predictor variables.

Variance theories thus posit an invariant relationship between causes and effects when the contingent conditions obtain. Process theories assert that the outcome can happen only under these conditions, but that the outcome may also fail to happen.

Variance and process theories also differ in their conceptualization of outcomes and precursors. In variance theories, these constructs are usually conceptualized as variables: entities which can take on a range of values. In process theories, outcomes are not conceived as variables that can take on a range of values, but rather as discrete or discontinuous phenomena, that might be called "changes of state." Process theories are useful precisely because while recognizing and accepting the complexity of causal relationships they do not abandon the goals of generalizability and prediction.

As the result of this study a new theory is presented in the form of a taxonomy, including a core category and tree of subcategories. Thus a choice between the variance and process theories is not relevant. There are relations between the categories of the theory, and system-type categories with descriptions of the categories are presented, but no particular variables are described in more detail (for example, the entities within categories with their range of values are not specified).

However, if that dichotomy was utilized, the functional model would lead me to the variance type of a theory. ICTS could be seen as "an independent variable", and the success of an enterprise as "a dependent variable".

4.4.2 Qualitative research

One of the general and most common distinctions of research methods is the classification between qualitative and quantitative methods. In Information Systems science there has been a general shift away from technological to managerial and organizational issues, hence an increasing interest in the application of qualitative research methods.

When applying the framework of research methods by Järvinen (2001) that classification is not efficient, because both the theory-testing and the theory-creating classes may include qualitative and quantitative methods. Another significant point is that in the science of Information Systems one of the most important specific features is to build and evaluate artefacts which are useful (or helpful, serviceable, profitable etc.) in a certain context. That consideration is included in Järvinen's classification of research methods.

Qualitative research methods help to understand people and the social and cultural contexts within which they live. According to Myers (2001 cit Kaplan and Maxwell 1994) the goal of understanding a phenomenon from the point of view of the participants and its particular social and institutional context is largely lost when textual data are quantified.

Where quantitative research seeks quantities (answering e.g. questions like "how much exactly?") and causal determination, prediction, and generalization of findings, qualitative research seeks, instead, illumination, understanding, and extrapolation to similar situations (answering e.g. questions like "which kind of?"). Qualitative research involves the use of qualitative data, such as interviews, documents (which both may include quantitative data as well), participant observation data and the researcher's impressions and reactions to understand and explain these phenomena. The purified data can be presented as tables, maps, trees, matrices and other structures to extract the most essential relationships and themes. Examples of qualitative methods are grounded theory, case study, phenomenography, contextualism and ethnography (Järvinen 2001). Although mostly either quantitative or qualitative research work is performed, it has been suggested combining one or more research approaches (e.g. Miles and Huberman 1984, p. 40 to 41, Eisenhardt 1989, Niglas 2004) in a study.

It is not very often possible to structure qualitative study as clearly as is commonly done in quantitative research. According to Alasuutari (1995, pp. 11 to 18) in a qualitative analysis of empirical findings two phases could be distinguished, but these two overlap. Alasuutari refers to the Grounded theory approach (see e.g. Glaser and Straus 1967, Glaser 1978, Strauss 1987, Strauss and Corbin 1990). The two phases would be purification of observations (in other words creating theory) and, if the concepts created need to clarification unriddling or interpretation of findings, "solving the enigma". The two phases illustrate the main features of the analysis, but there are naturally other views of qualitative research structures (see e.g. Niglas 2004). In this study the eight-phase model of Eisenhardt (1989) is followed. The model is described in the following Section 4.5.

4.4.3 Case Study

According to Yin (1994) a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. For example, Markus (1983) has presented a theory of management information system (MIS) implementation in terms of case study methodology (ref. by Järvinen 2001, p. 67) in a nutshell: "The case study will show implementation only succeeded when the organization was able to re-structure itself, and not just overlay the new MIS on the old organization structure".

In his overview article on methodological problems involved in the study of a single case, Lee (1989) considers four problems he recognizes at case studies – making controlled observations, making controlled deductions, allowing for replicability, and allowing for generalizability. Lee also uses Markus (1983) as an example of resolving those problems, and concurrently he reflects the scientific methodology that involves the deductive, positivistic theory testing.

Case study is appropriate with a technically distinctive situation in which there are many more variables of interest than data points. It relies on multiple sources of evidence with data needing to converge in a triangulation as another result. A case study also benefits from the prior development of theoretical propositions, like innovation and knowledge management, to guide data collection and analysis. A case study is not either a data collection tactic or a design feature but a comprehensive research strategy (Yin 1994).

In general, case studies are the preferred strategy when "how" or "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. "What" questions, when asked as a part of an exploratory study, pertain to the case research strategy as well (Järvinen 2001 p. 8, Yin 1989)

Case study methodology can be qualitative, quantitative or both. Yin (1994) notes that the primary weaknesses of case study are that there may be a lack of rigor in the study, the studies may provide little basis for scientific generalization, and they can often take too long and result in massive, unreadable documents. However, case study methodology is appropriate for the evaluation of an anti-positivistic approach research (Burrell and Morgan 1979).

In addition to the question of scientific generalization, several alternative conceptions of validity and reliability have been offered to serve as features of qualitative and case research (e.g. Yin 1994, Niglas 2004). According to Dubé and Paré (2003) a key principle to be followed to increase the reliability of the information presented in a case study is the maintenance of a logical chain of evidence. Multiple viewpoints to the data will give rise to a more complete evaluation than a single source. The concept of triangulation means combining of different viewpoints, and it is in this study described based on Denzin (1978) and Jick (1979). The view of this study can also be characterized as naturalistic according to so called "naturalistic paradigm" (Guba and Lincoln 1985). That is an important point of view, because it leads to consider the questions of rigor and trustworthiness, questions of validity and reliability from different angle than, for example, in rationalistic research view. All the above mentioned views shall be considered at the end of the dissertation, in Chapter 8, "Discussion".

Cunningham (1997) provided a summary of the common case study approaches, each of which was used for different purposes (see Table 4.1). Some of the approaches were used for descriptive research, some for encouraging discovery, and some for establishing proof. According to Cunningham the identification of principles for a type of case study evolves out of the type of knowledge and information the researcher is seeking to gather.

Table 4.1: *Different types of case studies according to Cunningham (1997), modified.*

	Intensive cases	**Comparative cases**	**Action research**
Purpose	To develop theory from intensive exploration	To develop concepts based on case comparisons	To develop concepts which help facilitate the process of change
Assumption	Creativity through comparison with existing theories	Comparison of cases leads to more useful theory	Theory emerges in the process of changing
Examples[22]	Dalton (1959)	~~(Eisenhardt 1989)~~[23]	Trist and Bamforth (1951)
Accommodation to Järvinen (2001)	Chapter 4, pp. 62-87	Chapter 3, pp. 34-61	Section 5.3
Situation	Usually evolves out of a researcher's intensive experience with culture or organization	Usually concepts are developed from one case compared with another case	Developing theory to assist practices and future social science
Types	Narrative; Tabulation; Explanatory; Interpretative	Case comparisons; Case survey; Interpretative comparisons	Diagnostic Action research Experimental action research

The classification by Cunningham is quite compatible to the here previously presented categorization of research approaches/methods by Järvinen, which is adopted in this study (see subsection 4.3.3). Intensive case methods develop new theory and concepts from intensive exploration just as the theory-creating approaches in Järvinen's model. Comparative cases develop concepts based on case comparisons, and instead of relying on specific in-depth information about a case there is a more general use of cases for illustrating and testing the soundness of concepts, which brings it near the class of theory-testing approaches by Järvinen. Also action research fits exactly in Järvinen's class of the researches stressing the utility of artifacts, respectively.

However, Cunningham mentions as an example Eisenhardt (1989), who has presented an iterative theory-creating method. According to Eisenhardt, theory-creating research is begun as close as possible to the ideal of no theory under consideration and no hypotheses to test.

Action research is a term for describing a variety of cases that focus on research and learning through intervening and observing the continuous process of change, which aims to utility. In the process of action research a researcher and a client develop a long-term interest in understanding and resolving a problem of an issue. According to Cunningham two main groups of people have contributed to the body of knowledge in action research: some concern

22 Year of publication of the examples/references are here added to the original summary.

23 Stricken out while table was modified. Eisenhardt did not actually use comparative cases, but her sample was included due to the rigorous form of the model.

themselves with experimentation (experimental action research), while the others focus on change through feedback and learning (diagnostic action research).

The comparative case studies can be viewed as being something like an experiment which should be studied using scientific conventions. A variety of cases can provide a better demonstration of a theory or set of concepts, because they permit replication and extension among individual cases. The use of contrasting observations from varied settings is emphasized and the development of clear concepts is highlighted. According to Cunningham there are three kinds of comparative case studies: a survey of cases, case comparisons and interpretative comparisons. The case surveys stand on their own as researchers use them much as they are gathering survey data from a large sample[24]. In the case comparison approach, the analyst develops an explanation for one case set or set of cases and then replicates this process with a similar case or set of cases. First set is a theory, against which the second set is compared. In the comparison, the analyst develops an understanding of why certain conditions did or did not occur, and then offers interpretations.

Interpretative comparisons cases provide criteria that can be used in benchmarking levels of success and in identifying novel strategies. The cases are e.g. descriptions of the reasons for the success of enterprises, some kind of models or "best practices". When interpretative comparisons are made, these models or best practices have the position of a theory.

The intensive case studies represent a research strategy where the analysis is based on an assortment of evidence from within the case, and they do not imply the use of one particular type of evidence, method or data gathering. Narratives, explanatory and interpretative cases tend to use historical information focused around questions, criteria, a sequence of occurrence, or testimonials. On the one hand the goal of the intensive case studies is to provide a history, description or interpretation of unique and typical experiences or events, and on the other hand very intensive understanding of events and practices of one person, group or organization.

Because the aim of this study is theory-creating it can be placed in the class of intensive case methods. Intensive case methods develop new theory exploratively. In this study comparisons between cases are made, but the new cases are used to supplement the conceptual view. The iterative theory creating method of Eisenhardt (1989) is applied in this study.

4.5 Model of Eisenhardt

In this section I preview the model of Eisenhardt (1989) with the eight steps it includes. Within every step I describe briefly the important issues of the data analysis I shall present later in this study. The following text describing the method (subsections 4.5.1 to 4.5.8) is based on Eisenhardt (1989) and Järvinen (2001).

24 Case survey is a survey in which analyzed unit is a case, see e.g. Järvinen (2001, Section 3.3). At the end of this study I present a distinct summary of the cases in the light of the emergent theory, which can be characterized as a case survey.

Eisenhardt divides the theory building process to the following steps: 1. Getting started, 2. Selecting cases, 3. Crafting instruments and protocols, 4. Entering the field, 5. Analyzing data, 6. Shaping hypotheses, 7. Enfolding literature and 8. Reaching closure.

4.5.1 Getting started

An initial definition of the research question is important in creating theory from case studies. Without a research focus, it is easy to become overwhelmed by the volume of the data.

In this study the research question is formulated as a "what" question: *What are the types of information and communication system innovations emphasized by a production SME when it adopts ICT?*

Subquestions are formulated as "how" questions:
- *How are the financial aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the social aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the technical aspects emphasized, when an SME adopts ICT-based innovations?*
- *How are the informational aspects emphasized, when an SME adopts ICT-based innovations?*

Eisenhardt argues that a priori specification of constructs can also help to shape the initial design of theory-creating research. That is valuable because it permits the differentiating of constructs more accurately. According to Eisenhardt, theory-creating research is begun as close as possible to the ideal of no theory under consideration and no hypotheses to test. It is quite difficult or even impossible to achieve the ideal, but an attempt is important, because preordained theoretical perspectives or propositions may bias the findings.

There are some models of this kind of issues. They cannot, however, be seen as particular a priori constructs but as help in focusing the research topic. For example, the external and organizational environments, with various network theories, form the background context in this study. Some other theories, such as the general systems theory (Higgs 1995) or the innovation theory by Rogers (1985) give base-line views. The IS innovation theory by Swanson (1994) is one of the most fundamental works categorizing IS innovations so far, and it is also compared with some of the results of this study. In addition, results of an earlier survey of SMEs (Mäki and Riihimaa 1995) and the description of my personal history represent my creation of pre-understanding.

However, the model adopted for describing the activities and the structure of an enterprise, the eight main functions model of an organization by Kerola and Järvinen (1975), with the tool for analyzing research data - the Chart of the four perspectives, presented in Section 3.5 - form kinds of a priori constructs in this study.

4.5.2 Selecting cases

In theory-creating research the concept of population is crucial, because the population defines the set of entities from which the research sample is to be drawn.

In Finland, the region of South Ostrobothnia is the most SME-intensive area. Entrepreneurship and small businesses characterize the region. With a great density of SMEs and a tradition of entrepreneurship the region can be seen as a laboratory for SMEs. More commonly, Finland can be seen as a laboratory for the Information society. This background forms an empirical basis to this research.

According to Eisenhardt, a good selection of an appropriate population controls extraneous variation and helps to define the limits for generalizing the findings. Theory-creating research relies on theoretical sampling, i.e. cases are chosen for theoretical, not statistical reasons (Glaser and Strauss 1967) and compared with theoretical sensitivity.

Main data

For this study I gathered two sequential sets of case interviews. During this study there were actually two separate phases in selecting an appropriate population for both of these settings. The first phase took place before entering the field to gather interview data. Another was when the preliminary case analysis of each set was made. In this second phase I selected the most different and most representative cases to be analyzed in more detail.

There were two cooperative projects supporting the data gathering. As a part of the cooperation is was necessary to collect data also for other purposes that this study alone, and also data concerning enterprises from other than the SME sector. However, that data offered a possibility of comparison on the one hand to larger enterprises, and on the other (especially within the second data set) to important parties within the SME networks, and also to other regional parts of the country.

When selecting the first set of case interviews the special project group considered the representatives of the leading enterprises of South Ostrobothnia in different business branches. From that basis the group, in which I was one of the members, chose the candidates for the interviews. It was important to have representatives from all types of production enterprises. The enterprises selected in the end operated in wood, metal and food industries and some of them also in ICT industries.

For the second set of case interviews the viewpoint was broadened from regional Southern Ostrobothnia into the whole of Finland. Also some large enterprises were included. The focus was also sharpened into the branch of metal and electrotechnical industries. To get a good scope of the target group it was necessary to have all types of enterprises of the branch involved in the research. Large enterprises play an important role as parties in the SME networks and as nodes of the supply chain networks. A number of metal and electrotechnical enterprises which met the criteria were selected. They were first recognized in cooperation

with the representatives of the Federation of Finnish Metal, Engineering and Electrotechnical Industries (MET). Based on the MET's experts knowledge representative enterprise candidates from Finnish metal, engineering and electrotechnical industries were selected and a list of potential enterprises for interviews was created.

Eisenhardt argues that the cases may be chosen to extend the emergent theory, or they may be chosen to fill theoretical categories and to provide examples of polar types. If the first case is seen as a first version of the theory, the cases may also be chosen for kind of theory-testing activities to replicate previous cases.

The first set of cases was defined as having an overview of different production SME industries. The enterprises selected were "best local cases". After the preliminary analysis of the set I chose one of the cases and derived the very first version of the theory from it. Next I took another, and so on, till the saturation point was reached and the iteration was ended (Yin 1994, p.111). The second set was chosen by using a criteria created from the basis of the first set. When analyzing the cases of the second set in the same way the emergent theory was extended further.

Secondary data

Secondary data is rarely used in existing IS research, and it is typical of secondary research to analyze data that had originally been collected for some other purpose, often for a nonresearch purpose (Järvenpää 1991).

Järvenpää defines (referring Hyman 1972, p.1) secondary data analysis as the "extraction of knowledge on topics other than those which were the focus of the original surveys." According to her, secondary sources are archival documents, electronic or physical traces, or measures gathered via hardware, such as a camera, in the process of accomplishing another activity. The secondary data methodology can be applied to studies designed for understanding the present and the past, to investigate change, to examine phenomena comparatively or to replicate or extend studies.

In this study the material which I consider secondary data by its nature were collected mostly when we were doing the interviews[25].

Case sets were supplemented with various background information about the enterprises, such as brochures presenting them and their products, presentation materials, such as Powerpoint slides (in printed form), separate organization charts, annual reports and interim reports, corporate and customer magazines, newspaper and magazine articles, and the enterprises' www pages, not forgetting discussions with other experts working with or within the interviewed enterprises. In this I had in my use also some internal databases (MET Intranet), including background information on most of the interviewed enterprises (mostly quantitative, descriptive information, such as the numbers of employees in the enterprises, turnovers of the companies etc.).

25 That secondary data of this study are not systematically registered, and not listed in the references.

In this study the secondary data are mainly applied to extend and strengthen the view of the enterprises, to ensure that we got the right picture of the enterprises and their products or that other issues concerning the enterprises were understood correctly by us researchers. In a way that data were collected to complement the main data and to give additional background information. The secondary data had no direct influence on the emergent theory as the final result of this study.

4.5.3 Crafting instruments and protocol

According to Eisenhardt, theory creating researchers typically combine multiple data collection techniques. The triangulation made possible by multiple data collection techniques provides stronger substantiation of constructs and hypotheses. Collecting different types of data by different methods from different sources produces a wider scope of coverage and may result in a fuller picture of phenomena under study.

Varied forms of triangulation applied in this study are presented later in a separate section (see subsection 8.1.3).

Although the terms “quantitative data” and “theory-testing methods” on the one hand and “qualitative data” and “theory-creating methods” on the other are often used interchangeably, Eisenhardt recommends that both quantitative and qualitative data should be used in any study, if at all possible. In this study the main data of the sets of case interviews is in a qualitative form.

Some of SME survey results (Mäki and Riihimaa 1995) represent a priori quantitative data, alike some secondary data discussed in the previous subsection. That forms a kind of a pre-understanding and therefore a basis to the qualitative analyzes of the enterprise cases.

However, using e.g. a survey as a research method within those groups of enterprises would have produced very distinct results difficult to interpret. In this kind of research settings case study can produce sensible results better than most other methods. This is because the case study method with interviewing is very sensitive; the researcher can interact with interviewed person(s) about the subject and concepts used and a common understanding can be created.

4.5.4 Entering the field

According to Eisenhardt, a striking feature in creating theory from case studies is the frequent overlap of data analysis with data collection. She argues that field notes and team meetings seem to support early analysis of collected data. An important feature of theory-creating case research is the freedom to make adjustments during the data collection process, for example, to add cases to probe particular themes which emerge, or to interview previously unknown individuals. Additional adjustments can also be made to data collection instruments, such as adding questions to an interview protocol or a questionnaire.

During the gathering of both of the sets of case interviews I had good supportive groups, and in almost every interview I also had an associate interviewer, so a multiperspective debate and evaluations were continuously kept alive. The frames of both of the circles of interviews stayed quite the same during the periods of interviewing. The number of interviews was defined in advance. However, it was possible to emphasize different aspects in different enterprises during the interviews, and there were no strictly formal questionnaires in use. Both I and my research colleagues also noticed the saturation point within both sets. After those points new, incremental information from new cases seemed minimal compared to the previous ones.

4.5.5 Analyzing data

Analyzing data is the heart of creating theory from case studies. Eisenhardt argues it is both the most difficult and the least codified part of the process. Qualitative studies tend to produce large amounts of data that are not readily amenable to mechanical manipulation, analysis and data reduction. Therefore, the basis goal of qualitative data analysis is understanding, i.e. the search for coherence and order.

In Eisenhardt's model within-case analysis is seen as a key step in analysis. According to her, it typically involves detailed case study write-ups for each site. An overall idea is to become closely familiar with each case as a stand-alone entity. That kind of analysis allows the unique patterns of each case to emerge before investigators push to generalize patterns across the cases.

In my study I had a total of 57 cases. The within-case analysis for the first phase was made by both of the researchers, me and my colleague, and also all the interviewees confirmed the interpretations. The total mass of those quite compactly written interpretations was about 300 pages. As mentioned earlier there was a necessity to collect data also from some enterprises not representing the SME sector for the needs of cooperative projects. I analyzed these cases as well, but the interpretation was made more carefully and the possible results were adapted for the SMEs' viewpoint (for example, while I evaluated the parties in subcontracting).

The cooperation with the concurrent SME development projects, discussions with the other interviewers and respondents and also writing other separate reports and articles (Riihimaa and Vuori 2000, Riihimaa and Ruohonen 2002, Ruohonen, Riihimaa and Mäkipää (2002, 2003)) offered me an opportunity to become intimately familiar with the sets of the case data.

According to the method of Eisenhardt the next phase is cross-case searching. The idea behind these searching tactics is to force one's way beyond initial impressions, especially through the use of structured and diverse lenses on the data. These tactics improve the likelihood of accurate and reliable theory. Cross-case searching tactics also enhance the probability that the investigator will capture novel findings which may exist in the data.

Eisenhardt argues that the tactics in cross-case search are driven by the reality that people are notoriously poor processors of information. The tactics she mentions are the one (1.) to select categories or dimensions, (2.) to select pairs of cases or (3.) to divide the data by data source. In this study open coding (Strauss and Corbin 1990, p. 61, Järvinen 2001, p. 66) is applied. Open coding is a process in which data is broke down, examined, compared, conceptualized and categorized. A category is the classification of concepts, and it is discovered when concepts are compared one against another and appear to pertain to a similar phenomenon. Thus the concepts are grouped together under a higher order, more abstract concept called a category.

I first selected a core category (cf. selective coding according to Strauss and Corbin 1990, p.116), but in the meaning of selecting the category representing the most abstract level of the ICTS innovation phenomena. I mainly analyzed that core category "top-down". The original term "core category" means the central phenomenon around which all the other categories are integrated (Järvinen 2001, p. 67), and so it does also in this study.

4.5.6 Shaping hypotheses

The following phase in Eisenhardt's model is systematic comparison between the emergent theory frame and the evidence from each case in order to assess how well or poorly it fits with the case data. The main idea is to compare the theory and the data iteratively, iterating toward a theory which closely fits the data.

The first step is sharpening the constructs by (1) refining the definition of the construct and (2) building evidence, which describes/measures the construct in each case. Constant comparison between data and constructs is made so that accumulating evidence converges on a simple, well defined construct.

Another step in the hypothesis-shaping in Eisenhardt's model is verifying the emergent relationships between constructs fit with the evidence in each case. At times it is confirmed by the case evidence, but at others it is revised, disconfirmed or thrown out for insufficient evidence.

According to Eisenhardt this verification process is similar to that in traditional hypothesis testing research. The key difference is that each hypothesis is examined for each case, not for the aggregate cases. Thus the underlying logic is replication. Cases which confirm emergent relationships enhance confidence in the validity of the relationships. Cases which disconfirm the relationships can often provide an opportunity to refine and extend the theory. In this study "the hypotheses" are the categorized views, presented as descriptions of screened innovation systems categories and showing for which different purposes ICTS innovations are adopted.

4.5.7 Enfolding literature

An important phase in Eisenhardt's model is the comparison of cumulative concepts, theory or hypotheses with extant literature. This involves asking what is similar to what, what does it contradict and why. A key to this process is to consider a broad range of literature.

In this study various (resource-based) perspectives, the financial (economic behavior, e.g. efficient utilization of the innovation, short repayment period), human (e.g. social networks, cooperation), physical (information and communication technology) and informative (e.g. databases, knowledge) perspectives are emphasized, which forms a rich, even contradictory theoretical basis. I presented the literature describing the background of these perspectives in earlier chapters of this study (chapter 2 and 3). The most suitable literature fitting for sharpening the view of each of the categories of the emergent theory will be referred to in the following Chapters 5 and 6, while I present the analysis of the emergent theory categories.

Examining conflicting literature with the emergent theory is important for two reasons. The confidence in the findings is reduced, if conflicting findings are ignored. As Järvinen argues, readers may, for example, assume that the results are incorrect (a challenge to internal validity), or if correct, are idiosyncratic to the specific cases of the study (a challenge to generalizability). Conflicting literature represents also an opportunity. A confrontation with conflicting results forces the researcher into a more creative, frame-breaking mode of thinking. The result can be a deeper insight into both the emergent theory and the conflicting literature, as well as the sharpening of the limits to generalizability of the focal research.

It must be noted that due to the structure of the emergent theory, in which the categories are paired off, the enfolding literature will in most cases strengthen the definitions of the categories. However, there will be also some conflicting literature.

In proportion, literature with similar findings is important because it ties together underlying similarities in phenomena not associated with each other. The result is often a theory with stronger internal validity, wider generalizability and a higher conceptual level.

4.5.8 Reaching closure

Eisenhardt argues that two issues are important in reaching closure: when to stop adding cases, and when to stop iterating between the theory and the data.

According to Eisenhardt adding cases should ideally stop when theoretical saturation is reached. Theoretical saturation means the point at which incremental learning is minimal, because the researchers are observing phenomena seen before (Glaser and Strauss 1967). In practice, theoretical saturation often combines with pragmatic considerations, such as time and money, in determining when to end case collecting.

For this study I gathered two sequential sets of case interviews. While cooperating with two projects there were pragmatic limitations due to the necessity to collect data also from some enterprises not representing the SME sector for the projects' purposes. In practice also time and financial resources were not unlimited. However, in both sets of cases it was possible to have two researchers involved. I also had an opportunity to visit practically all of the enterprises interviewed, and I had also supporting colleagues when the within-analysis of the cases were made. It would have been possible to add incremental cases into both of the sets of cases, but my colleague and I did not find that necessary. In both of the sets we noticed when the saturation point was reached and the same type of issues begun to arise at the end of the circles of visits to the enterprises.

Eisenhardt argues that, as the second issue of closure, saturation is another key idea for when to stop iterating between the theory and the data. The iteration process should end when the incremental improvement to the theory is minimal.

The final product of creating theory from case studies may, according to Eisenhardt, be concepts, a conceptual framework, or propositions or possible mid-range theory.

In this study the new theory describes a taxonomy, a principle for classifying the information and communication technology system innovations adopted by small and medium sized enterprises in the context of the Information society.

The process of building theory from case study research according to Eisenhardt is summarized in the following Table 4.2.

Table 4.2: *Process of building theory from case study research (Eisenhardt 1989, p. 533).*

Step	Activity	Reason
Getting started	Definition of research question. Possibly a priori constructs. Neither theory nor hypothesis.	Focuses efforts. Provides better grounding of construct measures. Retains theoretical flexibility.
Selecting cases	Specified population. Theoretical, not random, sampling	Constrains extraneous variation and sharpens external validity. Focuses efforts on theoretically useful cases – i.e., those that replicate or extend theory by filling conceptual categories.
Crafting instruments and protocol	Multiple data collection methods. Qualitative and quantitative data combined. Multiple investigators.	Strengthens grounding of theory by triangulation of evidence. Synergist view of evidence Fosters divergent perspectives and strengthens grounding
Entering the field	Overlap data collection and analysis, including field notes. Flexible and opportunistic data collection methods.	Speeds analyses and reveals helpful adjustments to data collection. Allows investigators to take advantage of emergent themes and unique case features.
Analyzing data	Within-case analysis. Cross-case patterns search using divergent techniques.	Gains familiarity with data and preliminary theory generation. Forces investigators to look beyond initial impressions and see evidence thru multiple lenses
Shaping hypothesis	Iterative tabulation of evidence for each construct. Replication, not sampling, logic across cases. Search evidence for “why” behind relationships.	Sharpens construct definition, validity, and measurability. Confirms, extends and sharpens theory. Builds internal validity.
Enfolding literature	Comparison with conflicting literature. Comparison with similar literature.	Builds internal validity, raises theoretical level, and sharpens construct definitions. Sharpens generalizability, improves construct definition, and raises theoretical level.
Reaching closure	Theoretical saturation when possible.	Ends process when marginal improvement becomes small.

4.6 Summary of research methods and philosophical assumptions

In this chapter I presented the philosophical and methodological assumptions behind this study. I reviewed the research approaches and techniques I shall apply in the following empirical part of the study. In the first section I also repeated the main research question and presented the subquestions.

According to a typical categorization of research purposes this study is characterized as phenomenological. I emphasize interactive discussion between the researcher and members of the studied organizations, so the results are transformed in the research process and concepts are developed with the organization members (Deetz 1996).

In this study I shall use my lived experience mostly in the analysis of the data I gathered (see following Chapters 5 and 6), not that much as data itself or even as findings, which might be possible as well. My aim is to carefully interpret the interviews I did, preferring to respect the "voices" and views of the enterprises.

All my experience has guided me towards anti-positivistic tendencies. To describe the categorization of philosophical assumptions of this study I referred to Järvinen (2001), Deetz (1996), and Iivari (1991). The "sliding" dimensions of contrast in Deetz's model makes it flexible for me to follow my own view and experience. I also described the aspects of ontology, epistemological assumptions and methodology, partly based on Iivari (1991) and Järvinen (2001). I did not do that through the subjectivist/objectivist dimension, but just by describing some dominant aspects of the background.

The aim of this study is characterized theory-creating, according to Järvinen (2001). Theory-creating studies are very appropriate for exploratory investigations, when no prior knowledge exists of a part of reality or a phenomenon. Qualitative methods such as case study are included in the theory-creating approach.

I characterized also some qualitative research issues and case study principles, which in this study are evaluated based on works of Yin (1994), Cunningham (1997) and Eisenhardt (1989). Eisenhardt's (1989) model is applied in this study, and I presented the model in this chapter in more detail.

In the following chapter I shall present the first empirical part of this study, the first case set with 17 interviewed enterprises. I shall present the three most representative cases in detail, and the core of the emergent theory will be created during the following chapter.

5 The first empirical part of the study: the ITEP interviews

In this chapter I shall present the first empirical part of this study, an ITEP (Information Technology in Etelä-Pohjanmaa[26]) case set with 17 interviews of production enterprises. In the first section I shall present the process of data gathering and preliminary analyses, as well as form the core category of the emergent theory.

In Sections 5.2 to 5.5 I shall present the three most representative ITEP cases and their analyses in detail. The emergent theory shall be gradually supplemented case by case. In Section 5.6 I shall combine the summary of the three case constructs with the findings of the rest of the ITEP cases.

I shall present the emerging theory in two forms: as a tree-structure and in a table format. In the tree format each "leaf" represents a separate category of ICTS innovations, and a top-down partition is presented. The summary of the identified constructs in the table format includes the categories of ICTS innovation types, their brief descriptions and references to enfolding literature.

The emergent theory will be supplemented in the following chapter (Chapter 6), when the other data set is considered.

5.1 The background of the ITEP data

This section will describe the process of ITEP data gathering and its preliminary analyses. I shall present the basis of the gathering process (subsection 5.1.1), the process of selecting the enterprises (subsection 5.1.2), the gathering methods of the ITEP data (subsection 5.1.3), a description of the interviewing process (subsection 5.1.4) and preliminary data analyses (subsections 5.1.5 and 5.1.6). In subsection 5.1.7 I shall form the core category of this study and at the end (subsection 5.1.8) I shall describe briefly the method of the forthcoming case analyses.

5.1.1 Specified population

For this study I gathered two sequential sets of case interviews. First of them was collected within a project frame called ITEP, Information Technology in Etelä-Pohjanmaa. The ITEP was a regional development project, which was born through the discussions of an informal group of information technology minded experts working with the regional development issues. I was involved in those discussions. The actual initiator of the group was a local agent of the Finnish National Technology Agency, Tekes. A local development plan of

26 "Etelä-Pohjanmaa", in English "Southern Ostrobothnia".

information technology published in the spring of 1999 provided a background for the discussions. It did not look comprehensive enough for us, so we thought other proposals and actions were needed.

Based on these thoughts of the expert group a particular project was established. The project was active primarily between the beginning of April 1999 and the end of June 2000. It was coordinated by the local office of Tampere University, its Institute for Extension Studies (TYT), and funded by the Finnish Department of Labor.

Although the TYT was given the coordinating position, the project was supported by a large local cooperative network. The partners, the total number of which was about 20, were the most important regional education and development organizations. That formed a good basis for project operations.

The project was organized into four teams: Managing team, Operative team, Enterprise development team and Educational team. I was involved in the first three. The aims of the teams were the following:

- the Managing team was to guide the main lines of the total project,

- the Operative team concentrated on supportive activities to reach the aims of the projects, such as organizing internal seminars and coordinating local studies on information technology,

- the Enterprise development team concentrated on the ICT problems of local enterprises and on cooperation with them and

- the Educational team concentrated on the anticipating viewpoint of educational questions of information technology.

As mentioned earlier, the focus of the regional development in South Ostrobothnia has currently been on three branches of production industries; food industry, wood industry and metal industry. During this time also the development of ICT industry activities became important.

The aim of the entire ITEP project was to produce comprehensive, visionary and anticipating knowledge on the issues of information technology in the region of Southern Ostrobothnia. The functions of the produced knowledge were to increase the adoption of ICT in different business branches, to create operational preconditions for local information technology industry and to increase the number of local enterprises in the branch of information technology industry. A very important issue of the ITEP project was to clarify the future educational and developing needs of local enterprises involved in information technology.

Among the activities of the Enterprise development team there were e.g. a study concentrating on the effects of ITC on business strategy made by a local, experienced management consultant, a survey concentrating on local ICT service providers, and three other studies of the current use and future needs of ITC. One of those three studies offered me an opportunity to gather the first case data set for this study.

The total number of the various research reports made within the ITEP project was about 20, among them Petäjä (2000), Riihimaa and Vuori (2000), Linnamaa et al. (2000) and Taipalus and Varamäki (2000). The documentation of the project was presented on a www page, http://www.sjoki.uta.fi/tyt/itep/osaraportit.html. Also 15 of the 20 reports mentioned above were published there.

5.1.2 Selecting enterprises for the ITEP interviews

For the selection of my case set of the ITEP interviews I and the enterprise development team discussed the most leading SME enterprises in different business branches in South Ostrobothnia. From the basis of the expertise of the group's members we chose the candidate enterprises for interviewing. As mentioned, I was also a member of the team. We felt it important to have representatives of all types of production enterprises, because we wanted to have a comprehensive view of the local use of ICT. In the end the enterprises selected operated in wood, metal and food industries, but also in the ICT industry. We argued, basing on our experience, that the selected enterprises were the "best local cases" to give an overview of different production SME industries.

Among the selected enterprises there were three large ones; a food (meat) processing enterprise, a newspaper operating in the publishing sector and in the graphics industry and a rapidly grown metal firm. With the exception of the latest, the reason for including those large enterprises was purely for the needs of the ITEP project. However, the data of the large metal firm was relevant also to me, because it had been an SME just a few years earlier, and currently it worked in cooperation with numerous SMEs.

The enterprises were typically represented by their chief executive officers, or in the large organizations by managers or directors. That was at the suggestion of the ITEP enterprise development team and I agreed with it. We argued that those persons had a good general insight of their enterprises. In the following Table 5.1 the ITEP cases are summarized briefly.

Table 5.1: *Summary of the ITEP cases.*

Enterprise	Classification	Short description	Size	Respondent
ITEP_A1	Consultation /services of productive industry	A privately owned company, founded in 1983. Digital processing with printing, scanning, filing and copying services	>10	chief executive officer
ITEP_A2	Consultation /services of productive industry	A privately owned ICT consulting company	<10	chief executive officer
ITEP_A3	Consultation /services of productive industry	Incorporated consulting company with internet services and education projects	<10	chief executive officer
ITEP_B1	Food industry	A large meat processing enterprise, incorporated company	> 250	information systems manager
ITEP_B2	Food industry	Data is not available for use	-	-
ITEP_C1	Wood industry	A joint sales and marketing company of five furniture factories.	<10	chief executive officer
ITEP_C2	Wood industry	A privately owned furniture production company making and planning customer-specialized projects	<10	chief executive officer and planner (2)
ITEP_C3	Wood industry	A vocational adult education center with business activities, specialized on wood and furniture	>50	chief executive officer
ITEP_D1	Metal industry with ICT components in products	A privately owned company manufacturing equipment for the handling of materials. Established in 1978	>100	director
ITEP_D2	Metal industry with ICT components in products	A privately owned company, founded in 1994. Produces large logistics systems with hardware and software components to support material flows.	>50	director
ITEP_D3	Metal industry with ICT components in products	A rapidly grown, privately owned company, founded in 1970, producing metal working machines and manufacturing systems	>250	information systems manager
ITEP_E1	Metal and electro-technical industry with ICT	A privately owned company founded for MATV equipment wholesale in 1972. Today sales activities supply various integrated systems in the field of digital technology systems (e.g. DTH, SMATV and Satellite Rebroadcasting Stations).	>10	chief executive officer and technical director (2)

ITEP_E2	Metal and electro-technical industry with ICT	An electronics manufacturer, founded in 1978. Specializes in control systems for various types of mobile and other machinery.	>10	chief executive officer
ITEP_E3	Metal and electro-technical industry with ICT	Supplies mobile communication software for large global manufacturers and operators.	>10	chief executive officer
ITEP_F1	ICT	A privately owned company, trade in ICT business. Computers, software, networks, internet-services etc.	>10	chief executive officer
ITEP_F2	ICT	A privately owned software company specialized in Internet, Intranet and Extranet based applications.	>50	chief executive officer
ITEP_G1	Media and publishing	A newspaper in publishing sector and in graphics industry. Incorporated company	>250	developing manager

5.1.3 ITEP data gathering techniques

My role as a researcher in the ITEP project was to work in cooperation with the project consultants of the Tampere Technology Centre, Hermia (Mr. Veli-Matti Vuori, later in the text VMV and Mr. Janne Vuorinen, later JV). The project did not pay me any salary for gathering data or any other activities. However, the organization where I work, Seinäjoki Polytechnic, was one of the partners in the ITEP project, which enabled my participation.

In the first phase I contacted the intended respondents of the proposed enterprises by phone and asked if their firms would consent to be involved. Nobody refused. In the following phase we sent the respondents a letter in which the main goals of the project and the themes of the forthcoming interview were described.

The setting we built for the ITEP interviews can be characterized as in-depth theme interviewing. In general, an interview can be defined as a discussion between a researcher and an interviewee or informant (respondent). Interviews can be structured or non-structured (Alasuutari 1995). The term "structure" refers to an outline constructed in advance. It follows the setting of questions for the study, the expressed themes (theme interview) or problems etc. The purpose of structuring is to ensure that the interview and the informant focus on the intended questions.

I selected the themes for the interviews with VMV and JV. The selected themes were common to all of the businesses, such as their core competencies, products, markets, forms of networking which the enterprise has, their product development and educational needs. The themes were not selected by using any particular scientific reference or any theory, they were based on our knowledge of businesses practices. The themes are presented in Appendix 1.

The overall viewpoint penetrating the themes was the adoption of information systems. During the interviews the originally quite general business themes were sharpened to case-specific questions, such as: "For which business functions do You adopt and apply information and communication technology?", or "How to decrease the disincentives of the use of ICT?"

5.1.4 Entering the ITEP field

To become closely familiar with each enterprise I had preliminary discussions with the members of the ITEP Enterprise development team, who knew the firms better than I did (these discussions were not documented). With some of the enterprises I already had previous connections, such as ICT consulting commissions (in four of the enterprises), enterprises' participation in educational projects in which I had been involved (in two of the enterprises), some operative issues (in one of the enterprises) or administrative cooperation issues (in two of the enterprises). In most of the cases the enterprises already had www pages, and I used also them as one of my pre-information sources.

There were 17 interviews, all done at the enterprises. In every case there were two interviewers, in most of the cases JR and JV, only in one case JR and VMV. The most of the informants were, as previously mentioned, chief executive officers or chief information officers. In two enterprises there were two persons present, in all of the others a single person. The informants in every enterprise were familiar with the main aims of the ITEP project and the future use of the data, including its use in this dissertation.

Interview studies usually bring up the question of protecting the interviewees' anonymity. Names of the enterprises or respondents are not mentioned in this study. That was promised to the enterprises to protect their anonymity. They were also informed that they were not assumed to give away any information that could be classified as a business secret. They were asked to tell us if there was any information which was confidential. None of that kind of information was written down.

The first of the ITEP interviews took place on 12th of November and the last one on 14th of December 1999. Every interview lasted about two hours, the shortest was one and a half hours and the longest three hours. The interviews were not tape-recorded, for we felt that would cause distrust in the informants. In some cases the interview situation had little disruptions, for example due to phone calls, but these were quite minor interruptions and did not disturb in any way.

In the ITEP interviews the respondents discussed the information systems of their enterprises. I argue that they emphasized the systems most important to them. Because most of the respondents were owners of the enterprises, chief executive officers or other managers, comprehensive views of the enterprises was achieved. The systems mentioned during the interviews were also the fundamental ones for the firms and can be recognized as ICTS innovations.

My associate interviewer (JV) had a laptop computer for field notes, I took mine manually. In most of the cases the interviewees offered also some additional material to us, typically brochures presenting the enterprise, but also customer magazines, copies of their presentation material or even preliminary answers to our questions in a written form.

5.1.5 The preliminary analyses of the ITEP data

There were a number of issues that offered me an opportunity to become familiar with the ITEP data, such as the cooperation with the rest of the ITEP project, discussions with the colleagues doing the interviews, various kinds of pre-orientation mentioned in the earlier section, additional material offered to us by the enterprises, and also writing a separate report (Riihimaa andVuori 2000).

In some of the research techniques all the communication that takes place in the interviews is analyzed, particularly the interviewee's input. We built the ITEP within-case documents quite parsimoniously. After the interviews we transcribed our field notes of each case comparing them and sometimes including other case-specific material (such as information describing the enterprise). At the end the completed within-case documents were copy-typed by using a laptop so we got all the data into an electronic format. A typical extent of a case was four pages in a paper format.

After both of us interviewers (JR, JV) had accepted the within-case interpretation I sent it to the informant for verification. The first of the transcriptions was e-mailed at the end of October 1999, following ones were posted as letters (10) or delivered personally (2) in mid-February 2000. The last ones (5) were sent by mid-March 2000, some of them by the e-mail. Some persons also asked for e-mail versions after they had received the posted letter.

If there were any corrections asked by the respondents I made the adjustments and sent the corrected version back to the informants for acceptance. In some cases also some other representatives of the enterprise checked the transcription. Among the enterprises there was one which never confirmed the interview transcription, in spite of many mutual contacts to it. The actual reason for the behavior never became clear to me. The data of that interview was not used in this study.

The data of the confirmed within-cases were also used when a separate report (Riihimaa and Vuori 2000) of that part of the ITEP project research was generated. For the report another exceptional method was used to supplement the data. After most of the enterprise interviews were transcribed, the representatives of the Tampere Technology Centre, Hermia, (VMV and Mr. Pekka Jussilainen) and the head of the training division of the TYT, Ms. Marjatta Jokisuu, organized an additional interview - I was interviewed by the triplet. The main idea of the method was to outline from their external viewpoint the most important lines that "rose" from the interviews of the enterprises.

5.1.6 Classifying the ITEP cases

To focus the first of the forthcoming analyses on the most versatile and descriptive cases I classified the ITEP enterprises according to their prioritized ICT use. The enterprises adopted and utilized ICT systems in innovative ways either for their production processes or for their products (or both). A preliminary classification of firms according to their business branches was already made when the enterprises for the interviews were selected. It was now possible to sharpen the classification based on the gathered data in preparation for more detailed analyses.

The enterprises which had ICT included in their products, in other words had software components integrated into their products, were selected as a class of their own. Quite expectedly those were the cases of metal industry and software industry. In the following Table 5.2 those enterprises are marked as "Product" in the column "Prioritized ICT use". Also among the enterprises placed in the other classes there were some examples of ICT as a part of the products, but the classification here was done by an emphasized focus on the use.

The enterprises for the second class in which ICT was mostly adopted for the production processes were selected in the same way. That class was further divided into two. The division was done to achieve two different perspectives: the "inside" perspective of a production enterprise emphasizing ICT in their processes and the "outside" perspective of a service firm, supporting the activities of production enterprises and emphasizing ICT in the processes.

The enterprises offering services to the production enterprises were also separated as a class of their own. In the following Table 5.2 these enterprises are marked as "process/ outside". The big media and publishing company was put into this class due to its activities as a media broker.

The rest of the enterprises made up the last class including firms from food industry and wood industry. In Table 5.2 these enterprises are marked as "process". It must be noted that the enterprises representing wood industry in this study concentrate on furniture business, and other wood industry branches were strictly-speaking not involved, e.g. sawmills, carpentry, producers of prefabricated houses, etc.

Table 5.2: *Different types of the enterprises/ ITEP.*

Enterprise	Classification	Size	Prioritized ICT use
ITEP_D1	Metal industry with ICT components in products	SME	Product
ITEP_D2	Metal industry with ICT components in products	SME	Product
ITEP_D3	Metal industry with ICT components in products	Large	Product
ITEP_E1	Metal and electrotechnical industry with ICT components in products	SME	Product
ITEP_E2	Metal and electrotechnical industry with ICT components in products	SME	Product
ITEP_E3	Metal and electrotechnical industry with ICT components in products	SME	Product
ITEP_F1	ICT	SME	Product
ITEP_F2	ICT	SME	Product
ITEP_B1	Food industry	Large	Process
ITEP_B2	Food industry	SME	- - -
ITEP_C1	Wood industry	SME	Process
ITEP_C2	Wood industry	SME	Process
ITEP_C3	Wood industry	SME	Process
ITEP_A1	Consultation /services of productive industry	SME	Process/outside
ITEP_A2	Consultation /services of productive industry	SME	Process/outside
ITEP_A3	Consultation /services of productive industry	SME	Process/outside
ITEP_G1	Media and publishing	Large	Process/outside

5.1.7 Forming the core category

After the preliminary within-analysis of the cases was over I selected the cases I recognized as the most versatile and representative to be presented more thoroughly. I selected three of the ITEP cases for the purpose of having different viewpoints from all of the 16 cases (originally 17, one was never confirmed and it was not used). However, during the analysis I did considered all of the cases.

For the analysis of the data in this study I applied open coding (Strauss and Corbin 1990, p. 61, Järvinen 2001, p. 66). It is a process in which data is broken down, examined, compared, conceptualized and categorized.

First I selected a core category. The original meaning of the term "core category" (cf. selective coding according to Strauss and Corbin 1990, p. 116) is the central category of the

phenomenon around which all the other categories are integrated (Järvinen 2001, p. 67). In this study the core category was selected to represent the most abstract level of the ICTS innovation phenomena, to analyze the phenomena "top-down".

I formed the core category called "ICTS roles" by using the classification of SMEs presented earlier in this study: "entity"/"in network". That means I divided the roles of ICTSs in the SMEs into two. The category of "Internal systems" represents systems having no external links (an SME as an entity) and the category of "External systems" represents systems with an external interface between the enterprise and its networking partners (an SME in a network). The core category "ICTS roles" with its sub-categories "Internal systems" and "External systems" are presented in Figure 5.1.

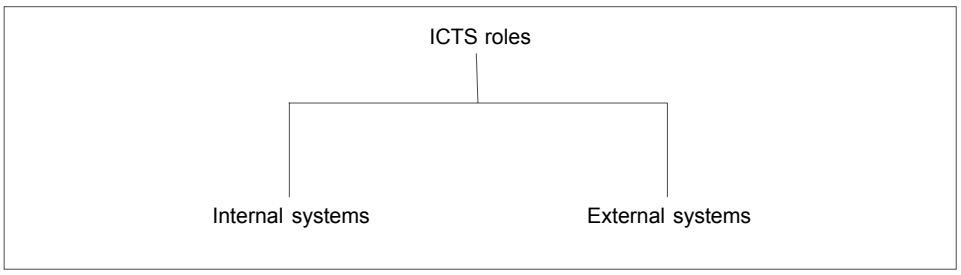

Figure 5.1: *The core category: "ICTS roles".*

As I argued in the earlier Section 3.5, the supporting functions always describe certain characteristics of an enterprise's ICTSs. The interviewed entrepreneurs had built their own visions of the information systems they had adopted. In the interviews they directly (when naming a system) or indirectly (when naming attribute(s) i.e. supporting function(s) of a system) told us which were the ICTS innovations they emphasized.

That assumption means that systems of both the Internal and the External kind have their own supporting systems, and Figure 5.1 can thus be supplemented. As an example, the branches of the sub-category "External systems" are presented in Figure 5.2. The sub-category "Internal systems" can be constructed correspondingly, as well as all the other forthcoming categories of the emergent theory. Later on the "Supporting systems" are in most of the cases omitted from the figures, as they are assumed to exist by default.

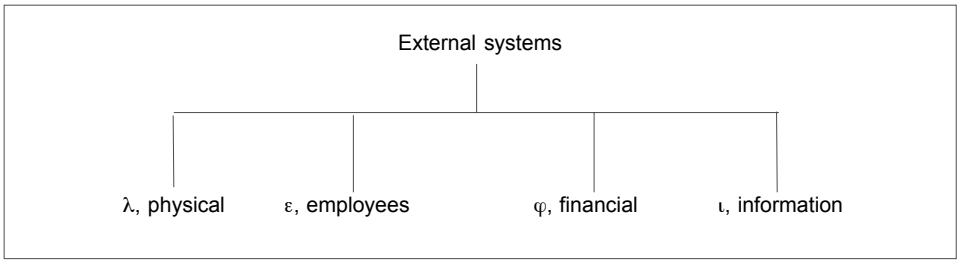

Figure 5.2: *The "Supporting systems"/functions ("External systems" as an example).*

5.1.8 Description of the case analyses method

After I had formed the emergent theory, i.e. the core category with the two sub-categories, or the preliminary classification, I aimed at recognizing and analyzing the ICTS mentioned in the cases. I tried to accommodate the information systems into the core category, and concurrently I tried to recognize new system categories not fitting into the classification.

As stated in Section 3.5, I built a particular tool for the phase of analysis to help me analyzing the data. The tool is a chart of four perspectives (see Figure 3.6), emphasizing SMEs' differing roles in differing organizational environments (as an acting organizational entity versus an actor in a network; the management function is present in both columns of the chart).

I used the chart of four perspectives when I interpreted the data material of the cases. I aimed at recognizing different ICTS systems according to the main research question. I did that by searching for pointers, building on the assumptions that each information system includes the supporting functions described in the model (=any of the four perspectives of the sheet) and that each of the supporting functions/resources (financial, employees/human, physical/information technology, and information/informative) represents in a way the information system it is included in. In other words I used the supporting functions as indicators of ICTS innovations when the empirical data was being analyzed. After recognizing the pointer I positioned the observed ICTSs onto the sheet of the four perspectives.
Following the four sub-questions of the research my next aim was to pick the characterizations of the ICT systems given by the interviewees and position those onto the sheet. After a couple of reflective and reductive iterations (which I will not describe in detail) I formed the categories and descriptions presented in the emergent theory.

However, while the theory-creating process advances, the analyses of some of those ICTSs mentioned in the charts of the four perspectives are described briefly. In the interpretation of each case I shall concentrate on issues bringing something new to the emergent theory.

It must be also noted that the names and terms concerning the ICTSs used in each chart of the four perspectives may not be quite the same as in the emergent theory. The names may also be in both singular and plural form. That is because the charts always include preliminary observation(s) of the system(s). When the systems are positioned into the emergent theory they are formulated more carefully. That is also why some of the minor observations mentioned in the charts may be omitted from the text.

The first of the ITEP cases which I analyzed was the case of ITEP_D1. In the next phase I replicated this process with every case of the ITEP set. The interpretation of the large enterprise case ITEP_D3 was done based on my experience focusing on the issues relevant to SMEs. Cases ITEP_B1 and ITEP_G1 were excluded as large organizations.

In the following sections I shall describe the three selected cases and supplement the core category into a cumulative emergent theory.

5.2 The three selected ITEP cases

I shall describe three ITEP cases (ITEP_D1, ITEP_C2, ITEP_E2) in detail in the following sections and supplement the cumulative emergent theory. After every step of analysis I shall form a synthesis of the previous results. After the three cases are analyzed I also present a brief summary of the results at the end of the chapter.

In the following Sections (5.3 to 5.5) the ICTS innovations I recognized in each of the three cases will be positioned into the chart of the four perspectives.

The first example, ITEP_D1, represents the class of the enterprises having ICTS in products (see Table 5.2). However, ITEP_D1 also applies much ICTS in its processes. That balanced duality and their long history of adopted technologies were the criteria why I selected the enterprise as the first case example. It seemed to me that this case represented most purely the "inside" perspective of a production enterprise, which assumption was the background for the first emergent theory iteration.

The next example case, ITEP_C2, represents the "process perspective" of a production enterprise. It is a wood industry firm, furniture manufacturing company planning and making customer-specialized products.

The third ITEP example which I shall present in detail, ITEP_E2, strongly emphasized both the product viewpoint and particularly the role of the customer. ITEP_E2 is an international component and system supplier for manufacturers of control systems for various types of mobile and other machinery.

5.3 The "inside" perspective of the production enterprise (the first ITEP case)

The first of the ITEP cases I analyzed was the case of ITEP_D1. It is an international company operating in the markets of manufacturing material handling equipment. Established in 1978 it has grown over the years as a family-owned company. It has over 20 years of experience of producing conveyor systems for various industrial sectors, such as food industry, paper and converting industry and metal industry. Since the beginning it has produced those systems and their automation controls. ITEP_D1 has other advanced products as well, such as wrapping systems and a fully automated cargo handling system for all kinds of vehicles. It has representation not only in the EU countries, but in the Far East and America as well. Its manufacturing is based on modern production methods, module components and standardization.

ITEP_D1 has adopted various technologies during the years. From the ICT viewpoint it characterized itself as cautiously renewing, not leading the way but buying new technologies as true needs arise.

5.3.1 Preliminary analyses of the case ITEP_D1

The competitive weapons mentioned in the case of ITEP_D1 were an efficient internal information flow and products with after sales services. By reusing historical planning data (e.g. CAD blueprints, planning documents, calculation models) they aimed at catching the possible errors in the earliest phase of planning when they are still cheap to correct. The future vision was to develop further their real-time activities, such as data delivery, efficient planning process, etc. To ITEP_D1 it was very important to have real-time data when it is needed.

From the viewpoint of networking, the operations of ITEP_D1 seemed to be quite suitable for the resource-based view (see subsection 2.3.1), but I was not able to recognize any other particular networking theories. The true needs of the end-customer were respected, and the products were built to help the end-customer to earn money. However, the products with high-skilled properties (e.g. the "Customer supporting center") and their utilization as an essential part of the production process of the end-customer are a good way to deepen the relationship and also to increase the control over the end-customer. That might also offer opportunities to make rules and regulate (cf. Pfeffer and Salancik 1978).

The information systems of ITEP_D1 are presented in the following Table 5.3.

Table 5.3: *Information systems of ITEP_D1.*

ITEP_D1	Organizational entity (SME)	Organizational structure (Networks)
Financial perspective	**Production process system:** *How?* - *new technology is invested in during the periods when the volume of orders is economically sufficient* - *development organizations has funded some of the R&D-type projects* **Internal (supporting) system:** Financial management system *How?* - *Job tickets are transferred into the financial management system electronically*	**Sales and marketing system:** *How?* - *Customer cooperation, products must help the customer to earn money* **Product system:** *How?* - *Products must help the customer to earn money*
Human perspective	**Production process system:** Project management system **Internal (supporting) system**: Employees' training system *How?* - *employees need a lot of re-training concerning ICT systems*	**Sales and marketing system:** *How?* - *Selling agents use only e-mail, and e-mail is used for customer communication*
Information technology perspective	**Production process system:** *How?* - *E-mail, networks were bought a couple of years earlier* **Sales and marketing system:** *How?* - *Salesmen use laptop computers*	**Acquisition system:** *How?* - *CAD blueprints are sent via e-mail* **Product system:** *How?* - *The products include various ICT components*
Informative perspective	**Production process system:** Planning system, product management system, data management system *How? It is important for:* - *Reusing production (CAD, plans, calculations) data* - *Catching the errors in an early phase of planning.* - *Having real-time information when needed* - *future vision: increasing real-time activities (planning etc.)* - *self-made steering data is used while CNC machine-tooling is bought* **Internal (supporting) system:** Information delivery system *How?* - *There has been some problems in the internal flow of information* - *CAD, LAN (Internal network) adopted* **Internal (supporting) system:** Information creation system *How?* - *Firm contracts out various levels of thesis to students*	**After sales system:** *How?* - *Products include a physical "Customer supporting center"* - *Modems/networks are applied for connecting to the center and tracing errors on-line, and involved in the customers' production processes -> added value*

5.3.2 Supplementing Internal systems category

I divided the a priori core category "**ICTS roles**" into two subcategories, the "**Internal systems**" and the "**External systems**". The category of "Internal systems" represents systems with no particular external links. In ITEP_D1 I was able to separate four different systems supporting internal systems (the a priori structure) in general (see Table 5.3): Financial management system, Employees' training system, Information delivery system and Information creation system. I omit describing the analyses of those systems, because they do not bring forth any new aspects.

However, the systems that do not at first fit in the a priori structure are more interesting. I recognized five of them: Production process system, Product system (Product as a system), Sales and marketing system, Acquisition system, and After sales system.

Almost all of the internal non-supporting systems mentioned in the ITEP_D1 data were connected to the production function (product or production process). The products of ITEP_D1 included various ICT components. The internal systems being linked to the production function were production process systems, such as a planning system, a product management system and data management systems, a project management system and also some self-made steering data, which was used while CNC machine-tooling was bought.

In his model Swanson (1994) integrates IS products and services with core business technology (his model type III innovation). Swanson argues that the innovation may well be strategic, in terms of offering competitive advantage to those who are among the early adopters. According to Swanson this advantage accrues either through product or service differentiation, or through low cost production.

The systems of ITEP_D1 fulfill these characteristic features. The efficient reuse of historical data just helps the planning process by making it more rapid (lowering costs) and by helping product differentiation (by customizing an old product base to fulfill the new requirements of the customer). In interviews it was also mentioned that the enterprise was among the first adopters of e.g. certain kind of electronic bus technology.

Swanson distinguishes three sub-types of the type III innovation. Type IIIa is defined as centered on the business's core work process. Type IIIb extends to basic products and services[27]. If compared to Kerola and Järvinen's (1975) model, Swanson's type IIIa and III b innovations are related to the π-function.

Basing on what was mentioned above I first titled the new categories to reflect these production function issues: "**Process systems**" and "**Product systems**". I connected them to another new category, which I labelled "**Production systems**". I added the latter under the category of "Internal systems" with "Supporting systems" (see Figure 5.3). Supporting systems/functions are presented in this figure under "Internal systems", later they are mostly omitted. They are imaginable also under both "Process systems" and "Product systems". As

27 Swanson's type IIIc innovation is not relevant from the viewpoint of Internal systems/production, because it provides for the integration or effective coordination of the business with its suppliers or with its distributors or customers, and represent the external interface of the enterprise.

mentioned earlier, it is assumed that each of the information systems includes all the supporting functions, and these are all bundled here and included under one category of "Supporting systems".

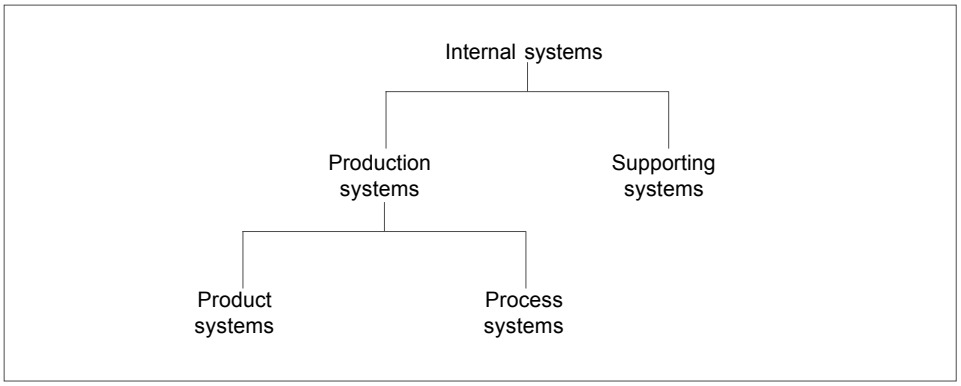

Figure 5.3: *Extended description of the "Internal systems".*

The two examples Swanson gives for core work process (IIIa) are material requirements planning and computer integrated manufacturing (CIM). According to him ICT is used to streamline, rationalize and control the production or service process. ICT will then affect cost reduction. In the case of ITEP_D1 a similar example of type IIIa innovation is the reuse of production data.

Swanson's examples of basic products and services (type IIIb) are airline reservation systems, remote customer order entries and follow-on customer service systems. Hence, type IIIb supports product and service differentiation. In the case of ITEP_D1 an example of that type is their conveyor systems with automated distance control properties.

5.3.3 Supplementing External systems category

The a priori defined category of "External systems" represents systems which have an external (an SME in a network) interface between the enterprise and its external partners. Next I analyzed the remaining systems (see Table 5.3): "**Sales and marketing system**", "**Acquisition system**" and "**After sales system**". All these systems were emphasized in the network environment of ITEP_D1, and thus I positioned them under the category of "External systems".

A "Sales and marketing system" was mentioned in both internal and external contexts. Anyway, its clear focus was in an external interface. With the exception of so called "internal marketing" I argue that it is also quite meaningless to discuss sales or marketing without an external target group. What was quite interesting, products of the enterprise ("Product system") were mentioned in an external context. However, this reflects on the one hand the role of "After sales system", and on the other some pre-sales activities, both of which I shall discuss in this subsection. It is quite natural that a product of an enterprise reflects a kind of external relationship with the customer.

A counterpart to "Sales and marketing system" and "Acquisition system" can be found among the above mentioned type IIIc innovations of Swanson (1994). They provide for the integration or effective coordination of the business with its suppliers or with its distributors or customers. Respectively those systems fit with the functions α, acquisition, and μ, marketing in Kerola and Järvinen's (1975) model.

At first sight it seemed to me that the role of after sales activities was very important to ITEP_D1. For example, I was told that modems and networks were applied for connecting to delivered products. It was possible to trace the customers' production processes (in which they utilized products from ITEP_D1) and to help them in their problems. That type of after sales service creates added value to the products of ITEP_D1.

In proportion, the selling and marketing activities of ITEP_D1 were also cooperative, based on each customer's individual needs. Basing on those findings I named the categories "**Sales and marketing systems**" and "**Acquisition systems**" and positioned them under the category of "External systems".

I went on to split the category of "Sales and marketing systems" in two: "**After sales systems**" to highlight the importance of the after sales services and "**Pre-sales systems**" as its counterpart to highlight the interactive role of selling activities. One of the five primary activities of a value chain according to Porter (1985, see also Porter and Millar 1985) is labelled "Service". It can be perceived to have the same type of meaning as "After sales systems", because the concept of Porter includes all the activities required to keep the product or service working effectively for the buyer after it is sold and delivered. I was not, however, able to recognize appropriate literature enfolding "Pre- sales systems".

Correspondingly, the importance of pre-sales activities and the ability to understand the customers' requirements were emphasized during the ITEP_D1 interview, and the following motto was expressed: *"Our products must help the customer to earn money"*. The ITEP_D1 findings, positioned under the category of "External systems" are described in Figure 5.4.

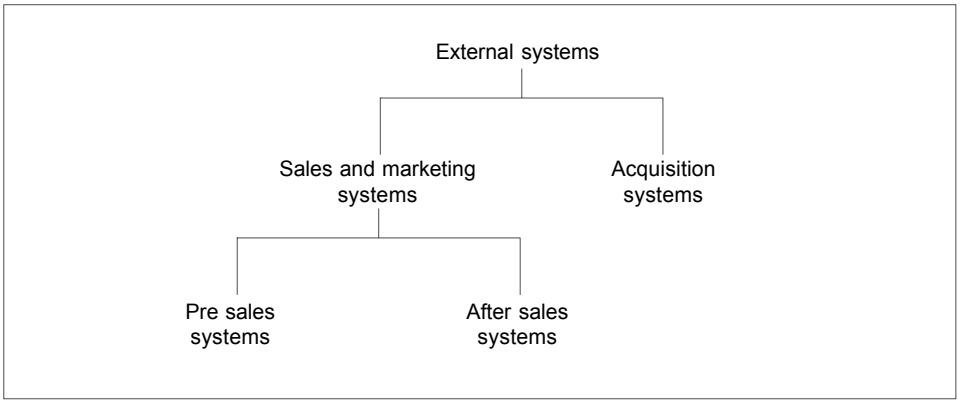

Figure 5.4: *Extended depiction of the "External systems".*

5.3.4 Synthesis after the first case ITEP_D1

An ICTS innovation occurs e.g. when an enterprise adopts new, ICT-related ways of making artefacts (products or services) or introduces new ICT-related artefacts to the markets. The concept may refer to financial aspects, to technical advances in how artefacts are produced by utilizing ICT, to informational issues related to artefacts or to shifts in social attitudes about how artefacts are developed, sold and marketed.

In the case of ITEP_D1 the most innovative issues were attached to production processes ("Process systems") and products as systems ("Product systems"). The latter ones include technologies that make innovative after sales services possible. "Process systems" emphasize the reuse of production data and thus re-inventing products already constructed. An innovative aim of the production process was also to catch the errors in an early phase of the planning and have information as real-time as possible.

The information perspective was emphasized the most, and the financial perspective was also important in many ways.

I present my supplemented emerging theory after the ITEP_D1 analyses as a tree structure (see Figure 5.5), and also as a summary of identified constructs in a table format (see Table 5.4), including the categories of ICTS innovation types, their brief descriptions and references to enfolding literature. It must be noted that due to the structure in which the categories are paired off, the enfolding literature strengthens the category definitions in most cases.

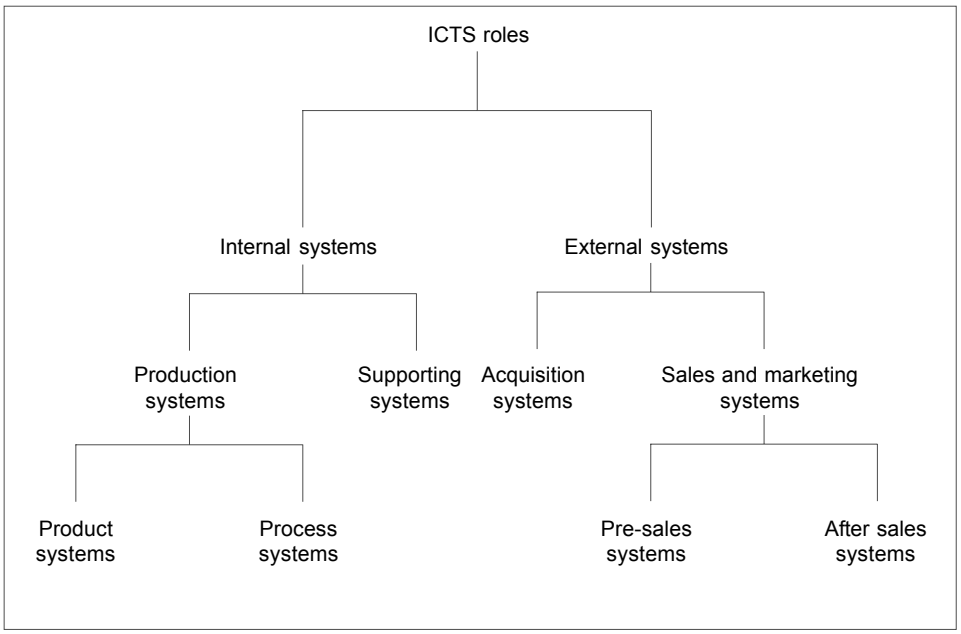

Figure 5.5: *Supplemented emerging theory after ITEP_D1 analyses.*

Table 5.4: *The synthesis of constructs after ITEP_D1 analyses.*

System type category	Category description	Enfolding literature (+/-)
ICTS roles	The aim of adopting ICTS innovations is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage.	A priori assumption, e.g. + Barney (1991, 1997) + Rockart & Scott Morton (1993) + Malone, Yates & Benjamin (1987) + Stabell & Fjeldstad (1998)
Internal systems	…are systems having no external links (an SME as an entity).	+ Kerola and Järvinen (1975)
Supporting systems	…are bundled supporting functions, which are included in each information system.	+ Kerola and Järvinen (1975)
Production systems	…are systems attached to the final outcomes of the enterprise.	+ Kerola and Järvinen (1975) + Swanson (1994)
Product systems	…are final outcomes of the enterprise, including kind of ICTS.	+ Swanson (1994): IIIb
Process systems	…are production processes of the enterprise, which produce the final outcomes.	+ Swanson (1994): IIIa
External systems	…are systems with external interface (an SME in a network).	+ Pfeffer and Salancik (1978)
Acquisition systems	… are systems which supply/produce from the system environment the necessary raw materials, components and other appropriate facilities required for the production of final outcomes.	+ Kerola and Järvinen (1975) + Swanson (1994): IIIc
Sales and marketing systems	… are systems which produce triggers from the system environment.	+ Kerola and Järvinen (1975) + Swanson (1994): IIIc + Pfeffer and Salancik (1978)
Pre-sales systems	… are systems involved in cooperative definition of product requirements.	—
After sales systems	… are systems involved in producing after sales services.	+ Porter (1985) + Porter and Millar (1985)

5.4 Production process systems of an enterprise (second ITEP-case)

As the second one of the ITEP cases I analyzed the case of ITEP_C2. The enterprise is a wood/furniture industry firm, founded at the end of the 1980's. It is a privately owned production company making and planning customer-tailored products. It plans and produces furniture, shop fittings and shop outlines for its customers, enterprises from different industrial branches.

The business of ITEP_C2 is based on a highly skilled enterprise network. The network, which is headed by ITEP_C2, is formed by enterprises with planning services in four different localities, carpenter firms and other firms which are experts of their materials. The most difficult designs are implemented by the three carpenters working inside the enterprise. The network has to have knowledge of how to manage and process materials and techniques of different kinds, because the suppliers produce components and entities using wood, metal, glass and plastic. Products are made in the form of projects.

Within the network there are various kinds of working cultures. For example, carpenters interpret the plans of architects and have the intellectual capacity to resolve problems. That is a positive skill, but more often the plans are exact and "*not too much creativity is desirable*". Within metal industries the tradition of working is more rigorous. However, the project managers of ITEP_C2 have skills to negotiate with the different types of customers and suppliers to make products of a suitable quality.

Adopted ICTS innovations are strategic tools for ITEP_C2. It sees itself as a visionary adapter of ICT in the wood industry branch it represents. It has also been a forerunner in presenting its products on the Internet.

5.4.1 Preliminary analyses of the case ITEP_C2

The competitive weapons mentioned in the ITEP_C2 interviews were the efficiency of the planning and production processes, rapid product differentiation and the systems enabling real-time (planning) processes. Also the highly skilled expert network with knowledge of how different materials are applied was very important to ITEP_C2.

The most important information systems for the enterprise (see Table 5.5) were the ones supporting just those above mentioned production function aims, such as

- planning systems
- product data management system (PDM)
- office management system and internal data management system
- customer relationship data system
- in-house CNC data creation and use
- project time management system.

In ITEP_C2 I recognized three different supportive internal systems (the a priori structure): Employees' training system, ICT technical maintenance and Information creation system. Again I shall not describe the analyses of those systems in detail.

Table 5.5: *ICT systems emphasized within the case of ITEP_C2.*

ITEP_C2	**Organizational entity (SME)**	**Organizational structure (Networks)**
Financial perspective		**Outsourced system:** Payroll accounting system (and other systems of that kind) *How?* - *aim of the enterprise is low, efficient administration*
Human perspective	**Internal (supporting) system:** Employees' training system *How?* - *future educational needs of employees are in data management and (technical) maintenance*	**Sales and marketing systems:** *How?* - *customers' skills in using ICT are poor, but that is no criterion in choosing customers* - *customer size is often large, and large partners are typically not flexible* - *customers' needs are the most important* - *connection with customers is human emphasized* **Acquisition systems:** *How?* - *subcontractors' skills in using ICT are poor, but that is no criterion in choosing subcontractors* - *subcontractors' working cultures are different (carpenters have their own culture, different cultures exist in different industrial branches)* - *connection with subcontractors is human emphasized*
Information technology perspective	**Internal (supporting) system:** ICT technical maintenance *How?* - *future educational needs of employees are in e.g. technical maintenance*	**Sales and marketing systems:** *How?* - *From the enterprise's viewpoint Internet marketing is just a part of business* **Acquisition systems:** *How?* - *e-mail and fax-based communication are used concurrently*
Informative perspective	**Internal (supporting) system:** Information creation system *How?* - *use of consultants is problematic for their insufficient skills* - *there are problems with the bureaucracy of development projects* **Production process systems:** - *Product data management, PDM, with own calculation/planning data models management* - *Office management system* - *Project time management system* *How?* - *Ways to use ICT are multifunctional* - *ICT use is an important, strategic issue* - *ICT applications are quite simple, models made in-house* - *Used ICT applications are standard (e.g. Excel-based calculation models)*	**Sales and marketing system:** Customer relationship data management, CRM *How?* - *Sales historydata (CRM) is collected* **Acquisition systems:** Co-operation with subcontractors *How?* - *Cooperative material optimization for production* - *Sales history data (CRM) may delivered also to the subcontractors* **Production process systems:** - Planning system with data management - In-house CNC data used *How?* - *ICT development is a continuous process* **Experimental system:** The Internet marketing system of Mööpelinet *How?* - *Financial advantages were low, but organizational learning about the Internet was high*

The planning and product data management applications are basically tried to be kept quite simple, in-house-made, based on common office software programs, such as MS-Excel or MS-Access. However, the number of the items of data is big in relation to the size of the firm, hundreds of calculation models. One of the important issues to ITEP_C2 is to built its own project models and to organize the data items. All documentation of the projects is stored, and the historical data it used while new projects are underway. The stored cases from the past and other customer relationship management (CRM) data may be the basis for new products. It is possible to modify the stored data and by these means quite rapidly create new, customized products with minimal planning costs. With the project time management system that is a way for efficient product differentiation.

Various systems reflect issues relating to networking theories (Section 2.3). Networking theories are also briefly referred to in the following text.

There were also various visions of future innovations, such as a videophone, or the needs of future skills of the employees, but they are not presented here, for they do not so far represent any existing ICTS innovation in ITEP_C2.

5.4.2 Finding Value chain systems and Value network systems

So far the skills in using data networks have not been any criterion to ITEP_C2 in choosing either supplier enterprises or customers. An important notice is that according to ITEP_C2 the ability of the customers to use ICT is much lower than the potential of ITEP_C2.

On the one hand fulfilling the needs of the customers is the most important issue. On the other it is not possible to apply ICT efficiently in these relationships due to the limitations of the customers. As an example, in the interview there was mentioned a large customer company situated in the Finnish metropolitan area. The only ICT equipment they used was a single PC on a desk, and no external network connections were allowed.

In the interviews it was also mentioned that: *"...it would give us additional advantage if the enterprise's partners used shared systems, and used them in a coherent way"*, but even then: *"...it is people who make the business"*. It follows from these limitations in "**Sales and marketing systems**" that ITEP_C2 first meets restrictions in the use of ICT and has to apply more "traditional" forms of interaction.

"**The Acquisition system**" at ITEP_C2 is formed by a network of supplier enterprises with both planning services in four different localities and other firms, which are experts in handling of various materials and knowledgeable in their use (such as skilful carpenters). The acquisition network of ITEP_C2 fits with the Uppsala school of thoughts, (Johanson and Mattson 1987, 1988), the social capital theory (e.g. Nahapiet and Ghoshal 1998), a kind of virtual organizing (Venkatraman and Henderson 1998) and also the inter-organizational learning according e.g. to Vesalainen and Strömmer (1999).

From ITEP_C2's viewpoint also the enterprises of the acquisition network had poor ICT facilities. Transferring planning data has so far been handled with "traditional" faxes or in some cases with e-mails when they became more common. Some of the cooperative enterprises already sent their data in a digital form, but there was a long way to a real-time network. Real-time management of data was felt very important. When planners are in four different localities, the turnover time of the data cannot be too rapid. For example, there was a situation when attachment files sent by e-mail were stocked somewhere for a day, because of which some of the planners had out-of-date data. ITEP_C2 had visions of how to develop the system further (an innovative vision of point-to-point connections between the parties). ITEP_C2 has also consulted their suppliers about the possibility of increasing this kind of activities.

As defined above, both types of systems - "Sales and marketing systems", and "Acquisition systems" - belong under the main category "External systems" of the emergent theory (see subsection 5.3.3). However, I argue that there is a clear difference between the nature of the sales and marketing of ITEP_C2 and its acquisition systems from the viewpoint of ICTS innovations: despite of the important role of the customers, the enterprise ITEP_C2 lays more stress on their acquisition systems.

Kumar and van Dissel (1996, based on Thompson 1967) separated three types of using IT resources: pooled IT resources, a value/supply chain and reciprocal interdependency (network). Correspondingly Stabell and Fjeldstad (1998, also based on Thompson 1967 and Porter 1985) presented tripartite classification with primary activities of each class:

- Value chain, with primary activities: Inbound logistics, Operations, Outbound logistics, Marketing and Service

- Value shop, with primary activities: Problem-finding and acquisition, Problem-solving, Choice, Execution and Control/evaluation

- Value network, with primary activities: Network promotion and contract management, Service provisioning and Infrastructure operation.

The idea of a value chain (Porter 1985, Porter and Millar 1985) is based on the process view of an organization. A productive or service organization is seen as a system which is made up of subsystems. Each of them is included in a chain with inputs, transformation processes and outputs which involve the acquisition and consumption of resources.

In the case of ITEP_C2 I can distinguish a value-chain-type of sales and marketing system. The distinctive criterion is a "one-way communication interface" of the system (input/output). Naturally the sales and marketing system is in interaction with the customers. However, the structure of the ITEP_C2 acquisition system with networked planners and skilful carpenters is more complicated, so the nature of the communication in acquisition systems is continuously reciprocal.

That observation led me to separating two different views and creating a new pair of categories, titled "**Value chain systems**" and "**Value network systems**". I positioned both of them under the category of "External systems" according to the definition of the "External systems" ("…are systems with an external interface").

Both of the new categories must have their own type of acquisition systems and sales/ marketing systems: The ones under "Value chain systems" (titled "**Value chain acquisition systems**" and "**Value chain sales and marketing systems**") with one-way communication, and respectively the ones under "**Value network systems**" (titled respectively "**Networked acquisition systems**" and "**Networked sales and marketing systems**") with continuous reciprocal, interactive communication (see Figure 5.6).

I considered whether the term "Value chain systems" would point too much to the direction of the concept of Porterian value chain. I do not see that the new category and the concept of Porter are necessarily always equal. Another appropriate choice of name for the new category would be e.g. "Supply chain systems". Anyway, I decided on the term "Value chain systems", because it is more general, but yet reflects the reality at the production SMEs.

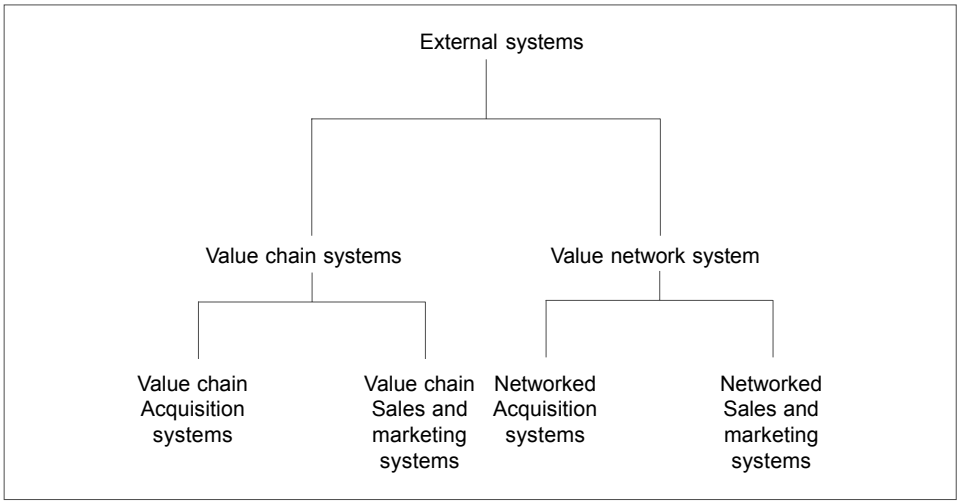

Figure 5.6: *"Value chain systems" vs. "Value network systems".*

In the same way, when I compared the case of ITEP_C2 with the classification of Stabell and Fjeldstad I came to a conflict whether the network category should be named in accordance to them, either "Value shop" or "Value network".

Value shop of Stabell and Fjeldstad means value-creation by problem-solving whereas Value network means value-creating by mediating activities (Network promotion and contract management, Service provisioning, and Infrastructure operation) with no own products. Thus the term of Value network according to Stabell and Fjeldstad could here refer more to the subcategory of "Networked Sales and marketing systems" (see Figure 5.6) than to the new main category.

ITEP_C2 clearly has activities compatible with the primary activities of Value shop (Problem-finding and acquisition, Problem-solving, Choice, Execution, and Control/evaluation). These activities reflect more the production process of ITEP_C2 than the kind of issues that should be positioned under the new network category of sales, marketing and acquisition. That is why I found the term "Value network systems" more covering, and at the end I chose it as the name of the new networking category. I want to point out that the name of the category is here used in a different, broader meaning than by Stabell and Fjeldstad (1998).

I got more confirmation to my interpretation when I rechecked the previous case, ITEP_D1. I argue that also its "Sales and marketing systems" have the same nature of reciprocal communication of "Value network systems", which I recognized here.

The new structure of "Value chain systems" vs. "Value network systems" is presented in Figure 5.6.

5.4.3 Finding Networked core production systems

Next I analyzed the production systems of ITEP_C2. The "Production process system" was very interesting to me. It was mentioned in both the internal and the external context, and it was tightly entangled with the acquisition system described above. In addition, when the system was discussed, the informative perspective was very much emphasized.

As mentioned above, the Value shop model by Stabell and Fjeldstad (1998) describes well the type of production process of ITEP_C2, with networked acquisition and problem-resolving activities. Even if the production process of ITEP_C2 seemed highly reciprocal to me, the end-products of ITEP_C2 were quite simple in terms of ICTS: they did not include either "intelligent components" or after sales services, and thus they were not necessary appropriate to be classified as an information system. However, the products of ITEP_C2 carry high-skilled knowledge of how different materials are applied.

Especially the problem-resolving activities in a networked environment and the products as the results of a problem-resolving process were suitable for the concept of core competence (Prahalad and Hamel 1990, see also Cohen and Levinthal 1990). Hence, a new category was required, which I named "**Networked core production systems**" (so I decided to reject also Stabell and Fjeldstad's term "Value shop").

In spite of a lack of evidence of networked products I adopted the structure from the category of "Production systems" positioned under "Internal systems" (see Figure 5.3). Analogously I divided "**Networked core production systems**" into two: "**Networked process systems**" and "**Networked product systems**". Due to the above mentioned limitations to evidence I considered that the latter category might need more confirmation, so I selected the next case to emphasize the issue of networked products (see forthcoming Section 5.5).

To keep the structure of the emergent theory dyadic I formed another new category, "**Networked intercessor systems**", which includes the previously defined categories of "Networked acquisition systems" and "Networked sales and marketing systems". I positioned both it and the above mentioned category of "Networked core production systems" under the main category "Value network systems" (see Figure 5.7).

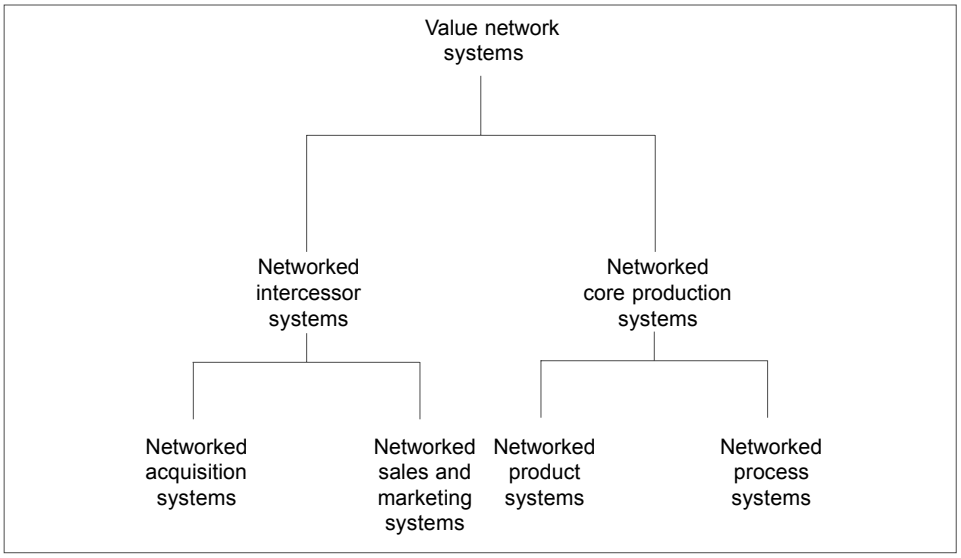

Figure 5.7: *The structure of "Value network systems".*

5.4.4 Finding Outsourced systems

Among other external systems of ITEP_C2 which were used in interaction with other enterprises there was also one named "payroll accounting system". I identified it as a type of "**Outsourced systems**" (Lacity and Hirchheim 1995), systems "cleared out" from the enterprise. This term is recognized also e.g. by the strategic management theory and Porter (1985).

Thinking that emphasizes outsourcing suggests that by transforming internal hierarchical structures into external flexible ones, higher levels of efficiency can be attained. The idea of outsourcing subsets of activities of an enterprise's value chain is not new. Firms in various industries have engaged in this practice for a long time. In the manufacturing sector industries like automotive, shipbuilding, or computer hardware outsource the building of components to external specialized manufacturers. Currently there is a broad scale of outsourcing contracts from short term service buying to partnership relations. Another aspect to outsourcing activities is the vendor's viewpoint, "insourcing" (Reponen 1993, Shepherd 1999, Ang and Slaughter 2002).

According to a survey by The Outsourcing Institute (1998) the most important reasons for companies outsourcing are:

1. To reduce and control operating costs
2. To improve company focus
3. To gain access to world class capabilities
4. To free internal resources for other purposes
5. Resources are not available internally
6. To accelerate re-engineering benefits
7. Function is difficult to manage/out of control
8. To make capital funds available
9. To share risks
10. Cash infusion.

The motivation for outsourcing at ITEP_C2 was to keep the organization of administration low, which fits in with the two most important reasons mentioned on the list.

I argue that outsourced systems also fulfil the characteristic features of pooled IT resources according to Kumar and van Dissel (1996) and Thompson (1967). "Outsourced systems" can be seen as shared resources, offered by an external service provider, and the communication flow is a typical value chain of one-way communication.

In addition, based also on my own experiences as a chief information officer, I agree that "Outsourced systems" do not have as much interactive cooperation as the systems positioned into the category of "Value network systems".

Basing on that I replaced the category of "Value chain systems" by a category of "Value chain intercessor systems" to describe the acquisition and sales and marketing activities of the value chain. In a way I lifted the category of "Value chain systems" upwards and defined a new category "Outsourced systems", which I placed under it with the new category of "Value chain intercessor systems" (see Figure 5.8).

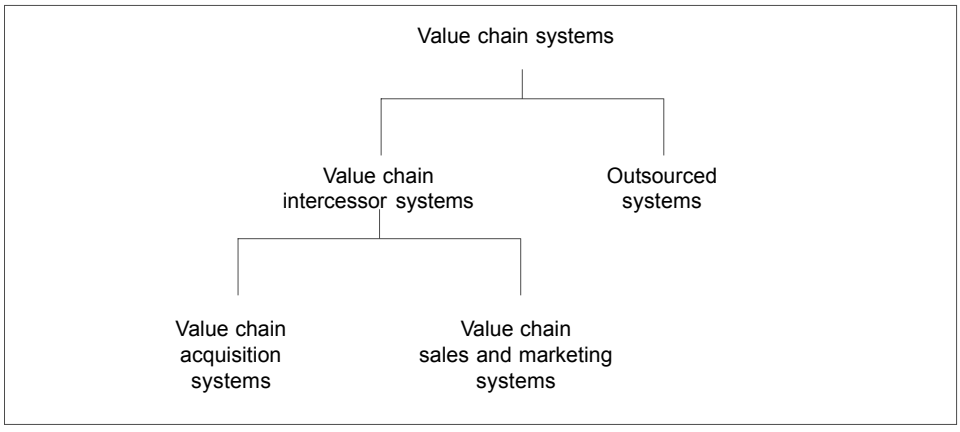

Figure 5.8: *Category of "Outsourced systems" under "Value chain systems".*

5.4.5 Finding Experimental systems

In the ITEP_C2 interview there was also mentioned an experimental system, MööpeliNet[28], which was adopted in 1994. MööpeliNet was a www-based network marketing system for enterprises in furniture business. The system was designed by the special project group and it was offered to entrepreneurs in the spring of 1994 when the first prototype was built. Seinäjoen Tietoraitti (later STR) was one of the cooperative partners of the innovative marketing net. In those days I was working at the STR, so I was familiar with the background. The idea of the MööpeliNet was to offer the SMEs an electronic market place on the Internet, where companies in the furnishing business could present their products and services. There were seven SMEs involved in the pilot system, among them also ITEP_C2.

According to the respondent, the adoption of the system was not commercially successful for ITEP_C2. It must be remembered that back in 1994 the www was a very new technology and it was used only by a few, if any of the potential customers of ITEP_C2. Just as Rogers argues (1995, pp. 313 to 317) interactive communication technologies follow a diffusion pattern and create a social impact that is quite different from the diffusion and impact of mass communication technologies. An interactive innovation is of little use to an adopting unit unless another units with which the adopter wishes to communicate also adopt it. A critical mass of units, i.e. at least the members of the enterprise network, must adopt an interactive communication technology before it is of use for an average unit in the system.

However, by being involved in the MööpeliNet and testing it ITEP_C2 became closely familiar with the Internet. Instead of financial success the enterprise came to know a totally new kind of communication tool. For ITEP_C2 the advantage of the system was not marketing or increased selling but being exposed to the Internet during the MööpeliNet project.

In consequence I came to the conclusion that the ICT systems described in the ITEP_C2 interview had two different roles: On the one hand ICTSs were adopted for creating competitiveness and sustainable competitive advantage – by making internal and external co-operative processes efficient - but on the other ICTSs were also adopted just for learning by using new kind of systems with little or no financial expectations.

That observation drives me to divide the original core category "ICTS roles" into two: "**Experimental systems**" and " **Competitiveness-creating systems**". I was also coerced to view my a priori assumption as follows: "The aim of the adoption of ICTS innovations is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage, or achieving experience of some phenomenon new to the enterprise".

According to Rogers' (1995) concept of innovativeness, ITEP_C2 is either an innovator (a gate keeper in the flow of new ideas into a social system) or most likely an early adopter (decreasing uncertainty about a new idea by adopting it and by then conveying a subjective evaluation to near-peers).[29] By the concept of innovativeness Rogers means the degree of adopting new ideas which a unit of adoption reaches relatively earlier than its competitors.

28 "Mööpeli" is a word in the brogue of Southern Ostrobothnia, meaning furniture.

29 The other three types of adopters Rogers mentions are an early majority, a late majority and laggards.

It is axiomatic that the category of "Experimental systems" includes also the categories of "Internal experimental systems" and "External experimental systems". The latter could be characterized as cooperative experiments with networking partners, and the former as internal experiments. Those categories are not presented in the following Figure 5.9. The MööpeliNet as a system goes under the category of "External experimental systems", because it was a kind of shared network service. This type of systems are also suitable for inter-organizational learning (see e.g. Larsson et al. 1998, Vesalainen and Strömmer 1999, A. Järvinen and Poikela 2001)

The category of "Experimental systems" is also close to the common concept of "research and development", R&D function. The research and development function has been included in Kerola and Järvinen's model, in each function (Järvinen 1985). I separated it here to emphasize the different roles of the information systems used in the enterprises for direct competitiveness and those used for the experimental learning of new skills.

The new structure of the core category is presented in Figure 5.9.

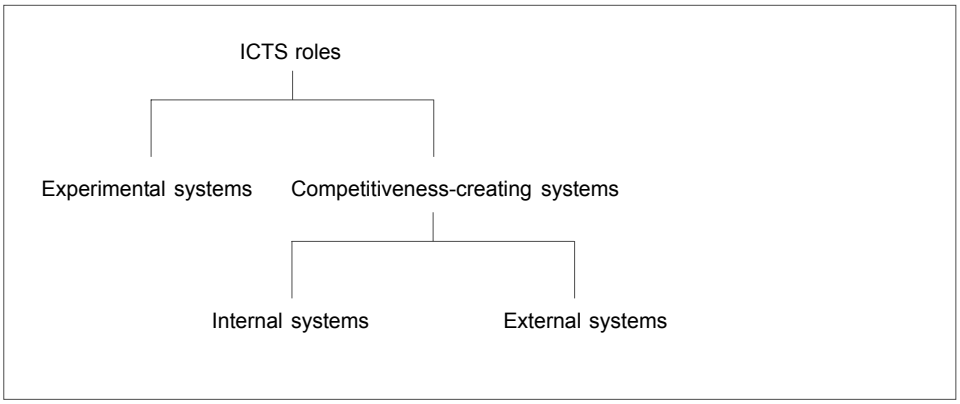

Figure 5.9: *"Experimental systems" vs. "Competitiveness-creating systems".*

5.4.6 Synthesis after the second case, ITEP_C2

In addition to acting as an early adopter of the described experimental issue, in the case of ITEP_C2 the other innovative systems were attached to the efficiency of planning and production processes, rapid product differentiation and the systems enabling real-time planning processes. The production process of ITEP_C2 also emphasizes the reuse of production data, and re-inventing previously constructed products.

Alike in the case of ITEP_D1 also here the informative perspective was emphasized, but in this case the human perspective rose as more important. The network of highly skilled experts with knowledge of how different materials are applied was essential, in spite of their poor skills in using ICT.

Also the customers' poor ICT skills restricted ITEP_C2's full use of their ICT know-how, but other views were much more important, and the human connection to customers came first.

When the categories of information systems mentioned in the interview of ITEP_C2 are combined with the current emergent theory basis, the structure presented in Figure 5.10 is achieved. In Table 5.6 the summary of identified constructs is presented (note that some names of System type categories are sharpened when compared to the previous version in Table 5.4). In the summary I changed the name of the category of "External systems" into a more specific "External competitive systems".

Table 5.6: *Synthesis of constructs after the ITEP_C2 analyses.*

System type category	Category description	Enfolding literature (+/-)
ICTS roles	The aim of the ICTS innovations adoption is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage, or achieving experience of some phenomenon new to the enterprise.	A priori assumption & case based observations
Experimental systems	…are systems aimed at having experience of some (new) phenomenon (internal & external with partners)	+ Rogers (1995): innovator, early adopter, + Larsson et al. (1998), Vesalainen and Strömmer (1999), A. Järvinen and Poikela (2001) - Järvinen (1985): R&D
Competitiveness-creating systems	…are systems the aim of which is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage	A priori assumption, e.g. + Barney (1991, 1997), Rockart & Scott Morton (1993), Malone, Yates & Benjamin (1987), Stabell & Fjeldstad (1998), Porter & Millar (1985)
Internal systems	…are systems having no external links (an SME as an entity).	+ Kerola and Järvinen (1975)
Supporting systems	…are bundled supporting functions, which are included in each information system.	+ Kerola and Järvinen (1975)
Production systems (Internal)	…are systems attached to the final outcomes of the enterprise.	+ Kerola and Järvinen (1975) + Swanson (1994)
Product systems (Internal)	…are final outcomes of the enterprise, including kind of ICTS.	+ Swanson (1994): IIIb

Process systems (Internal)	…are production processes of the enterprise, which produce the final outcomes.	+ Swanson (1994): IIIa
External competitive systems	…are systems with external interface (an SME in a network).	+ Pfeffer and Salancik (1978) and other mentioned networking theories
Value chain systems	…are value chain intercessor or outsourced systems	+ Thompson (1967), Porter & Millar (1985), Kumar & van Dissel (1996), Stabell & Fjeldstad (1998)
Value chain intercessor systems	…are value chain acquisition or value chain sales and marketing systems	+ Porter & Millar (1985), Swanson (1994): IIIc
Outsourced systems	…are internal systems delegated to external partner to take care of	+ Thompson (1967), Kumar & van Dissel (1996), Porter (1985)
Value chain acquisition systems	… are systems which from the system environment supply/produce necessary raw material, components and other proper facilities required for the production of final outcomes	+ Porter (1985), Porter & Millar (1985), Kerola and Järvinen (1975), Swanson (1994): IIIc
Value chain sales and marketing systems	… are systems which produce triggers from the system environment	+ Porter (1985), Porter & Millar (1985), Kerola and Järvinen (1975), Swanson (1994): IIIc
Value network systems	…are Networked intercessor systems or Networked core production systems	- Stabell & Fjeldstad (1998): Value shop + Thompson (1967), Kumar & van Dissel (1996)
Networked core production systems	…are Networked product systems or Networked process systems	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked product systems	…are final outcomes of the enterprise, produced in cooperation with external partners and including kind of ICTS.	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked process systems	…are production processes of the enterprise with cooperative partners involved, which produce the final outcomes.	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked intercessor systems	…are Networked acquisition systems or Networked sales and marketing systems	See Networked acquisition systems or Networked sales and marketing systems literature
Networked acquisition systems	… are systems which in continuous reciprocal cooperation with external partners from the system environment supply/produce necessary raw material, components and other proper facilities required for the production of final outcomes	+ Johanson and Mattson (1987, 1988), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999)
Networked sales and marketing systems	… are systems which in continuous reciprocal cooperation with external partners produce triggers from the system environment	+ Stabell & Fjeldstad (1998)
Pre sales systems	… are systems involved in cooperative product requirements definition.	—
After sales systems	… are systems involved in producing after sales services.	+ Porter (1985), Porter and Millar (1985)

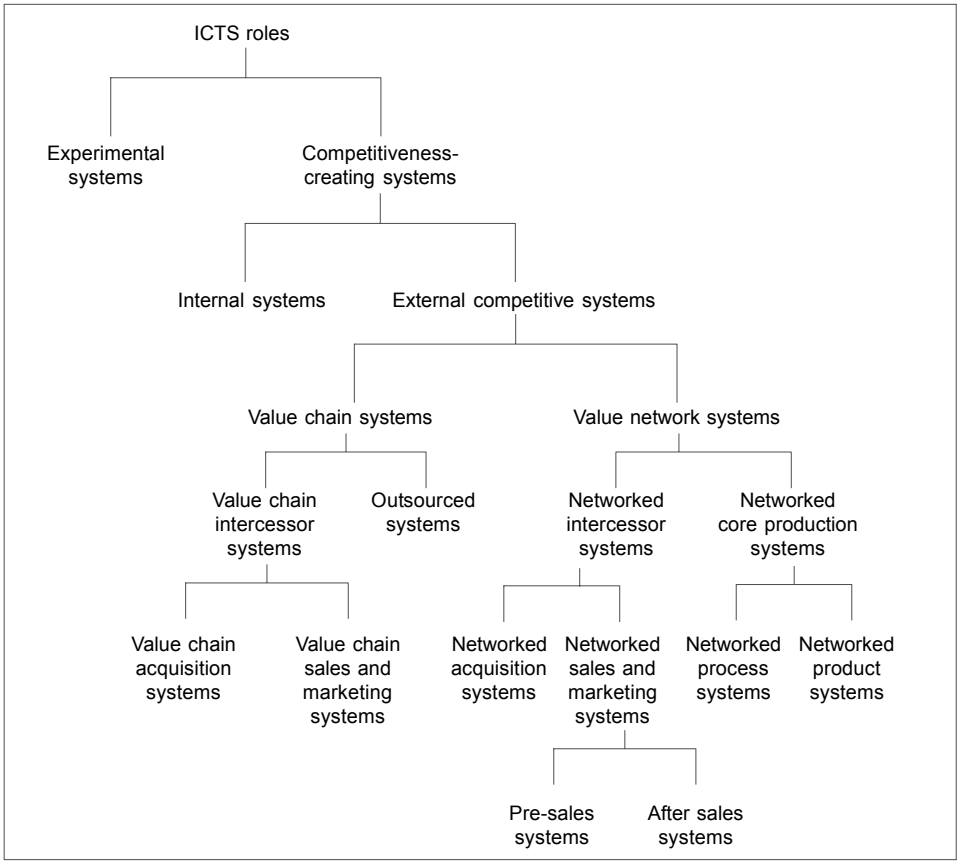

Figure 5.10: *Supplemented emergent theory after the ITEP_C2 analyses.*

5.5 Networked product viewpoint (the third ITEP case)

In the following phase I took the case of ITEP_E2 and combined its analyses into the emergent theoretical model. ITEP_E2 is an electronics manufacturer founded in 1978. ITEP_E2 has grown little by little, concentrating on businesses which its has found reasonable. When a new focus has been found it has always been difficult to cut down on other businesses. Now the enterprise is in good going, with almost 30 employees and rapid growth. Over one third of the staff works at the R&D department.

ITEP_E2 is an international component and system supplier for manufacturers of control systems for various types of mobile and other machinery. The enterprise designs and manufactures in-house electronic, programmable basic components or modules required for these control systems.

In cooperation with customers, modules are developed for control systems which are designated to be installed in the customers' machines. The enterprise produces components, not stand-alone products. It aims at standardized, modularized solutions, which will be tailored for the customers. That way it is possible to reach the advantages of serial production in customer-oriented applications.

ITEP_E2 has designed more than a thousand items of electronic equipment and a huge number of systems based on them. They think it is possible that the enterprise has too large a variety of products. When located in a rural area, the problem has previously been the necessity of "*making all kind of things*".

The nature of the products makes it easier to uphold competitiveness and remain situated in the countryside at the same time. In the branch of ICT and electronics the products have a little or no mass at all, so logistics are not a problem.

The enterprise has almost no local customers. The global aspect is strong. The cooperation covers deliveries for customers' manufacturing plants in Finland, Sweden and Canada. The customers' network of dealers includes more than 80 dealers with 300 places of business. One of the most important customers is the world's leading designer, manufacturer and distributor of forestry equipment, which has been using the durable and safe control systems of ITEP_E2 in its forestry machines since 1993. "*We have a customer which is the largest company of its kind in the world. In cooperation with them in 1993 we developed a system the kind of which our competitors do not have even today.*"

According to ITEP_E2, in Southern Ostrobothnia there are not many people with programming skills, nor many places giving work to them, so a lack of skillful employees is one of their challenges.

5.5.1 Preliminary analyses of the case of ITEP_E2

The ITEP_E2 interview strongly emphasized two aspects (see Table 5.7): the role of the customer and the product itself. The competitive weapons mentioned in the case of ITEP_E2 were rapid product differentiation, niche products and close customer cooperation. ITEP_E2 also has an aim to grow, to increase the size of the company – a point that they believed would bring forth new competitiveness.

Even though the analyses of the case of ITEP_E2 generated observations from various types of ICTS innovations, I shall state them only briefly, and in this subsection I shall concentrate on the system types reflecting those two above mentioned issues: the role of the customer and the networked product.

In ITEP_E2 I was able to separate four different internal supporting systems (the a priori structure): Financing procurement system, Employees' training system, Information delivery system (Intranet), and Information creation system. The physical network was mentioned in an external context, but it may belong into the internal context as well.
The enterprise has all its manuals, documents of products and quality system in their Intranet. By the respondent this arrangement was characterized as "*fantastic*" compared to the earlier state of things. For example, the manuals used to be edited in the firm's copy room, now the enterprise has a very high quality printer as an extension of the Intranet (the printer technology is classified in Table 5.7 as a part of the internal "Production system").

Within that case also some experimental systems can be noticed. For example, the first version of ITEP_E2's homepages was built on a multimedia course (classified in Table 5.7 as a separate "Sales and marketing system"). User manuals previously compiled and copied manually were moved to Intranet. There was a developmental step towards extranet and thoughts of opening it to a few selected customers. However, in ITEP_E2 these experiments were not as tentative as in the previous case of ITEP_C2. Due to the importance of the maintenance function within the after-sales processes these kinds of systems would also rapidly become an essential part of the products of ITEP_E2.

I omit more detailed analyses of the above mentioned systems, because those systems do not bring about any new aspects.

When I focused on the meaning of customer relationship, I found it very strong: "*The example given by the large enterprises is remarkable. Our large customers rear us hard and the auditors of quality keep us awake*". For example, the products produced for one of the most important customers, the forestry equipment, are only a part of the chain of timber harvesting. The core knowledge of ITEP_E2 is to understand the requirements of the customer, electronics are: "*...just a by-product*". The aim of the products is to bring as much comprehensive ICT services to customers as possible, "*...our own knowledge is accommodated to other worlds*". ITEP_E2 also emphasized that the whole logistics chain must be well known when the products are developed. That means knowing the needs and environments of the real end-user, not only the machinery-building customer.

Correspondingly ITEP_E2's products, control systems, are based on independent and intelligent modules with ICT qualities. The modules are linked using a high-speed bus, forming an integrated system. New types of open solutions support also the customers' programming. ITEP_E2 has been able to enhance considerably the performance of machinery by focusing on the user-friendliness and fault-tolerance of the systems.

In addition to "physical" end-products, ITEP_E2 provides such services as training and user instructions, supplies maintenance and operating manuals and, if necessary, participates in the further development of the system. ITEP_E2 must pay very close attention to quality and to the needs of the actual user-environment of the product.

Table 5.7: *ICT systems emphasized within the case of ITEP_E2.*

ITEP_E2	**Organizational entity (SME)**	**Organizational structure (Networks)**
Financial perspective	**Internal (supporting) system:** Financing procurement *How?* - *no local financing institutions* - *no local stock exchange listing specialist services*	
Human perspective	**Internal (supporting) system:** Employees' training system *How?* - *Enterprise is in need of skilled employees*	**Pre sales system:** Customer is involved in product definition *How?* - *Customers' (and end users') needs are most important issues. Needs to understand the customers' requirements and the needs of the true end-user are high* - *Customer size is usually large, and they demands a lot and rear their partners hard (e.g. in quality issues).* - *Customers' skills to use ICT are high*
Information technology perspective	**Production process systems:** High quality printer system (see Intranet below) *How?* - *New purchase, printing replaces paper copied manuals,a digital press*	**Supporting system:** Physical network (also internal) *How?* - *Physical networking came true when external fiberbased connection was purchased*
Informative perspective	**Internal (supporting) system:** Information delivery system, Intranet *How?* - *Intranet is in broad use (manuals, documents, quality system), Internet is not used that much* **Internal (supporting) system:** Information creation systems *How?* - *projects with national (and local) development organizations* **Product and Production process system:** In-house components *How?* - *Centralized production, all components are made in-house. That is not a self-purposeful aim, but proper components cannot be found at the markets*	**Experimental systems:** Extranet *How?* - *Intranet will be broadened and opened to some of the customers* **Product system:** Various technical ICT components, which are included into the products *How?* - *The degree of such issues as product modulation, module independency, module intelligence, module standardization and product customization abilities is wished to be kept high.* - *product portfolio is maybe "too wide"* **After sales systems:** - diagnostics service - (software) maintenance - help desk services - instructor (for the customers' maintenance people) *How?* - *safety demands are high* - *distance user diagnostics is not necessary possible* - *sphere of operations is global* **Sales and marketing system:** WWW pages *How?* - *First version of pages was created in an educational development project*

The products are unique and sometimes it is not possible to have components from external markets, even if it is important to build products in a standard way. "*All components are self- made. It is not an aim in itself, but we can't get comparable items from the markets. We had a good example, a prefabricated software from Germany, which we had to program completely anew*".

Standards must reflect the environments of the end-users, and organizing communication in the most standard way is a fundamental question. The more complex the products and systems are, the more external standardized modules and services are needed: "*The number of ICT components within the products is increasing, e.g. we must create as one of our products an explorer connection. The question is, who will organize the communication part, are there standard solutions to be found? At the moment we use GSM* ."

It must be remembered that applications are also safety-critical. That means a broad scope of issues, including e.g. the safety of the harvesting system, diagnostics, care and maintenance. It must be possible to analyze the products globally, so proper tools are needed. Distant (mobile) use of the products is possible in theory, but not yet in practice, "*...you can't connect with GSM somewhere in the middle of Alaska*".

5.5.2 Supplementing Networked product systems

While analyzing ITEP_E2's data and systems mentioned above I paid attention to one particular issue: the role of the product being sandwiched between two different customer interfaces: pre-sales and after sales systems.

Despite of a most product-oriented view, no particular product/process system, such as a planning system or a production automation line, was mentioned during the ITEP_E2 interview (excluding the high quality printer system). ITEP_E2 is self-sufficient in its production process using no suppliers, so it was also not possible to find evidence of "Networked production process systems" in that case. However, based on my earlier cooperative experiences with the enterprise I knew that ITEP_E2 has this type of information systems as well. I interpreted it so that from ITEP_E2's point of view they are such static applications when compared to the customers' needs or the attributes of the products that they did not deserve any attention during the interview.

As stated earlier, I found the "Product system" of ITEP_E2 heavily influenced by the customers. Alike in the previous section (see subsection 5.4.3) it can be compared to Prahalad and Hamel's (1990) results on core competences of a firm, but in the previous case of ITEP_C2 the production enterprise got a larger degree of freedom to define and create the product and its structures.

In the current case of ITEP_E2 the production enterprise and its products are much more bound to the customer in forms of demanding (pre-sales) requirements of the product and multiform after sales services. As a matter of fact these two cases describe two intertwined pairs of issues: "Networked acquisition systems" intertwined with "Networked production process system" (see the previous case of ITEP_C2 in Section 5.4) and "Networked sales and marketing systems" intertwined with "Product system" itself (ITEP_E2).

5.5.3 Synthesis after the third case ITEP_E2

In the case of ITEP_E2 the most innovative ICT systems were attached to the product itself and to the requirements of the end-customer. Alike in the previous cases also here the information perspective was emphasized. In this case the human perspective was mostly attached to the role of the customer.

According to the case of ITEP_E2, when an enterprise operates in a network it is very difficult to draw a line where the sales and marketing activities end and where the production activities begin. The same is correspondingly true when moving from the production activities into "After sales systems".

I defined earlier, when considering the case of ITEP_D1, the categories of "Presales systems" and "After sales systems" under the category "Networked sales and marketing systems" (see subsection 5.3.3, Figure 5.4), but now the case of ITEP_E2 testifies that both pre-sales and after sales activities could be extremely important parts of the product.

I considered whether there should be a difference between "Sales and marketing systems" and "Pre-sales systems". Should the "Pre-sales systems" be a part of the "Networked product systems"? Those were questions I was not able to answer at the present juncture.

Anyway, in my mind I moved at least "After sales systems" away from the category of "Sales and marketing systems" into "Networked product systems". I also decided to draw back both of the categories "Pre-sales systems" and "After sales systems" until further notice and analyze them later if sufficient evidence could be found.

The structure of the emergent theory after the analyses of the case of ITEP_E2 is presented in Figure 5.11, without the above mentioned categories "Pre-sales systems" and "After sales systems". Because no new categories were particularly identified, no summary in a table format is presented at the end of this section.

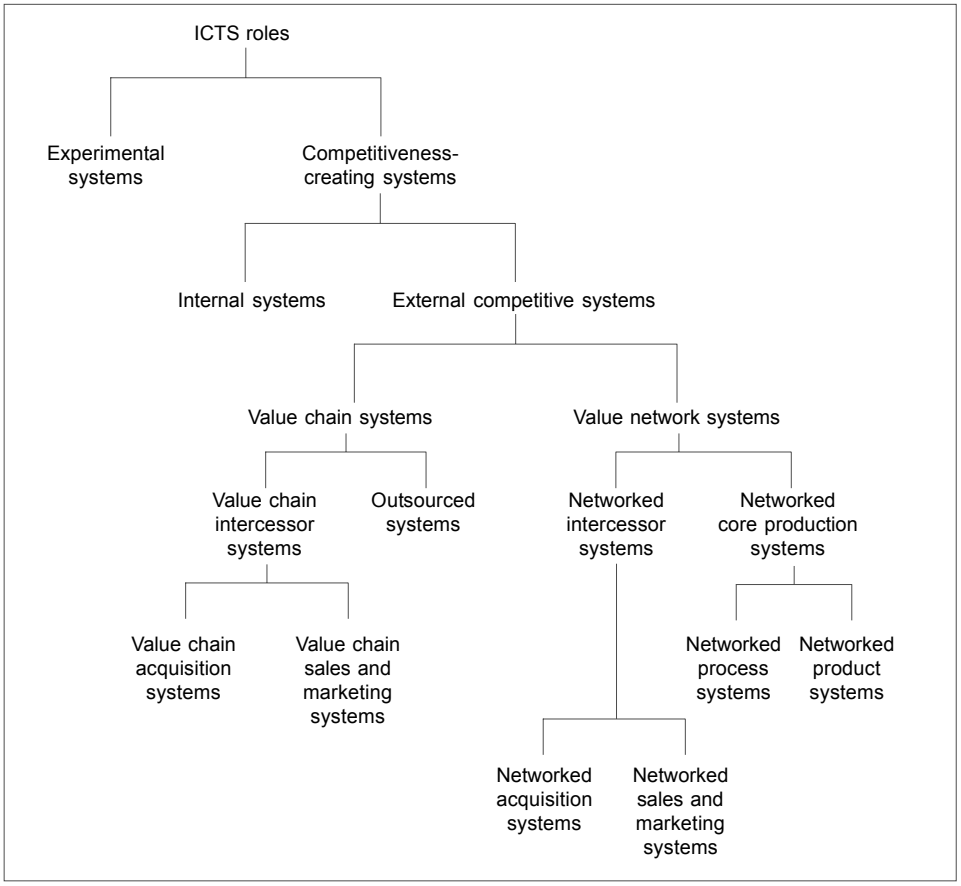

Figure 5.11: *The structure of the emergent theory after the analyses of the case of ITEP_E2.*

5.6 Finding Fake systems (additional ITEP cases and their results)

At the end of the ITEP data analyses I shall combine a synthesis of the three previous case constructs with the rest of the ITEP cases. I shall present the most important observations but not the detailed intermediate phases.

To achieve my aim I scanned trough the rest of the ITEP cases aiming to make observations of new ICTS innovation types. However, there was only one case which seemed to include systems not already recognized in the three cases I presented above. The case of ITEP_F1 includes several kinds of ICT systems. As a matter of fact, not the case as such but the evolution of the enterprise after the interview directed me to consider another possible role of the ICT systems. The enterprise ITEP_F1 acted in the ICT branch and had various ICT-related business activities. Some of them grew very fast and got much attention and publicity in the media, also on an international level. The enterprise also adopted some brand new and innovative technologies with a very high public profile. Some business activities were also hived off and then merged with a larger company. Its stock-issue was organized, a pile

of money was gathered from investors – and some time later the business collapsed. That was a quite typical story of the Internet-hype or an e-business firm at the beginning of the 2000's.

That makes me argue – not based necessarily on the mentioned case of ITEP_F1 as such but more commonly – that in enterprises ICTS innovations may also have a role of a "Potemkin facade". ICT system innovations may be used for presenting a certain image, in the worst cases without any original purpose of having real competitiveness but to siphon investors' money into owners' accounts. Much more than in the SME sector that became true, for example, in the Internet-hype business at the turn of the 21st century.

Among the networking theories the transaction cost theory includes the concept of opportunism, which as a basic assumption refers to a self–interest seeking individual profit with guile (Williamsson 1985, p. 47). The theory has been criticized (e.g. Larson 1992, Uzzi 1979) for describing the human being as an opportunist, or guile, meaning that an individual is willing to lie, steal and cheat in order to gain advantage to himself. However, these findings supported Williamsson's theory and his concept of opportunism.

These observations based on the case of ITEP_F1 made me supplement the core category of the roles of ICTS with categories titled "**Fake systems**" and "**True systems**". (See Figure 5.12 and Table 5.8. Note that there is no particular literature supporting the concept of "True systems".) That causes again a division of the original core category of "ICTS roles" into two. I was also coerced to broaden out my a priori assumption as follows: "The aim of the adoption of ICTS innovations is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage, or having experience of some phenomenon new to the enterprise, or creating a manipulated image for opportunistic reasons".

Again, it is axiomatic that the category of "Fake systems" includes also the categories of "Internal fake systems" and "External fake systems". They are not contemplated here in detail. However, the latter could be attached to e.g. tricks aimed for investors, as above, when the enterprise wants to get new external funding, and a simple example of the former could be e.g. some new internal software without any particular use, purchased by the leader of the organization just to look "faddish".

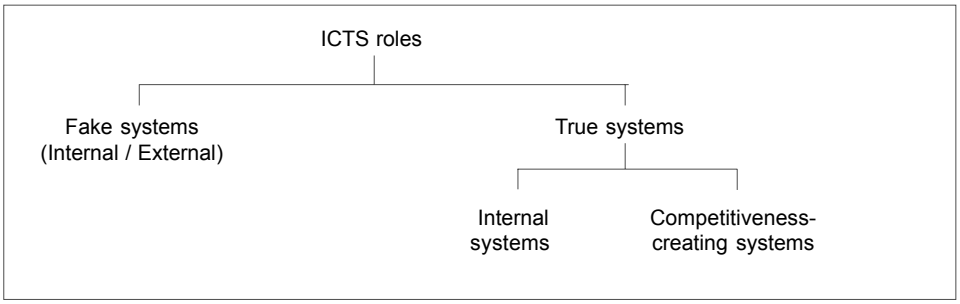

Figure 5.12: *"Fake systems" vs. "True systems".*

Table 5.8: *The synthesis of constructs after the ITEP data analyses.*

System type category	Category description	Enfolding literature (+/-)
ICTS roles	The aim of the adoption of ICTS innovations is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage, or achieving experience of some phenomenon new to the enterprise, or creating a manipulated image for opportunistic reasons.	A priori assumption & case based observations.
Fake systems	…are systems creating a manipulated image for opportunistic reasons	+ Williamsson (1985): TCT opportunism, costs of cheating - Larson (1992), Uzzi (1979): criticism against TCT opportunism
True systems	…are systems aimed successfully or unsuccessfully at learning or creating competitiveness	—
Internal systems	…are systems having no external links (an SME as an entity).	+ Kerola and Järvinen (1975)
Competitiveness-creating systems	…are systems the aim of which is the financial success and competitiveness of the enterprise, achieving sustainable competitive advantage	A priori assumption, e.g. + Barney (1991, 1997), Rockart & Scott Morton (1993), Malone, Yates & Benjamin (1987), Stabell & Fjeldstad (1998), Porter & Millar (1985)

5.7 Summary of the first empirical part of this study: the ITEP interviews

In this chapter I presented the first empirical part of this study, the ITEP case set with 17 interviewed production enterprises. In the first section I went through the process of data gathering and some preliminary analyses, and I also formed the core category of the emergent theory.

In the Sections 5.2 to 5.5 I presented the three most representative ITEP cases and their analyses in detail. The emergent theory was gradually supplemented case by case. At the end of the chapter, in Section 5.6 I combined the summary of the three case constructs with the findings of the rest of the ITEP cases.

The emergent theory shall be completed in the following chapter (Chapter 6), when the other data set, of the MET, is considered. The further focus of this study will be more on various types of networked systems.

6 The second empirical part of the study: the MET interviews

In this chapter I shall present the second empirical part of this study, the MET (the Federation of Finnish Metal, Engineering and Electrotechnical Industries[30]) case set with 40 interviewed production enterprises.

In the first Section 6.1 the process of gathering the data and its preliminary analysis will be presented, and in the following Section 6.2 the three most representative MET cases on a general level will be described. In Section 6.3 I shall supplement the view of "Experimental systems" by including some new categories, and in Section 6.4 an additional category, "ASP network systems" will be included. I shall also utilize examples from additional cases of the MET set alongside with the ones I shall present in more detail, in the event when they include some additional information.

It must be disclosed beforehand that from the subsection 6.4.3 onwards the case analyses will not bring in any particular new categories to the emergent theory, but they will specifically sharpen the picture of categories fundamental to production SMEs, the categories attached to various types of networked production systems. I shall concentrate on the main category of the emergent theory, "Value network systems" with its subcategories. The picture of "Value chain systems" is quite clear, due to Porter's well-known theory. In addition I shall later (see Chapter 7) return to the model of Stabell and Fjeldstad, which includes a value chain view.

At the end of Section 6.4 I shall also combine two different cases and by doing so supplement the view of "Networked acquisition systems" and "Networked process systems". In section 6.5 the view of "Networked product systems" and "Networked sales and marketing systems" will be supplemented, the latter especially from an end-customer's viewpoint.

At the end of the chapter, in Section 6.6, the synthesis of the whole emergent theory will be presented.

6.1 The background of the MET data

In this section I shall describe the process of gathering the MET data and its preliminary analysis. I shall present the basis of the gathering process (subsection 6.1.1), the process by which the enterprises were selected (subsection 6.1.2), the gathering techniques of the MET data (subsection 6.1.3), a description of the interviewing process (subsection 6.1.4) and a preliminary data analysis (subsection 6.1.5).

30 The name of the organization was changed to Technology Industries of Finland at the beginning of June 2003.

6.1.1 Specified population

The other set of cases and data for this study is based on interviews of a MET project. I collected that nationwide data from 40 metal and electrotechnical enterprises with Professor of Information Systems Science Mikko Ruohonen (MR), in cooperation with a sponsor organization, the Federation of Finnish Metal, Engineering and Electrotechnical Industries (MET). The data consists of 40 company visits, in-depth interviews and related documents with 59 directors or managers responsible for e-business decisions. The MET allowed me to use the data also for the personal research purposes of this study.

The particular objective of the MET project was to outline the paths of development of the Finnish metal and electronics industries focusing on finding what the state of art in e-business strategies in each company was, and what role e-business innovations had in their strategies. An operational aim of the project was to study e-business processes enabling innovative and new kind of products and business concepts. Another aim for the MET was to recognize 3 to 5 potential themes of development in the Finnish metal industry. The results of the project are reported in details in Riihimaa and Ruohonen (2002, in Finnish). Visits to the enterprises were done between December 2000 and March 2001.

6.1.2 Selecting enterprises for the MET interviews

In the first phase we (JR, MR) had some mutual negotiations with experts from the MET to define the actual project and research plan. In these discussions also this dissertation was taken into account. Based on our proposal the largish case study was decided to be realized by the MET. The same principles of case studies I described in Chapter 5 were followed, as well as the question of protecting the interviewees' anonymity. The names of the MET enterprises or respondents are not mentioned in this study.

To get the funding for the project the MET sent a special project plan based on our proposal to the Finnish National Technology Agency, Tekes. It was finally accepted at the end of 2000, and the resource made it possible for us to meet the respondents at the enterprises. After different models had been sketched of my role in the research project, the final decision was my part-time engagement as a project manager in the MET. It offered me the opportunity of having all the knowledge resources and services of the MET at my disposal and also gave me a more official status, which we saw to increase my trustworthiness at the enterprises.

To have the best possible scope of the target group it was necessary to have various types of enterprises to be involved. Concurrently that kind of many-sided data offered an opportunity to test the preliminary views constructed on the basis of the ITEP cases.

The case companies were selected by using theoretical sampling in cooperation between us and MET experts. According to Eisenhardt (1989) theoretical sampling can be used when a researcher wants to replicate a study, expand a created theory, to fill theoretical categories or to give examples of polar types.

A representative sample of metal and electrotechnical enterprises was in the first place proposed by the experts of MET. They selected the candidates of Finnish metal, engineering and electrotechnical industries based on their knowledge (both member and non-member enterprises of the federation). Based on my suggestion the target group was also supplemented with some additional SMEs from Southern-Ostrobothnia.

Both large enterprises and SMEs were included in the study as the role of SMEs was seen crucial for the metal industry supply chains governed by large enterprises. The large enterprises also most often administrate the customer relationships in the supply chains in the metal industry, which gives them an essential role in the networks.

The total number of potential candidate enterprises was about 70. The MET first contacted the candidate enterprises by a "marketing letter" in which the project was presented. In some few cases that preliminary contact was taken in person. In the next phase the project manager of the MET (Mr. Juhani Kangasniemi, marked here JK) called potential candidates personally and asked if they were willing to be involved. There were some enterprises which refused, some which asked for more time to consider the proposal and some enterprises for which it was difficult to find a person responsible for their e-business. When a total number of 40 affirmative replies was achieved, the query process was finished. The final list of the 40 participating enterprises was put together at the end of October 2000.

In the study group three quadrants represented the machinery and metal production industry while one quadrant came from the electrotechnical industry. About one third of the enterprises were SMEs and the others were large ones. Geographically they came from different parts of Finland. Most of the large companies in Finland are headquartered in the capital city (Helsinki) area, which meant that about a quadrant of chosen firms came from that area. However, geographically there were 24 different Finnish cities or municipalities represented.

After a phone contact from the MET the enterprises internally selected the persons and the respondents to receive the preliminary e-mail in advance. Typically the representatives of these enterprises were the managers coordinating the e-business in the company (for detail, see Table 6.3). Among the company representatives there were various types of managers, from chief executive officers to quality managers.

There were 10 enterprises which were located or had subsidiary companies in Southern Ostrobothnia (five SMEs and five large enterprises), and additionally five (two SMEs and three large enterprises) which had business contacts to Southern Ostrobothnia. In the following Tables 6.1 and 6.2 the size, the geographical location and the industry branch of the enterprises are presented. To ensure anonymity the enterprises are codified according to these factors by using letters and numbers.

Table 6.1: *The size and positioning of the MET project enterprises.*

(n) of the enterprises	Size/SME	Size/Large
Geographical location/ Southern Ostrobothnia	7	8
Geographical location/ Other part of Finland	6	19

Table 6.2: *The types of enterprises/the MET cases.*

Case	SME/Large	South Ostrobothnia (SO related) / Other part of Finland (Fi)	Representing metal industy / electrotechnical industry
MET_A1	SME	SO	Metal
MET_A2	SME	SO	Metal
MET_A3	SME	SO	Metal
MET_A4	SME	SO	Metal
MET_A5	SME	SO	Metal
MET_A6	SME	SO	Metal
MET_A7	SME	SO	Metal
MET_B1	Large	SO	Metal
MET_B2	Large	SO	Metal
MET_B3	Large	SO	Metal
MET_B4	Large	SO	Metal
MET_B5	Large	SO	Metal
MET_B6	Large	SO	Metal
MET_B7	Large	SO	Metal
MET_B8	Large	SO	Metal
MET_C1	SME	Fi	Metal
MET_C2	SME	Fi	Metal
MET_C3	SME	Fi	Metal
MET_C4	SME	Fi	Metal
MET_C5	SME	Fi	Metal
MET_C6	SME	Fi	Electr.
MET_D1	Large	Fi	Metal
MET_D2	Large	Fi	Metal
MET_D3	Large	Fi	Metal
MET_D4	Large	Fi	Electr.
MET_D5	Large	Fi	Electr.
MET_D6	Large	Fi	Electr.
MET_D7	Large	Fi	Electr.
MET_E1	Large	Fi	Metal
MET_E2	Large	Fi	Metal
MET_E3	Large	Fi	Metal
MET_E4	Large	Fi	Metal
MET_E5	Large	Fi	Metal
MET_E6	Large	Fi	Metal
MET_E7	Large	Fi	Electr.
MET_E8	Large	Fi	Electr.
MET_E9	Large	Fi	Electr.
MET_E10	Large	Fi	Electr.
MET_E11	Large	Fi	Electr.
MET_E12	Large	Fi	Electr.

6.1.3 MET data gathering techniques

For the interviews special presentation material was put together as a working tool, i.e. a handout of 13 pages and with seven main themes. It was given to the respondents at the beginning of the interviews. Handout material (see Appendix 2) also included some graphical illustrations and textual contributions in order to clarify aspects of various themes related to e-business.

The term e-business was figured by us (JR, MR) to have a nature of generic, cumulative organizational innovation. We defined the term beforehand in quite a broad way in order to give all the respondents an opportunity to construct their own view of e-business. However, we stated some preliminary guidelines to e-business as follows, to stress the nature of organizational innovation: "***e-business**: the use of information and communication technology (ICT) as a basis for communications, operations and management of an organization and as a driving force for business changes*".

The aims of the handout were to present the goals of the project and study, to have a tool with which to guide the discussion during the interviews and to function as a catalyst for the interviews. We bundled up some theoretical models, which we argued to be in relation to the development of e-business. However, it must be noted that the handout was a compromise to fit together the practical aims of the MET project and more theoretical research activities, including the aims of this study. On each page a particular theme was presented. A theme page of the handout typically included an illustration, a diagram or a list of examples and some questions affiliated with the theme. All questions were open-ended.

On the first pages of the handout we presented the MET project aims once again and depicted the framework with four basic factors presented below in Figure 6.1. From my viewpoint that framework can also be seen as a preliminary view of the comprehensive model of an organization. Later I adopted the model of Ives, Hamilton and Davis (1980) for this study, which I presented in Chapter 2 (Section 2.1).

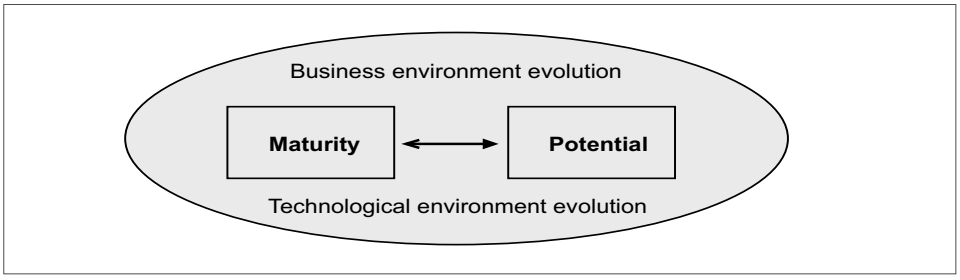

Figure 6.1: *The MET project framework.*

There were four basic factors used as the basis of the interviews (see Figure 6.1):

- Business environment evolution, which was included to reflect the networking aspects, corresponding to the External Environment of the comprehensive model of Ives et al. (1980).

- Technological environment evolution, which was included to reflect the development of the information technology resource, intertwined with the informative resource. That aspect was especially emphasized due to the then existing common view that e-business innovations had their base in physical networks (the Internet) and network services.

- Maturity, which was included to reflect the resources/functions and possibilities of an enterprise to adopt e-business innovations.

- Potential (of e-business innovations in the adopting enterprise), which was included to reflect the motives and advantages the enterprise sees relevant when it adopts e-business innovations.

Business environment evolution was modelled for the interviews according to two most essential views: Firstly, according to the tendency from a value chain organization model towards other value creation models, such as value shops and value networks (Stabell and Fjeldstad 1998), and secondly, according to the role and depth of the customer relationship (Cross and Smith 1995, Cross and Smith 1997, Kalakota and Robinson 1999, Kalakota and Robinson 2001). We also included the degree of commitment of the customers, which was pictured for the interviews according to Cross and Smith (1995). The evolution of the technological environment was described e.g. by using a list of IT capabilities by Bharadwaj et al. (1999).

The concept of maturity to adopt e-business innovations was derived from the results and experiences of the ITEP project (see previous Chapter 5). The first observations of the ITEP data were at that time analyzed and they were divided into three sub-factors: Management maturity (cf. management function described in Section 3.4), Technological maturity (compatibly to Technological environment evolution, stressing the information technology and informative resources of the enterprise) and Organizational maturity to correspond to the other resource emphases of the enterprise.

6.1.4 Entering the MET field

The final process of interviews was based on two phases. In the first phase I phoned the company to organize a meeting in person. About a week before the meeting I sent a short preliminary e-mail-based questionnaire to find out the common views of the respondents of the procedures which the growing use of e-business necessitates.

In the second phase of the process we conducted the particular interviews. In practice all of these were performed during company visits. In most of the cases there were two interviewers attending (JR and MR). In four of the cases just I was present and in one case only MR

(MET_A7). Additionally JK attended three of the cases. The first interview was done on the 13th of December 2000 and the last on the 5th of March 2001. The interviews lasted about two hours. Two of the shortest had limited time beforehand and they lasted about 1h 15min. The longest interview lasted 2h 25 min. The interviews were not taped, because the questions we discussed were very sensitive and strategic to the enterprises involved.

Most of the enterprises (28) were represented by just one respondent, but in eight of the enterprises there were two persons and in three cases three persons involved. In one case the interview was organized by the respondent as an internal discussion and education meeting with six persons present. It gave an excellent perspective to different kind of thoughts inside that particular enterprise.

Table 6.3: *Division of the interviewed companies and persons.*

Industry		Size of the Companies		Interviewed person						
	Total	**SMEs**	**Large**	**CEO & Vice**	**CIO & IT staff**	**Marketing**	**Quality & Development**	**Production**	**Other Managers**	**Other**
Metal	29	12	17	15	6	2	7	6	8	2
Electronic	11	1	10	4	4	1	4	0	0	0

The respondents were typically presidents or vice presidents of the enterprise (19), but there were also e.g. information systems managers and other IT staff (10), marketing managers (3), quality and developing managers (11), production managers (6), and some other managers and staff (10).

6.1.5 The preliminary analyses of the MET data

According to our observations practically every interview was started by making overtures into the respondents' views of e-business and correspondingly into the expertise of the interviewers. Typically, after about an hour the discussions became more confident and fruitful.

All notes were taken manually. We transcribed them into an electronic format after the interviews, and the transcriptions of each case were matched to each other. When both of us interviewers (JR, MR) had accepted the transcription, I sent the text to the respondent by e-mail. The case descriptions were validated in each company separately. A typical extent per case was 5 to 6 pages in a paper format. The first of the transcriptions was e-mailed at the beginning of April 2001.

After analyzing the cases the results were presented in three half-day seminars, in which the interviewed enterprises were asked to be involved, and further comments and suggestions were discussed.

Among the answers there were some requests for constraint in using the data, just concerning a few issues of individual enterprises. This feedback has been noticed also in this dissertation – that part of the data is not referred to or utilized in any form.

We were also able to supplement the MET case set with various background information about the enterprises, such as brochures presenting the enterprises and their products, enterprise presentation materials such as Powerpoint slides (in a printed form), separate organizational charts, annual reports and interim reports, corporate and customer magazines, newspaper and magazine articles, and the enterprises' www pages, not forgetting discussions with other experts working with or within the interviewed enterprises. I also had at my disposal some internal databases (the MET Intranet), including background information of most of the interviewed MET enterprises (mostly quantitative, descriptive information, such as numbers of employees, turnovers of the companies etc.).

6.2 The three selected MET cases

I shall describe three MET cases (MET_A2, MET_A3, MET_A6) in detail in the following sections, and supplement the cumulative emergent theory.

After the within-analysis of the MET cases I firstly made an overview-type of analysis through all the MET data against the emergent theory. I aimed at recognizing whether the categories of the emergent theory would be sufficient to cover the systems I should found from the MET cases.

Most of the systems I recognized suited the current categories of the emergent theory. However, in the case of MET_A2 there were some examples of experimental issues which did not fit very well into the current category of "Experimental systems". The category of "Experimental systems" includes systems aimed at gaining experience of some new phenomenon, but the examples mentioned in the case of MET_A2 did not seem to have that nature.

Other strange kinds of system types were "Outsourced systems" existing in networked environment. Those types of systems were mentioned in some of the cases, e.g. by MET_A3.

In the case of MET_A2 there was also an interesting contradiction concerning the production process systems of the enterprise. At first sight they seemed to be mostly closed, with no external linkups. However, some of my considerations concurrently showed that the enterprise did have a networked production process, and especially the informative perspective was important to them.

That observation made me to return to the question of differences between (Internal) "Process systems" and "Networked process systems". Should there be a third type of category to describe production activities, or maybe even more categories? Further, that led me to consider correspondingly also the characteristics of the main categories "Value chain systems" and "Value network systems" of the emergent theory.

In summary I had three significant observations after the overview-type of analysis of the MET data:

- The category of "Experimental systems" would have to be extended.
- A networked counterpart for the category "Outsourced systems" was found.
- The categories of "Value chain systems" and "Value network systems" under the category of "External competitive systems" would have be analyzed more carefully.

To answer those challenges I first chose the case of MET_A2 to be looked at in detail to supplement the "Experimental systems" category of the emergent theory. Correspondingly I chose the case of MET_A3 to supplement the view of "Outsourced systems" in networked environment.

I came to conclusion that the tripartite classification model of Stabell and Fjeldstad (1998) was one of the most promising ways of analyzing the need of categories additional to "Value chain systems" and "Value network systems", for they had presented their own Value chain and Value network models and also an additional concept of Value shop. I decided to return to the model of Stabell and Fjeldstad later and test it against the emergent theory (see Chapter 7, Section 7.2).

I also decided to concentrate on the main category of the emergent theory, "Value network systems" with its subcategories, to increase my knowledge of them and of the possible need of additions. However, the picture of "Value chain systems" seemed quite clear if compared to the category of "Value network systems", due to Porter's well-known theory.

For these purposes I found it necessary to bundle up the cases of MET_A2 and MET_A3 to analyze "Value network systems" in more detail. Also the third example case which I chose to be presented, MET_A6[31], was a most representative case to characterize some additional features of the categories of "Value network systems".

6.3 Supplementing Experimental systems (the first MET case)

MET_A2 is a small manufacturing company concentrating on sheet metal work and medium-sized steel structure welding. The enterprise produces customized components and modules. It is a private, family owned company located in a rural area. Its customers are typically large enterprises. MET_A2 started as a raw material distributor, but the enterprise has grown to the position of a system contractor. That status is important to MET_A2, and it had reached for it since 1995. The strategic plan of the enterprise is based on a partnership network. MET_A2 buys sheet metal work from its suppliers when its own capacity is not sufficient, and it has networked partners for various kinds of specialized supply activities, such as e.g. laser cutting, tooling, different types of metal painting or robot-based welding.

31 MET_A6 is not located in South Ostrobothnia, but it has business cooperation with e.g. the South Ostrobothnian enterprise ITEP_E2.

6.3.1 Preliminary analysis of the case of MET_A2

The case of MET_A2 emphasized two current categories: "Experimental systems" and "Networked process systems". In the field of experiments the enterprise has been an active initiator. The enterprise wants to "push" developing activities. According to the respondents the edge condition for getting large enterprises involved in experiments is operating in the form of pilot projects. MET_A2 expects the main supplier to be active, because the project proposals of MET_A2 have not always been treated seriously: "*Very much so, we have discussed developing issues, but when that has not been successful we have concentrated just on taking care of our particular job*".

In the case of MET_A2 the production process was described from many angles ("Networked sales and marketing systems" and "(Networked) process systems", see Table 6.4), which shed more light on the nature of the various categories of "Value network systems". I shall consider that issue in detail later, in subsections 6.4.3 to 6.4.6.

The analyses of the two "Internal supporting systems" I recognized (see Table 6.4) are omitted.

6.3.2 Preparing to supplement Experimental systems

The case of MET_A2 did not include much information of experimental systems. Quite the contrary, the enterprise had had some unsuccessful experiences concerning pilot project proposals they had made. However, some other MET cases also described various experimental systems. I list them briefly here, but they did not require the forming of any new categories.

Because there were many large enterprises in the MET case set, there was also quite a large range of issues of some experimental nature. Most of those systems were aimed just at gaining experience of a single new phenomenon. Some were aimed at rapid competitiveness-creating, and thus they could be classified into other system categories as well. The mentioned experimental systems included e.g. various kinds of pilot projects and the use of simulations (MET_E2). More interesting was the model of organizing competence centers (MET_D1, MET_B2, MET_E12), into which experimental (R&D) activities were centered. An ultimate example of experimentation was the building of a whole factory with the nature of a prototype, the model of which was afterwards reproduced for many foreign countries.

Rogers' (1995) classical model of innovation diffusion is based on a "bell-shaped" curve of normal distribution. The curve represents the frequency of a product adoption over time. If the cumulative number of adopters is plotted, the result is an S-shaped pattern. The categorisation of adopters by Rogers on the basis of innovativeness is the following: an innovator, an early adopter, an early majority, a late majority and laggards.

From the viewpoint of the emergent theory, Rogers' category of early adopters is compatible with the "Experimental systems" category of the emergent theory. That nature of

Table 6.4: *Information systems of MET_A2.*

MET_A2	**Organizational entity (SME)**	**Organizational structure (Networks)**
Financial perspective	**Experimental systems:** *How?* - *It is expensive to be an early adopter* **Internal (supporting) system:** Accounting system *How?* - *The accounting system is taken care of by the enterprise itself*	**Networked process system:** *How?* - *In the supply chain the administrative overhead moves (easily) to the supplier.* - *It is not easy to have recompense for specialized knowledge* **Networked sales and marketing systems:** *How?* - *delivery agreements*
Sociological and psychological perspective		**Experimental systems:** *How?* - *The enterprise has been an active initiator.* - *In the first example the experimental project was given the thumbs down by the CIO of the main supplier.* - *In another case the proposals were not treated seriously enough.* **Networked process system:** *How?* - *Production priorities are ruled by customer needs* **Networked sales and marketing systems:** *How?* - *trust/system contractor status*
Information technology perspective	**Internal (supporting) system:** Backup-system **Process system:** - "ERP"software, such as Työkalupakki, Nova, Scala - actual cost calculation *How?* - *Relatively cheap, but incompatible (closed), basic applications.*	**Networked process systems:** E-mail, CAD/planning system *How?* - *Eager to have an access to the systems of large customers or/and to have some kind of shared mailbox system (e.g. to CAD blueprints).*
Informative perspective		**Networked process system:** *How?* - *Faxes churn out paper on and on* - *Lack of production forecast information of good quality* **Networked sales and marketing systems:** *How?* - *Heterogeneous practices mean new documenting processes* - *Uncertainty of who is responsible for saving product data* - *Problems caused by heterogeneous coding in product data management*

"Experimental systems" was discussed earlier in this study (see subsection 5.4.5), but MET_A2 's description of some unsuccessful experiences caught my attention and made me look at the reverse side. Should there also be laggards of the ICT systems? According to Rogers (1995, pp. 248 to 250), laggards adopt innovation last, are traditional and "…tend to be frankly suspicious of innovations and change agents. The laggard's attention is fixed on the rear-view mirror".

In the case of MET_A2 there were two examples of this kind of issues. In the first example the suggested experimental project (transmitting CAD blueprints by using e-mail) was given the thumbs down by the CIO of the main supplier. Some other important information concerning the purchase orders was asked as well, but the main supplier did not have the courage to give it.

In their second example another main supplier was asked to act as a mediator of the CAD blueprints they got from the main supplier of the whole supply network. MET_A2 asked the main supplier to give new prints automatically also into their use. The proposal was not treated seriously enough, because it was unclear to the main supplier if they had the rights to deliver the prints in that way.

6.3.3 Experimental systems vs. Competition obstructive systems

I argue that both of the above mentioned examples from MET_A2 refer to situations where earlier routines prevent the development of new practices. It means that there are systems which rather retard competitiveness than create it. That observation made me to analyze the issue more carefully. I argue that the proper "lens" (Giddens 1984, p. 326) for analyzing this issue further is the concept of "path-dependency".

The concept of path-dependency

The concept of path-dependency refers to a process in which initial moves in one direction prevent further moves in that same direction (see e.g. Magnusson and Ottoson 1997, North 1990, Goldstone 1998). According to North (1990, pp. 98 to 99), path-dependency is a process that constrains[32] future choice sets: "At every step along the way there are choices – political and economic – that provide… real alternatives. Path-dependency is a way to narrow conceptually the choice set and link decision-making through time. It is not a story of inevitability in which the past neatly predicts the future."

Based on Davis (1988) Håkansson and Lundgren (1997) states there are two separate explicit forms of path-dependency; lock-in by small historical events and path-dependent transitions. The first of the forms refers to dynamical processes, which can be locked into particular evolutionary paths through seemingly insignificant and entirely random events. The second form is accordingly described by Håkansson and Lundgren (1997): "Path-dependency of

[31] The term lock-in is used in some of the economic literature, e.g. Davis (1994), Arthur (1989). There are also some other interpretations of the term path-dependency. E.g. Miller (2003) has used path-dependency in a positive sense of the term. In statistics path analysis is a variation of multiregression analysis, which can be used for studying causal-statistical relationships between many variables (see Järvinen 1999, Pedhazur 1982, Griffin 1977).

transition probabilities refers to a class of models where history really matters in the sense that knowledge of the present is not sufficient when it comes to predicting the future: some knowledge of the past is also necessary. The dynamics of a system are not only governed by where it is, but also from where it is coming from."

In their review Coombs and Hull (1998) argue that the concept of path-dependency is potentially "located" in three different domains within the enterprise. The first domain, "technology-as-hardware", comprises the specific technological artefacts such as products, machinery, equipment, software, etc. These items bear the impression of previous choices and change events, and they shape future possibilities for the development of further artefacts.

The second domain in which path-dependency may be located is the "knowledge base" of the firm. This knowledge base is interpreted variously. It may be seen as narrowly defined by the specific technologies and markets of which the enterprise has experience, or more broadly defined as the culture of the organisation, which includes but transcends the more narrow definition.

The third potential domain is the collection of routines which are carried out in the firm in order for it to conduct its regular business. According to Coombs and Hull some of those routines are related to innovation. These would include routines which deploy the existing knowledge base of the firm in order to make sense of particular problems in the area of product and process development. These would also include e.g. routines which aim to characterise customer requirements, to identify technical solutions, and to establish projects to implement solutions. According to Coombs and Hull path-dependency may be located in all of the three domains: in the "technology-as-hardware", in the knowledge base, and in the routines of the firm. This follows from the way in which the three domains are bound up with and depend on each other. The knowledge base structures the routines, which in turn deploy knowledge to create the technology, which in turn underpins the knowledge, and so on.

Examples of path-dependency in ITEP and MET cases

The three mentioned types of path-dependency refer to the supporting resources (Kerola and Järvinen 1975): technology to the technical resources, knowledge to the informative, and routines (at least partially) to the human resources respectively, but the financial path-dependency constraints are not mentioned.

To get a closer view I scanned through both the ITEP and the MET case sets aiming to find some more examples corresponding to issues of path-dependency. I recognized the following issues as examples referring to history, to types of path-dependency (the corresponding resource types in parenthesis):

- MET_E7: The enterprise has 18 different, concurrent ERP systems (technological).

- ITEP_E2: When a new focus has been found it has always been very difficult for the CEO to cut down old businesses (human).

- MET_A4: Not very successful attempts to pressure the main supplier to give production forecasts of good quality (informative, human).

- MET_E12: Constraints due to conservative customers (informative, human).

- MET_A3, MET_E8: Aged employees are not willing to adopt new technologies (human).

- MET_E8: Financial constraints (financial).

In the case of MET_E8 there was described an economic picture with a lack of financial resources, and it was not possible for the enterprise to develop their systems: "*...our organization is not able to apply information technology, we have lived from year to year very meticulously and have not developed*". I argue that this kind of situation reflects yet another type of path-dependency.

In the case of ITEP_A1 I was told a whole story of a pilot project for metal enterprises including problems of path-dependency of all of the three previously named types. Participating in that project there were also the enterprises ITEP_A2, ITEP_A3, ITEP_D3, MET_B4 and MET_B5, and I was also involved in it, so I was able to have differing viewpoints of the pilot project. The example is described in the following framed box (with no further analysis).

Among the cases there were also at least three that described even more types of systems, seemingly not competitiveness-creating. New categories were needed for these types of cases:

- In the case of MET_D2 two separate but functionally concurrent customer service systems were in progress in their group of companies. The respondent as the CEO of the coordinating company was worried about the situation but was not able to correct the way of their operation.

- In the case of MET_D3 they had had an unsuccessful large ERP project, currently preventing future adoption of the alternatives.

- In the case of MET_A3 the respondent received from the main supplier an instruction to start using a large ERP system, which from his angle was the most inflexible and expensive system to use.

The story of the pilot project for metal enterprises

The story told by ITEP_A1 took place in the year of 1998. There was an educational pilot project for metal firms to help them form new subcontracting supply chains. The needs of sharing CAD pictures (here: blueprints) and other manufacturing information of the kind between the enterprises were the focus of the project. ITEP_A1 was chosen as the partner to offer the network-based data management services to the project enterprises. Representatives of the enterprises ITEP_D3, ITEP_A2, ITEP_A3, MET_B4 and MET_B5 and also I were involved in the project.

At the beginning of the project the leading manager of one of the enterprises defined current problems of the metal firms and the expectations and aims for the piloted system. His definition excellently illustrates the needs and the target of usage of a document management system.

Typical problems in metal industries
- Tight schedule of delivery: No time for unnecessary delays when orders and blueprints are processed.
- Blueprints: More and more enterprises have CAD systems in use, but in spite of it paper images are still mostly used.
- Suppliers delineate the same blueprints again, which is a waste of time and brings risk of errors. The repeatedly faxed blueprints are unclear.
- Call for bids and orders: They are often made by phone. This causes misunderstandings and no documentation occurs.
- Capacity: The use of available capacity varies very much and there is no information available of it.

Expectations and aims of the network-based information system to be piloted
- Information sharing processes: Become more rapid, more explicit, more homogenous and also documented.
- Blueprints: Unnecessary overlapping work diminished, chance of errors minimized, printing out the documentation made possible and a forum given to processing the blueprints in cooperation.
- Call for bids and orders: Possibility to use them as a basis for bids and confirmation of orders.
- Capacity: Easy to tell one's own free capacity to partners.

According to ITEP_A1 the group was promising, *"the whole supply chain was present, as should be"*. There were many possibilities for developing effectiveness. Unfortunately for the project, the enterprise which was the primus motor was sold, which led to the cancellation of the project.

There were other problems as well. According to ITEP_A1 one project partner *"...begun to asses and envy that there would be an enormous amount of business for us... ...if there should be a hundred or a thousand users [of the new system]. But, how to get the first five at least? We had other similar experiences. It is obscure to outsiders how hard it is to get things to grow into real business."*

According to another interviewed project participant who was looking at the issue from an opposite position: *"...it was a good idea, but it did not came into operation. Greediness burst onto the scene, and the touch to the ground was lost... ...too small details were included. The policy of developing in small steps should have been chosen, as well financially as operationally."*

The consultant involved in the project argued: *"The chief information officer of one large metal industry enterprise [who was also involved in the project] was an old time stubborn person. Large firms operate with mainframe systems. The chief information officer of that firm noted they had made their own free in-house EDI system, but nobody ever used it. But I think the man should have understood that EDI is a common standard, not any monopoly product. That same kind of attitude broke down the enthusiasm at the very remarkable metal firm for the metal industry cooperation network [= this pilot project]. It is a way of ruining good innovations, if the opinion is at first sight that the idea was not successful when they first tried it. That kind of old time stubborn people, chief information officers are opinion leaders. However, they usually work in administration, and they don't understand the production processes. But it is not necessary to computerize everything, also the human component should be accepted."*

Competition obstructive systems

As a summary of the above mentioned issues I first divided the category of "True systems" into two: "Competitiveness-creating systems" as defined earlier, and as its counterpart a new category of "Competitive surrounding systems". The latter characterizes on the one hand the category of experimental, early adoption of the ICTS innovations, and on the other the category of systems obstructing the development (see Figures 6.2 and 6.3). It must be noted that there is no specific emergent literature concerning that category (see summary in Table 6.5).

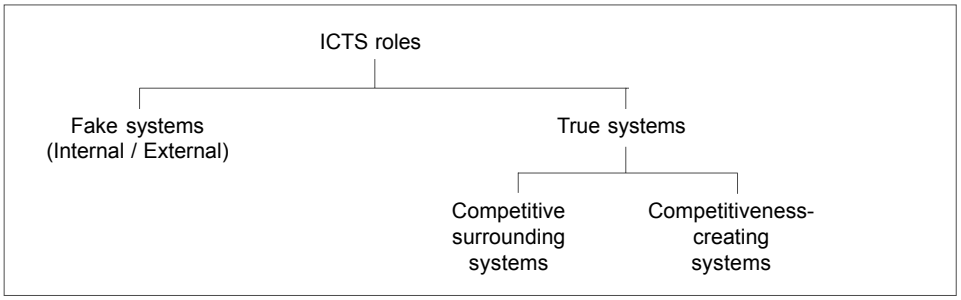

Figure 6.2: *"Competitive surrounding systems" vs. "Competitiveness-creating systems" .*

Under the category "Competitive surrounding systems" I positioned the before defined category of "Experimental systems" and a brand new category of "Competition obstructive systems". I also divided the latter further into two categories: "Failure systems" and "Relic systems" (see Figure 6.3 and Table 6.5).

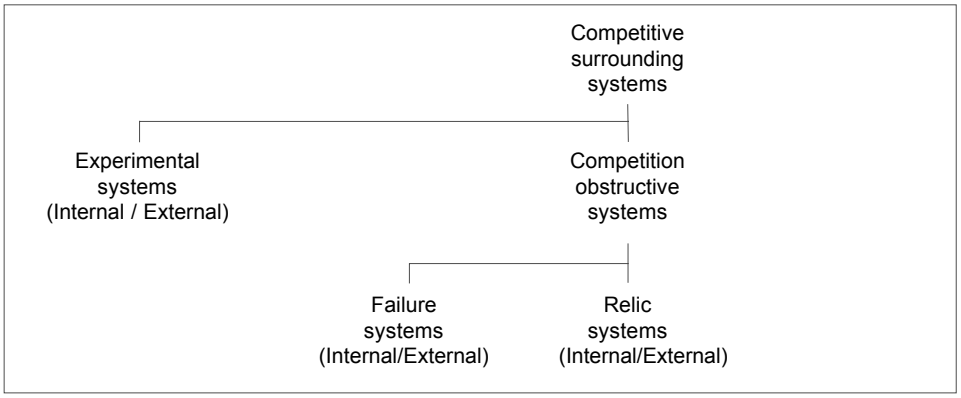

Figure 6.3: *The structure of "Competitive surrounding systems".*

The category of "Experimental systems" is here a positively loaded term with learning expectations. Contrary to that, the category of "Competition obstructive systems" is negatively loaded; its subcategory "Relic systems" refers to the "laggard" kind of historical systems which should be learned away from. The category of "Failure systems" represents the kind of systems which are created simply based on wrong decisions. In practice it may be difficult to see whether a system really is a failure, and there are naturally also different viewpoints of the same system. However, that division reflects the two explicit forms of path-dependency

according to the above mentioned Håkansson and Lundgren (1997) and Davis (1988). It can also be argued that this type of systems should not be seen as innovations, but based on Rogers' (1995) work these categories are included in the emergent theory, reflecting the innovation diffusion view and innovation adoption over time.

As stated earlier, it is axiomatic that the category of "Experimental systems" includes also the categories "Internal experimental systems" and "External experimental systems". Analogously the system categories "Failure systems" and "Relic systems" both include their own internal and external categories, but they are not illustrated here (see Figure 6.3). The "Internal failure systems" are, for example, wrong investments in an unsuccessful piece of software applied inside an enterprise. An example of "External failure systems" was in the case of MET_A3 the large ERP system and the instruction from the main supplier to take it into use, even if from the enterprise's angle it was the most inflexible and expensive system.

In proportion, "Internal relic systems" are internal old systems which are still used although they should be discharged, or they are adopted in a "too late" phase of the innovation's life cycle. A good example of "External relic systems" would be physical networks not using open data transmission protocols (TCP/IP). Within many interviews this kind of physical networks of the large (customer) enterprises were criticized. Those were mentioned to be mainframe-based, closed entities with no external access allowed to the suppliers. Reasons were technical (old-fashioned equipment and protocols), social (negative attitudes of CEOs), financial (too expensive to build new kind of infrastructure) and informational (no proper knowledge).

6.3.4 Synthesis after the case of MET_A2

The case of MET_A2 led me quite unexpectedly to find the reverse side of the ICT system innovations. Rogers's model of innovation diffusion includes the category of laggards, organizations adopting innovations in a late phase. Some unsuccessful experiments by MET_A2 made me to reflect the diffusion model of Rogers against the emerging theory and case of MET_A2. The concept of "path-dependency" was the proper "lens" for further analysis of this issue.

In the case of MET_A2 there was also an interesting contradiction concerning their production process systems. When I first viewed the "Process systems" of MET_A2 according to the information technology perspective, they were quite modest administrative programs of the internal type (see Table 6.4) and seemed to be mostly closed, with no external linkups. However, the enterprise had made serious proposals of an access to the physical networks of the main supplier, and they already used e.g. e-mail for exchanging CAD blueprints with their partners. All the networked perspectives of MET_A2 reflect a more networked production process, and especially the informative perspective seemed to be the most important.

This latter issue will be discussed later in Sections 6.4.3 to 6.4.6.

The changes that occurred in the emergent theory after the analysis of the case of MET_A2 are presented in Figure 6.4 and Table 6.5.

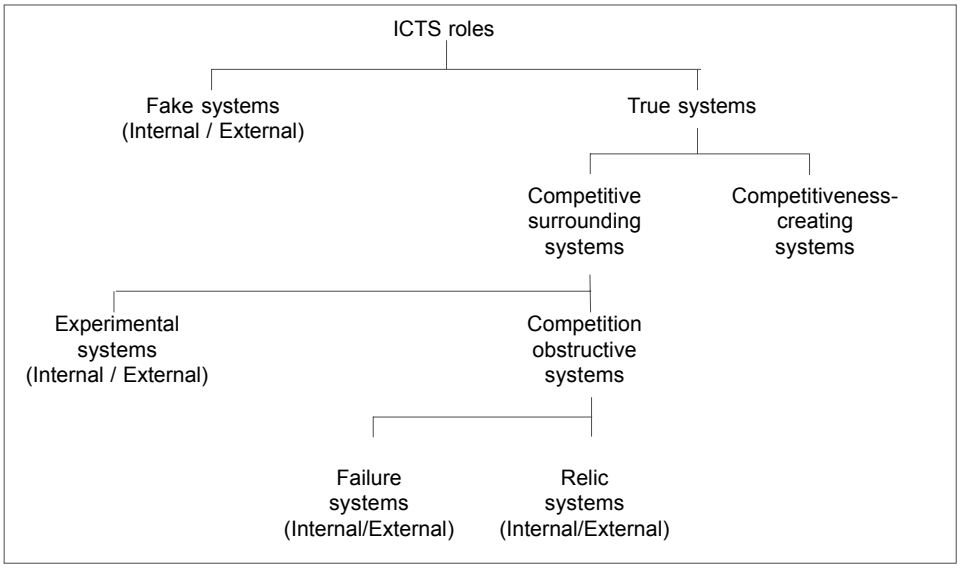

Figure 6.4: *The structure of the emergent theory after the analyses of the case of MET_A2.*

Table 6.5: *The synthesis of constructs after the MET_A2 analyses.*

System type category	**Category description**	**Enfolding literature (+/-)**
Fake systems	…are systems creating a manipulated image for opportunistic reasons	+ Williamsson (1985): TCT opportunism, costs of cheating - Larson (1992), Uzzi (1979): criticism against TCT opportunism
True systems	…are systems aimed successfully or unsuccessfully at learning or competitiveness-creating	—
Competitive surrounding systems	…are Experimental or Competitive obstructing systems	—
Competitiveness-creating systems	…are systems the aim of which is the financial success and competitiveness of an enterprise, achieving sustainable competitive advantage	A priori assumption, e.g. + Barney (1991, 1997), Rockart & Scott Morton (1993), Malone, Yates & Benjamin (1987), Stabell & Fjeldstad (1998), Porter & Millar (1985)
Experimental systems	…are systems aimed at having experience of some (new) phenomenon (internal & external with partners)	+ Rogers (1995):innovator, early adopter - Järvinen (1985): R&D
Competition obstructive systems	…are systems which obstruct competitiveness-creating	+ Coombs and Hull (1998), Håkansson and Lundgren (1997), Davis (1988)
Failure systems	… are systems which are created based on wrong decisions (internal & external in cooperation with partners)	+ Håkansson and Lundgren (1997), Davis (1988): small historical events
Relic systems	…are historical systems which should be learned away from (internal & external in cooperation with partners)	+ Håkansson and Lundgren (1997), Davis (1988): path-dependent transitions

6.4 Supplementing Production systems (the second MET case)

MET_A3 is a small metal manufacturing company employing about 30 persons and concentrating on mechanical engineering. Also important for the company is metal cutting by using a special water cutting technology. The enterprise produces special components and modules which demand high professional skills, tolerance in size and delivery in term.

It has one important main supplier; a large customer in the neighbourhood buys 90 % of the production of the enterprise. MET_A3 is in the position of a system contractor.

6.4.1 Preliminary analysis of the case of MET_A3

Also in the case of MET_A3 "Networked process systems" were emphasized very much. They were mentioned in all the four networked perspectives, and "Internal process systems" exist as well in human and informative perspectives (see Table 6.6). There were also a "Networked sales and marketing system" and a "Networked acquisition system" mentioned, as well as a couple of "Internal supporting systems".

When I considered the "Networked process systems" (emphasizing here the perspective of information technology) I noticed that there was a networked, outsourced type of service, which on discussion was mentioned to support, for example, supply network activities and project coordination. I wanted to look at that type of systems more carefully, because they were mentioned also in some other MET cases. I shall present that consideration in the following subsection 6.4.2.

As stated already at the beginning of Section 6.3, I shall consider the category of "Value network systems" and its subcategories (here "Networked process systems", "Networked sales and marketing system", and "Networked acquisition system") more carefully later, in subsection 6.4.5.

The analysis of "Internal supporting systems", which are mentioned in Table 6.6, are again omitted.

Table 6.6: *Information systems of MET_A3.*

MET_A3	**Organizational entity (SME)**	**Organizational structure (Networks)**
Financial perspective	**Internal (supporting) system:** Financial management	**Networked sales and marketing system:** *How?* - *Prices of the products are defined in delivery agreements. The price is determinant [would like to have also some other scope, such as time-scale or quality].*

Financial perspective		*- Time of delivery of products needs exact rules* *- Aimed at cost cutting* **Networked process system:** *How?* *- The stock of the main supplier X has shifted to MET_A3 - Reclamation processes* *- Need to standardize processes with the main supplier*
Sociological and psychological perspective	**Process system:** *How?* *- Software developing people and firms speak different languages* *- CEO is the only person with skills to use fundamental applications*	**Networked process system:** *How?* *- When the operations were too unstructured, a man from a neighbouring [enterprise] production line could just come and borrow something, which caused material losses.* *- It is often down to personal attributes, if proposals of development are not successful. Especially older people do not like to have new operations models.* **Networked acquisition system:** *How?* *- Some suppliers have only telefaxes, the enterprise has proposed some steps of development.*
Information technology perspective	**Internal (supporting) system:** *How?* *- Many difficulties in IT systems maintenance*	**Networked process systems:** *- Supply chain management* *- CAD/planning system* *- order management* *- ASP nature software* *How?* - Great challenge to develop transparent supply chain management and management of materials - Transferring of CAD blueprints has helped a lot, the system is implemented with two main suppliers - Data security is one of the bottlenecks in connecting with the main supplier, issues such as firewalls and virus checking - Considering the need and usability of software of ASP nature
Informative perspective	**Process system:** *How?* *- The importance of continuous creation of information and documentation is not felt important, which is a problem* *- Quality management issues*	**Networked process system:** *How?* *- The customers maintain and share a database, which is used for example for printing work orders* *- Product Data Management is an important issue* *- Production forecast information is needed*

6.4.2 Finding ASP network systems

Some of the respondents (in addition to MET_A3 and MET_D3, also the cases of MET_E3 and MET_B8) discussed networked, outsourced services, supporting supply chain/network activities and, for example, project coordination. There were examples of a common project portal for managing a long-term construction project or similar (for example, plant delivery) when a group of companies was founded.

Project portals, maintained possibly by external, so called "third parties", serve as storage for project information, an instruction base for the partners' work performance in different phases and at the same time as a common interchange of information about the development of a project. A project portal enables continuous documentation of a project to ensure its quality.

The role of third parties as partners in information transfer and supply chain management was still unclear to respondents in the MET cases. This kind of activities have started in Finland, but according to the respondents no real industry specific application service provision (ASP) has been significant.

Currie and Seltsikas (2001) explored in their article the supply-side of IT outsourcing by focusing upon the emerging role of application service provision. They defined ASP as third party service firms which deploy, manage and remotely host software applications through centrally-located services in a rental or lease agreement.

Peterson and Fairchild (2002) considered ASP adoption particularly in SMEs. They argued that the realization of any type of benefit is dependent upon the motivation and abilities of both SMEs and ASPs. Consequently, value drivers and propositions for ASP adoption can incur significant strategic risks, if and when motivation and abilities are discordant. They also presented drivers and risks of ASP adoption (see Table 6.7), based on various articles.

Table 6.7: *Drivers and Risks of ASP adoption according to Peterson and Fairchild (2002) ref. Jayatilika et al. (2002), Kern and Krijger (2001), Klueber (2002).*

Type	Value Drivers	Strategic Risks
Business	Operational excellence	Cost-inefficiencies
	Focus on core competencies	High level of ASP dependency; Low level of SME control
	Reduced need to develop ICT skills	High level of ASP dependency; Low level of SME control
Technical	Easy and efficient access to, and use of new applications and services	Low quality of ASP service; High ex-post ICT costs
	Flexible deployment	Low level of application integration by ASP
	Application standardization	Low level of customization by ASP

Currie and Seltsikas talked about a "third wave of the outsourcing". They trace the transition from the first wave IT outsourcing in the 1960's, to the business-centric outsourcing in the 1980's and 1990's to the application outsourcing in the 21st century.

They made a comparison of traditional outsourcing and application outsourcing (see Table 6.8), and also presented a conceptual framework consisting of a taxonomy of ASPs, which is used to demonstrate the different market segmentation strategies adopted by ASPs for competing issues.

Table 6.8: *A comparison of traditional outsourcing and application outsourcing.*

Traditional outsourcing offered by traditional suppliers	Application outsourcing offered by ASPs
One to one	One to many
Application owned by customer	Applications owned by ASP
Significant up front costs	Not up front costs
Legacy applications paid by customer	Pricing based upon usage
Located at customer site or sometimes with third party	Application located at ASP, third party or at customer site accessed across their LAN

Drawing from empirical research carried out in the US and Europe, Currie and Seltsikas evaluated ASP strategies for deploying, hosting, managing and enabling software applications on behalf of their customers, and how this is currently changing the nature of the outsourcing contract and relationship between client and supplier (see Table 6.9). They also argued that the ASP business model is advocated as an attractive value proposition for SMEs, and in addition to such businesses as dot.com companies, or other startup firms seeking hypergrowth.

Table 6.9: *Key themes in the emerging ASP business model.*

Key themes	**Types of ASP Business models**	**Evaluation of ASP business models**
Three waves of IT outsourcing	• Traditional outsourcing • Enterprise outsourcing • Application outsourcing	• Outsourcing vs. insourcing • Core competence debate • Economics of IT outsourcing • IT skill shortages
Taxonomy of ASPs	• Enterprise ASPs	• Strategic alliances
	• Pure-play ASPs • Vertical ASPs	• Channel partnering • Market opportunities (vertical and horizontal)
	• Horizontal ASPs • ASP enablers	• Cross-national comparisons
Performance criteria for ASPs	• Delivery	• Customer satisfaction, time to market
	• Integration • Management and operations • Enablement	• Pricing models • Reliability, availability and scalability • Data security • Service level monitoring • Bandwidth requirements

Although some of the issues Currie and Seltsikas presented were not very well justifiable (especially the quite optimistic view of ASP's suitability for presenting new opportunities to SMEs with little history or experience of outsourcing), those observations made me consider the category of "Outsourced systems" positioned under the category of "Value chain systems". It did not have a networked counterpart under the category "Value network systems". I argue it was reasonable to add one, based on my observations and also based on literature. That required also the addition of a new category (with no particular enfolding literature) between the categories of "Value network systems" and "Networked core production systems". I labelled the new category as "Cooperative production systems" (see Figure 6.5).

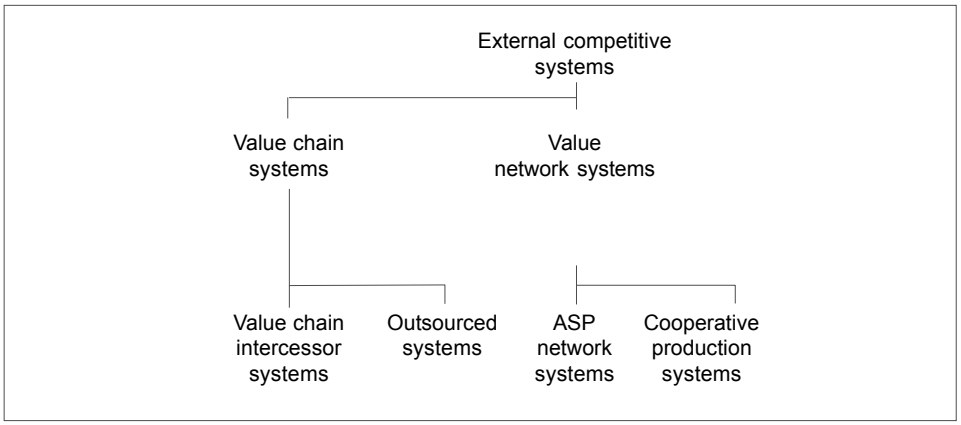

Figure 6.5: *"ASP network systems" in the emergent theory.*

I argue that the increment of one ASP-category is sufficient, even though Currie and Seltsikas presented various types of ASPs. Naturally it is possible to create new subcategories if that is felt necessary, but for the purposes of this study the classification "Outsourced systems" vs. "ASP network systems" is exhaustive enough.

It must also be noted (Riihimaa and Ruohonen 2002, Ruohonen, Riihimaa and Mäkipää 2002), that expectations for the provisioning of application and business services have been high. However, successful utilization of ASP services requires standardization of industrial processes, strong management of product standardization and above all management of industrial differences.

According to Riihimaa and Ruohonen (2002) only a broker conducting merely routine business transactions can manage as a very cost effective industrial broker, while others have to concentrate on managing a part of the customers' processes as well. This is already partly happening in the electronic industry, for example, in the production of components and software.

The administration model of the industry's ASP brokering was unclear to the MET respondents. Still, broker operations can be founded either by the business partners themselves, an independent broker conducting business operations or any of the associations serving the industry. A broker can operate with contract partners only or immediately open the operation for all potential companies. However, experiences from elsewhere have

suppressed the biggest enthusiasm. For example, electronic marketplaces were clearly living their critical period during the times of MET interviews. From the point of view of a company acquiring the services, ASP operations are very diverse, because the same kind of service can be received from small, independent entrepreneurs, telecommunication operators or system integrators (Riihimaa and Ruohonen 2002).

6.4.3 Combining the cases of MET_A2 and MET_A3

My preliminary analysis of the case of MET_A2 (see Section 6.3) made me think more carefully of the differences between "Internal process systems" and "Networked process systems", and more broadly of the differences between "Value chain systems" and "Value network systems" and their subcategories.

I also decided to concentrate on the main category "Value network systems" and the subcategories (in other words "Networked acquisition systems", "Networked process systems", "Networked product systems" and "Networked sales and marketing systems") of the emergent theory, to increase my knowledge on those categories and to weigh the possible need of additions. As I stated, the picture of "Value chain systems" seemed quite clear if compared to the category of "Value network systems".

To check "Value network systems" more carefully I first decided to combine the case of MET_A2 with the case of MET_A3. Both of these represent the same kind of small specialized metal production enterprises, but they also have some complementary features. The connections which the pair of enterprises has to other MET cases offered an opportunity to analyze not only "Networked process systems" but also "Networked acquisition systems" and also "Networked sales and marketing systems".

For example, the enterprise MET_2 had a large supplier (MET_B4, a steel wholesale business) and "behind" it in the supply chain/network there were a huge steel works (MET_B8). In turn MET_A2 was a supplier to MET_B7, which, for one, was working for MET_B6. Although all the other "members" of that five steps supply chain/network are large enterprises, I argue that the principals of the acquisition systems are if not equal, very much alike. Both of the emphasized cases, MET_A2 and MET_A3, are also networked with a same common main supplier, MET_B3.

It must be disclosed beforehand that the analysis of the combined cases of MET_A2 and MET_A3 did not at the end bring in any new categories to the emergent theory, but it sharpened the picture of the categories fundamental to production SMEs, the categories attached on "Value network systems" (or, more precisely, on its subcategory "Cooperative production systems"). In these considerations the chart of the four perspectives was an efficient tool for analyzing the features and emphasis of all of these networked systems, to which issue I will concentrate in the following (see subsections 6.4.4 to 6.4.5 and Section 6.5).

It must be also noted that when acting in a reciprocal supply network, the main supplier's networked acquisition systems seem to have intertwined counterparts, either "Networked sales and marketing systems" or "Networked process systems" of the supplier. In the light

of the MET cases it seemed that the nature of main supplier's customer relationship differs from the one of the end-customer. Both types of customers are felt important by the production enterprise, but the main supplier customer seems to have more power of control over its suppliers. Communication within a supply network is more concentrated on issues of the production process. Correspondingly, communication with the end-customer is on the one hand focused on "pre-sales" activities, such as the phase of product definition and product planning, and on the other on after sales services.

Both the concept of "Networked product" and the end-customer relationship from the viewpoint of "Networked sales and marketing systems" are discussed later in more detail, when the case of MET_A6 is presented (see Section 6.5). In the following subsection 6.4.4 the main supplier customer relationship from the viewpoint of "Networked sales and marketing systems" is simultaneously considered as a counterpart to "Networked acquisition systems".

6.4.4 Supplementing Networked acquisition systems

Networked acquisition systems in the MET cases emphasized cooperative tools for such issues as delivery and pricing agreements, inter-organizational learning, defining technical preconditions for helping to standardize processes between partners, definitions of shared data and issues aimed at cooperative problem solving. In summary, networked acquisition operations are in close connection to the actual producing process, because they try to dispose of the possible non-productive tasks.

Financial perspective

Alike in all business relationships, also in networked acquisition the typical starting phase is making more or less formal delivery agreements, which in the case of networked acquisition are in the form of long-term framework agreements between trusted partners. The main supplier for both MET_A2 and MET_A3, the large enterprise of MET_B3, said they have in addition to that an [annual] developmental discussion with their partners.

In both of the cases of MET_A2 and MET_A3 the respondents argued that the financial perspective is currently emphasized in the agreements and the price plays a too determinant role. They would like to include also some other scope, such as the importance of time-scale or quality issues.

The ways of how to share the profit are defined in these agreements, and there is a need for new kinds of models of sharing. According to MET_D5: "*At one's best partner enterprises today it is contemplated how the balancing of losses should be done, but they should go further and contemplate also how to share the net profit together.*" In consequence, an extremely important aim for production SMEs in the middle of a supply chain/network is to create activities which include either end-customer oriented pre-sales or after sales services. Without this kind of service components or other value sharing agreements the additional value and profits are raked in by the main supplier, which is managing the end-customer relationship.

In some of the cases (e.g. MET_B4) it was an open question whose responsibility it is to invest in new infrastructure. In the case of MET_D1 the respondent emphasized a financial interface between the parties and, attached to that, such issues as copyright agreements, core competencies and a clear division of responsibilities (cf. e.g. Engeström 2003, reintegration of organization, work and learning, presented in Chapter 2).

Also MET_E3 called for new pricing models: "*In any case we are moving towards a structure of contract cost and open pricing, in which even the customer knows what the cost is comprised of and also the price of the materials per item. Open pricing has already created knowledge of the cost structures, and it is done with the important partners. We have done that for five or six years now with a few important customers. The openness of pricing ensures that we are able to transfer new costs to the customer.*"

Human perspective

From a human perspective trust between the persons seemed to be a very important feature of the networked acquisition system (cf. Johannisson 1987, Pfeffer and Salancik 1978). Alike in MET_A2, networked suppliers got gradually new responsibilities. The respondent of a main supplier MET_B3 with a total number of 20 to 50 of "ordinary" suppliers describes: "*...it is typical that MET_A2 does more than it has promised, and it is currently a trusted systems contractor...*", and "*...it is a very big decision if we accept new system contractors*".

Many other cases also strengthen that observation. As a matter of fact enterprises tried in this way to reduce the number of external interfaces, and thus manage their network better. For example, MET_E6 said they had quartered the number of their suppliers. MET_D5 mentioned they were guiding also some of their customers to using other firms' services, because they wanted to concentrate on a small number of their key customers.

Production enterprises have many highly skilled professionals and much knowledge oriented towards problem-solving. A networked acquisition system is a close collaborative process, with a main supplier and other suppliers contributing complementary knowledge and skills. They need inter-organizational learning (e.g. Larsson 1998, A.Järvinen and Poikela 2001, Vesalainen and Strömmer 1999) to help them cope with e.g. the complexity of new products. In the interview of MET_A5 we discussed cast aluminium workpieces. The enterprise had learnt from their customers that by using CAD systems it was possible to design pieces and virtual models which were impossible to execute in real life due to certain features of aluminium as a material. Those material features were not known to the main supplier's planners, but the workers in the supplier factory knew them. Feedback of this kind of knowledge is important to the main supplier, and the example describes finely the interactive nature of the networked acquisition process.

However, it is a bit paradoxical that from the viewpoint of acquisition the "Production process systems" of a trusted partner in a network seem to become more independent. For example, MET_A2 has the status of a system contractor. That means the enterprise has more responsibility for developing larger entities independently. The interface of the supplier's product is cooperatively well-defined, but the main supplier is not that much interested in the actual internal implementation of the piece.

Information technology perspective

From the perspective of information technology it is interesting that SMEs (such as MET_A2 and MET_A3) typically have quite modest administrative programs, ERP (Enterprise Resource Planning) systems at best, but usually with no external interface. Physical networks and services such as e-mail and the Internet are in use, but a "real" connection to the main supplier's systems is missing (see also Taipalus and Varamäki 2000). However, the technical barriers, such as the lack of a physical network connection or incompatible software interfaces, did not prevent the existence of "Networked acquisition (or production process) systems", just made forming them more difficult.

Another technology-related example of reciprocal cooperation were machine tool programs, programmed by the main supplier MET_B3 and directly applicable to the machine tool of the supplier. This kind of cooperation requires that the main supplier knows the exact models and versions of the supplier's machinery.

Informative perspective

In addition to the inter-organizational learning mentioned above, networked acquisition systems mean from an informative perspective also standardized data and sharing it between the partners. Alike MET_A2, several of the MET cases emphasized that the heterogeneous practices mean new documenting processes, and also problems are caused by heterogeneous coding in the product data management. One of the problems is the managing of different revisions (MET_A3): "*... we have discussed revision versions for 2 to3 months. The main supplier may have the same code, but still a different piece (different revision). Concurrent ways of identifying the piece are the code number, type code or line number of the design. The same material may have several names. Concurrently internal slang is used and enterprises may have their own, individual names to pieces.*"

6.4.5 Supplementing Networked process systems

"Networked process systems" concerning production in the MET cases emphasize issues similar to "Networked acquisition systems", while the nature of the latter category is more focused on preconditions of the production and the former on operational issues.

Production process priorities in the MET cases were mostly ruled by the customers' needs. The main supplier customer has power over the production process. Operative cooperation between the partners is a very important issue, because the activities are aimed at cost-effectiveness. Advanced, networked process systems expect standardized processes between the partners. Administrational barriers, such as formal orders, are tried to be diminished. These problems do not necessary exist only between partners. Also the internal organization of an enterprise may cause difficulties. Especially the large enterprises are "honeycombed". MET_B3 describes: "*The mentality in the office is different from the one here in production, those [administrative] people do not know the quality requirements*".

The tempo of production is so fast that the time, not only the date, of an order is significant. To an SME supplier it is not that easy to organize the production well and keep it effective. Just as the main supplier MET_B3 said: "*The suppliers are not specialized on express deliveries, but despite of that those are half of their lives.*" An additional express order from a customer causes big modifications to production process. It must be noted that "*...the process may expect a delay of several hours in the form of arrangement and ordering-work for a five-minute production operation*". The respondent of the main supplier MET_B3 comments further: "*We are demanding but also prepared to pay. We must pay for the mistakes of our own*".

Financial perspective

Despite of the comment above, according to MET_A2 it is difficult to get recompense for specialized knowledge, and the suppliers should get more compensation also e.g. for those express deliveries.

From the financial perspective the fluidity of production is the fundamental issue for a supplier enterprise and for the whole network. For the main supplier MET_B3 a guaranteed time of delivery is one of the most important criteria. The quality requirements are tight as well. Both of these issues are affected by data transfer. If it is done manually there are many sources of errors and delays, just as the combined list of those problems mentioned by the respondents of MET_A3 and MET_A4 shows:

- *delays in noticing faxed blueprints*
- *errors and confusions with blurred pictures*
- *material availability checking*
- *ensuring the properties and management of the material*
- *confirmation of the order*
- *transfer from design to production*
- *production planning*
- *production.*

Human perspective

People within the production process systems are an important resource despite the growing rate of automation. As mentioned earlier production enterprises have much knowledge and highly skilled professionals oriented towards problem-solving (alike in the previously told aluminium knowledge case of MET_A5). MET_A2 describes the role of the human resources in production prioritization: "*…[in spite of the computing] you get the best information by just phoning the large customer's [=main supplier] production line and asking the workers what they are planning to do next…*".

The large enterprise MET_D3 has various types of suppliers, some of them most labor-intensive: "*...at the other end there are the smithies, which twist a couple of pieces of metal, and they mostly use just a pencil and a piece of paper. In spite of that they may be a*

very lean manufacturer of those metal pieces. If this kind of enterprises had ERPs or production halls it would make the production too expensive. That means ICT-based systems are not necessary suitable for every place".

Information technology perspective

When I included software components into the information technology perspective I noticed some big problems. A large and problematic field is the lack of software compatibility between networked partners. The most typical examples of incompatibility are the ones supporting cooperative production, such as CAD or ERP programs. For example, MET_A3 had four different CAD programs for managing different interfaces of customer software. As MET_A2 said, the difference between the large and small enterprises is huge: "*Main suppliers have [ERP] software that costs millions of euros, our system cost 10.000 euros*." Large ERPs are also typically closed systems, and if a small supplier has several main suppliers, it must be prepared to manage all the different ERP interfaces their main suppliers have.

However, that is the pitfall shared by all the suppliers. A good example is MET_2 with quite a large supplier MET_B4 and the huge steel works MET_B8 "behind" it. When transparency thorough the value chain/network is an important aim, it means that the closed ERP systems form very serious bottlenecks. Solving these software problems is difficult. MET_A3 had some examples. The respondent of the enterprise stated that there is a substance and communication problem between metal industry entrepreneurs and software developing companies: "*It is just fruitless even to begin to discuss if you yourself are not an ICT professional, better to try to find specialists [to speak of your behalf]. We just speak different languages.*"

According to MET_A3, an additional problem is that all software is designed and aimed at companies producing their own end-products. That means, for example, that properties for material management are totally missing or the input routines of the programs for that are too slow for rapid production operations: "*...cutting an iron bar cost [to us] 0,15 euros, but the [administrational] groundwork and input routines with the software [aimed at cutting] may cost four times that*."

Informative perspective

Also the informative perspective is very important in a networked production process. Product definitions and planning data creation are inseparable parts of networked production. For example, the size of a production series was in the case of MET_B3 from 1 to 3 pieces, and the products of the MET_B3 were really large, expensive items of equipment. Another company (MET_B2) said they were using product configuration software which allows the customer to order 265 million variations of a product, which at first sight seemed to be quite simple. Their average produced series size was 1.7, and the products also had 10 years service of spare parts.

It means that parts, components and products are continuously changing, but concurrently the process has more responsibility of documenting all the products accurately. "Networked process systems" need transparency of the networked enterprises and shared real-time data between the production parties. That includes different production-related data, such as planning information, CAD blueprints, and PDM data (Product Data Management), but also information of end-customers and of the situation of the whole production chain/network. The respondent of the MET_B3 argued: "*The whole chain and the end-customer must be known. Grass-root workers must more than before think of the whole span time of the process, being rapid at some short piece is not sufficient anymore*".

For the same reasons also qualified production forecast information is needed thorough the whole supply chain/network. Qualified forecast information gives more time for reacting and helps right timing when e.g. expensive materials are ordered in stock.

6.4.6 Synthesis after the case of MET_A3

My preliminary analyses of the production process of the case of MET_A2 made me think more carefully also the differences between the categories attached to "Value network systems". To check these issues I bundled the case of MET_A2 with the case of MET_A3. Both of them represent the same kind of small specialized metal production enterprises, but they have complementary features.

I used again the chart of the four perspectives to analyze the features of these ICTS innovation categories. Various combinations of the MET enterprise networks also offered an opportunity to analyze the categories "Networked process systems" and "Networked acquisition systems", and as their counterparts also "Networked sales and marketing systems". The analysis of the MET_A2 and MET_3 cases did not bring in any new categories, but it sharpened the picture. Important characteristics of all of the networked categories were the interactive discussion and trust between partners.

The summary of the constructs after the MET_A3 analyses is presented in Table 6.10. Because no new categories were found, I do not present any figures here.

Table 6.10: *The synthesis of constructs after the MET_A3 analyses.*

System type category	Category description	Enfolding literature (+/-)
Value network systems	…are Networked intercessor systems or Networked core production systems	- Stabell and Fjeldstad (1998): Value shop + Thompson (1967) + Kumar and van Dissel (1996)
ASP network systems	… are systems of third party service firms which deploy, manage and remotely host software applications through centrally-located services in a rental or lease agreement	+ Currie and Seltsikas (2001) + Peterson and Fairchild (2002)
Cooperative production systems	…are networked operative production systems	—
Networked intercessor systems	…are Networked acquisition systems or Networked sales and marketing systems	See Networked acquisition systems or Networked sales and marketing systems literature
Networked core production systems	…are Networked product systems or Networked process systems	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked product systems	…are final outcomes of the enterprise, produced in cooperation with external partners and including kind of ICTS.	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked process systems	…are production processes of the enterprise with cooperative partners involved, which produce the final outcomes.	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990)
Networked acquisition systems	… are systems which in continuous reciprocal cooperation with external partners from the system environment supply/produce necessary raw material, components and other proper facilities required for the production of the final outcomes	+ Johanson and Mattson (1987, 1988), Johannisson (1987), Pfeffer and Salancik (1978), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999), Larsson (1998), A.Järvinen and Poikela (2001)
Networked sales and marketing systems	… are systems which in continuous reciprocal cooperation with external partners produce triggers from the system environment	+ Stabell & Fjeldstad (1998), Johannisson (1987), Pfeffer and Salancik (1978), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999), Larsson (1998), A.Järvinen and Poikela (2001)

In the preliminary analysis of all of the MET cases I found the case of MET_A6 pertinent for presenting a "missing link" which was not mentioned above, "Networked product systems". MET_A6 gives an outstanding example of this issue. I also wanted to study more carefully the significance of the end-customer compared with the main supplier customer. That is what I shall do in the following Section 6.5. For both of these issues I found the case of MET_A6 appropriate.

6.5 Supplementing Networked product systems and the role of the end-customer (the third MET case)

MET_A6 is a small manufacturer of solid waste machines concentrated on landfill compactors, but it aims at being seen more as an expert of solid waste management technology. It offers a variety of waste solutions to landfill customers by pooling together different key technologies. Their product is not an adaptation of an existing machine such as a wheel loader or an asphalt compactor. MET_A6's compactors have always been designed from the ground up with one goal in mind: to be the world's most productive compactor in managing solid waste on a landfill site.

MET_A6 was established in 1971. It has survived and developed through turbulent times from a small workshop in the late sixties to the expanding assembly facilities of today. In 2003, MET_A6's share of the markets was 20 %, where present. The company has experienced a steady annual increase of 30 % in sales volume and profitability over the past three years. The company has kept constantly evolving throughout its existence. The current management purchased and recapitalised the company in 1995. They have invested heavily in the people behind the success as well as in product development. MET_A6 is not located in Southern Ostrobothnia, but it has business co-operation with e.g. ITEP_E2.

Solid waste management faces challenges relating to volume, legislation and logistics. The new EU Landfill Directive places strong restrictions on landfill waste by requiring pre-treatment. This results in the landfill waste changing substantially, becoming more homogeneous and very often more difficult to compact. The cost lifecycle of a landfill is most important. No longer will a landfill owner or operator be able to invest in a compactor for the sake of compaction only. All sites will have to justify their operations on an acceptable level of cost of waste treatment per ton. Most do this already. Minimising the cost of treatment per ton maximises the profits. Profitability in terms of treatment productivity, minimised machinery down-time and better turn-around timing of waste transport is the key – MET_A6 wants to demonstrate its open willingness to be a part of that environment together with its customers.

MET_A6 has customers in 27 countries around the world through a network of independent distributors. The Sales Department exists through independent partners on 5 continents. The partners are reputable professionals dealing in capital equipment in their respective regions, and they all have a factory-trained, expert approach to supporting the products.

6.5.1 Preliminary analysis of the case of MET_A6

The case of MET_A6 is suitable for supplementing the knowledge of the categories "Networked product systems" and "Networked sales and marketing systems", which emphasizes the end-customer. Both of these categories are represented in the analysis of the case, and in addition MET_A6 in the interview described an extraordinary model of networked product with multifaceted features.

There were also some other types of systems mentioned (see Table 6.11), which I do not analyze here; a couple of "Internal supporting systems" and a value chain oriented "Sales and marketing system" (quite a simple implementation of the enterprise' www pages with one way communication).

The product of MET_A6 has layered sources of additional value. According to the enterprise's way of thinking, information and knowledge are the route to getting close to the end-customer.

The end-customer relationship of MET_A6 is based on personal contacts, and they are aimed at a consultative marketing strategy. The skilful management of information and knowledge type of resources means they are able to develop the work of the end-customer and thus increase trust between the partners. MET_A6 also has a kind of an end-customer community, and idea they have bounced in Norway.

Table 6.11: *Information systems of MET_A6.*

MET_A6	**Organizational entity (SME)**	**Organizational structure (Networks)**
Financial perspective		**Product system:** *How?* - *confidence in maintenance is a selling point, and the role of selling and maintaining spare parts increases* - *role of after sales services increases, after sales activities will be kept as standard as possible* - *role of subcontracting increases* - *value chain of the business is changing* - *layered product model*
Sociological and psychological perspective	**Internal (supporting) system:** Internal education	**(Networked) Sales and marketing system:** *How?* - *selling to end-customers is based on (personal) customer relationships -> consultative marketing strategy* - *information and knowledge = developing the work of the end - customer* - *end-customer community, the idea is being bounced in Norway* - *involving the dealers is important*
Information technology perspective	**Internal (supporting) systems:** - Word, Excel - ERP system *How?* - *for the present internal implementation*	**(Value chain) Sales and marketing system:** Web pages *How?* - *currently quite a simple implementation* - *has been a long term project to push through the idea of www pages as a information sharing platform* **Product system:** *How:* - *Products include several intelligent components* - *CRM*
Informative perspective	**Product system:** *How:* - *Some problems in documentation* - *Purchasing mass information has been charted*	**Product system:** *How:* - *The product has layered sources of additional value* - *Information and knowledge are a way of getting close to the end-customer* - *Life cycle of using the product*

6.5.2 Supplementing Networked product systems

MET_A6 gives an excellent example of a "networked product", which is presented in a nutshell in Figure 6.6. In the core there is the physical product, in the case of MET_A6 a heavy vehicle, a landfill compactor. It is important to take a closer look at this example of a networked product, because it shows what a multifaceted innovation system that type of product can be.

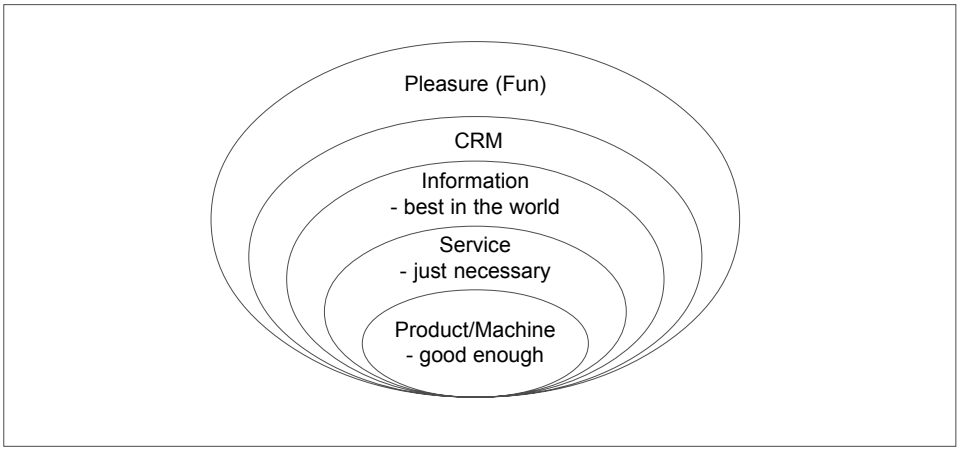

Figure 6.6: *The product with layered sources of additional value, according to the respondent of MET_A6.*

The layers of the "Networked product system"

The physical vehicle must be good enough to satisfy the end-customer's needs, but that is not enough. According also to most of the other MET cases, the role of the after sales services increases continuously, and so it does also in the case of MET_A6. In this particular case the service is aimed to be kept as standard as possible, because of the relatively small number of delivered vehicles and the lack of MET_A6's own resources.

More commonly, various kinds of after sales services are a fundamental part of the networked product. Vice versa, also customers' demands concerning the product's or component's later traceability (e.g. MET_D6) may need new kinds of information systems and networked relationship with the end-customer.

In the case of MET_A6 the "Information" layer is more emphasized than the services. According to the respondent, that means investment in knowledge which is aimed at developing the work of the end-customer. MET_A6 aims at reaching a high knowledge level to become a trusted partner of the end-customer, so that the end-customer would receive valuable advice from MET_A6 in developing its own production processes.

One big challenge recognized by MET_A6 is how to involve the dealers. According to MET_A6 traditional dealers are not professionally skilled consultants but rather product experts. It means that the discussion with the end-customer is usually based on the quality

of the product, not on the end- customer's true needs. If a close relationship with the end-customer can be reached, the trust makes it possible to start customer relationship management (CRM) activities, such as knowledge sharing. According to the MET_A6 respondent a successful, knowledge based end-customer relationship generates pleasure and positive experiences to all the parties: to the end-customer, the deliverers and also MET_A6's own personnel.

Two models describing the development of end-customer cooperation This cooperation at its "highest level" can be seen as kind of community (Cross and Smith 1995). In the case of MET_A6 there was the idea of an end-customer community, which they bounced in Norway. The same kind of systems were implemented in an even more advanced way by the large enterprise MET_B6. Another important viewpoint, which is not clearly presented in the previous model (Figure 6.6), is the time dimension and managing of a customership's life-cycle. That issue was emphasized e.g. by the representative of MET_B2. In that sense there is a number of steps on the road to systems which take full advantage of a customership by utilizing product systems focused on knowledge management (see e.g. Cross and Smith 1995):

1. Awareness, with "classic" home pages, has huge challenges because of the large number of pages on the Internet. The customer has no experience of the enterprise.

2. Recognition, when the customer has noticed the enterprise or its products. The customer may try out samples and is having his/her first experiences of the enterprise. This is the step of getting new customers.

3. Relationship, when there is constant commerce between the parties. That requires continuous relationship update and management.

4. Community, when there exists active collaboration. The Customer trusts the enterprise and there may also be a kind of "reliance".

5. Advocate, when there is a true, deep partnership. The customer acts in the community as a spokesman for the enterprise. That kind of relationship is typically possible only after several years of collaboration.

Another model figuring development phases oriented to this issue is the model of "Four evolutionary phases of e-business". It was one of the key results of the study of Riihimaa and Ruohonen (2002)[33], based also on the MET cases. Especially the two last phases of the model are tightly attached to "Networked product systems" described by MET_A6. This four-phase model aims at describing the actions taken for developing e-business innovations, emphasising different types of information system innovations in each of the phases. These four phases seemed also to be the order of organizational development. The phases are:

33 See also Ruohonen, Riihimaa and Mäkipää (2002).

- ERP phase, e.g. putting the foundation of an enterprise's internal information systems in order,

- SCM phase, e.g. boosting the information system innovations of supply chain management,

- CRM phase, e.g. deepening and improving the (end-)customer relations and knowledge,

- KM phase, e.g. taking advantage of business intelligence system innovations which handle either customer, supplier or business relationship based knowledge in knowledge networks (see also Ruggles 1998, Ruohonen and Salmela 1999).

It must be noted that only a few of the enterprises had advanced in their e-business initiatives into that level, but there were some, among them MET_A6 and MET_B6. They focused on deepening their relationships with superior management of supplier, customer and business partner based knowledge.

Financial perspective

From the financial perspective a networked product may bring new ways of showing a profit, and thus also challenges to form new kinds of ICT system innovations to trace the value creation. In addition to the changes in the total form of value on the service, information, customer relationship and pleasure layers described in Figure 6.6, at least three other, new kinds of models were proposed during the MET interviews.

In various cases (e.g. MET_D1) the final price of the product (produced for the production process of the end-customer) was dependent on the financial outcome of the end-customer, so the business model was a kind of provision.

In some other cases (e.g. MET_C5 and MET_D2) we discussed business models in which the product (typically some large equipment or system for the production process of the end-customer) is owned by the producer. In the first variation of the model the end-customer buys only the operational volume of the system. In another variation the end-customer gets the production system in use for free but is committed to buying all the after sales services from the producer. I argue that all these kinds of profit share models are very much based on trust and constant interactive relationship between the business partners.

Human perspective

From the human perspective networked products also create new challenges. Just as the respondent of MET_A6 described, emphasizing the information layer means investment on knowledge which is aimed at developing the work of the end-customer. That means continuous acting as a consultant to the end-customer and also continuous internal and inter-organizational learning processes to keep the knowledge of the staff on a high level.

MET_E6 said the same thing in the following way: "*Most of the products are customized, made to meet the customer's requirements, and there is an obvious need for some kind of configuration. The offered portfolio and the offering of a new product based on an analysis of the customer's needs are kept as separate as possible. The functional processes of the customer are looked at as an entity, even if the supply is just to a part of the value chain. It is also helpful if you know the history. When you understand his process better than the customer himself, you can sell him well-informed consulting that adds to the value.*"

Information technology perspective

Physical networks are an essential supporting component in a networked product. They are typically used as a communication tool and as a way of enabling the diagnosis of the delivered products. Wireless networks were already used for diagnostic purposes in some of the cases (e.g. MET_C4), and that trend seems to be strengthening. From the perspective of information technology also all the various pieces of software are an important part of a networked product systems, for example, the applications supporting the after sales services or some activities of managing the customer relationship.

Further, from the perspective of information technology one particular form of the products enabling also networking properties are so called embedded systems or the ones under the label of mechatronics (see e.g. Auslander 1996). They have intelligent ICT components, such as microprocessors, just applied e.g. to collect historical or logistical information of the use of the product, to make self-diagnostics and to sound an alarm if malfunctions occur. Also active and intelligent materials, such as shape memory alloys (Ullakko et al. 2002), can be used.

Informative perspective

The fundamental role of the informative perspective is obvious. Already Porter and Millar (1985) noted that all products include a component of information. However, in a networked product that component is multifaceted. It may be represented e.g. by various communicative features of the physical product, by interactive long-lasting after sales services, by knowledge of the end-customer's business processes and consultation activities based on them, by interactive activities of customer relationship management based on CRM data, by shared experiences between the producer and the end-customer, etc.

The challenges of information technology and informative perspectives are intertwined in a most interesting way in some of the cases (e.g. MET_C3 and MET_E4). An example of MET_C3: "*The life-cycle of our products is long… …in the product data management we currently use miscellaneous, different data formats, such as MS_Word, MS_Excel, CAD formats, cross-ruled paper, etc. As paper documents and CD-ROMs we have documentation covering the past 20 years… …we have old software in use, for example, Eurosys software from the 1980's… …10 years is the definite time for storing the documentation, but we will serve [the customer] for a longer time than that…*".

Anyway, I could not figure out whether some other features mentioned in the interviews should be seen characteristic to a networked product. Those were e.g. a small size of a production series, and in that sense the role of the OEM-produced products[34].

6.5.3 Networked sales and marketing systems (end-customer oriented)

In the light of the MET cases it seemed that the nature of a relationship to the end-customer differs from the nature of that to the main supplier customer. That is why I wanted to analyze the issue separately. Both types of customers are felt important by the producing enterprise, but communication with the end-customer is on the one hand focused on "pre-sales" activities, such as product definition and the product planning phase, and on the other on after sales activities.

Reflecting the pre-sales activities by the mass customization model

One of the specified frameworks we used in the MET interviews was the mass customization model by Gilmore and Pine (1997) reflecting exactly the pre-sales activities. The idea of mass customization is to combine efficient mass production with effective customization of products and services according to end-customers' individual needs. Gilmore and Pine have made a classification of mass customization strategies, which captures the most fundamental dimensions of customization alternatives: product and representation. This classification was evaluated to be a useful framework for the interviews. Gilmore and Pine identify four customization strategies described in Figure 6.7: collaborative, adaptive, cosmetic and transparent. Note that the original framework has been modified by changing the product and the representation categories into dimensions. In empirical settings the scales should rather slide flexibly from one extreme to the other, than just offer two options: change or no change.

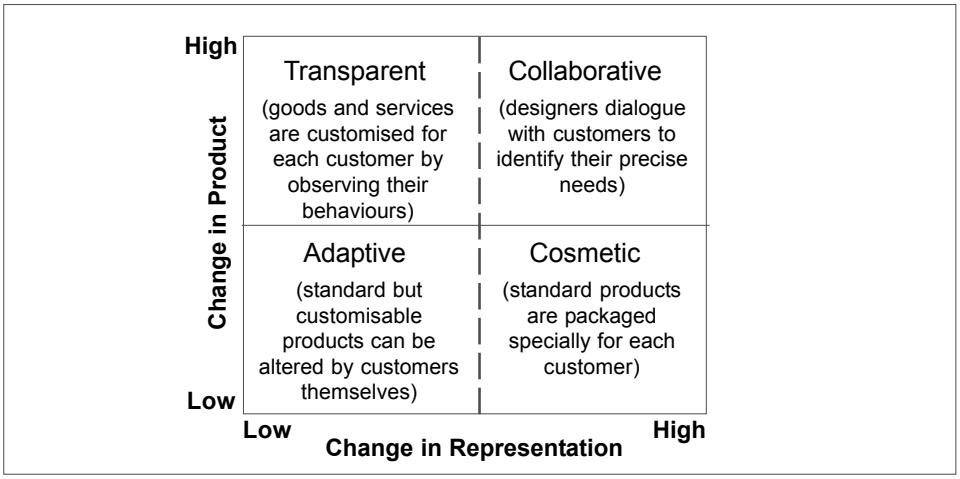

Figure 6.7: *Mass customization alternatives (modified from Gilmore and Pine, 1997).*

34 This term has at least two meanings: Originally, an OEM (original equipment manufacturer) was a company that supplied equipment to other companies to resell or incorporate into another product using the reseller's brand name. More recently, OEM is used to refer to the company that acquires a product or component and reuses or incorporates it into a new product with its own brand name. Also a similar term VAR (value-added reseller) is applied to the repackaging of software. See http://whatis.techtarget.com/definition/0,,sid9_gci214136,00.html (accessed at 23.2.2004).

Mass customization in MET enterprises

The mass customization framework is a proper lens also for looking at the end-customer-oriented issues of "Networked sales and marketing systems". In the MET enterprises mass customization is mostly practiced in a collaborative and adaptive way (for more specific details, see Riihimaa and Ruohonen 2002, Ruohonen, Riihimaa and Mäkipää 2002, Ruohonen, Riihimaa and Mäkipää 2003). A transparent way to mass customize is the most appropriate choice for producing after sales services. However, an explicit mass customization strategy is unique to the company developing and implementing it (Hart 1995). To retain customer loyalty companies should serve every customer as an individual by offering customized products and services at a reasonable price (Pine 1993). Mass customization, as "an ability to use of flexible processes and organizational structures to produce varied and often individually customized products and services at the price of standardized, mass-produced alternatives" (Hart 1996), is one of the solutions in this inconsistent situation.

As noted, a typical way for the MET enterprises to customize products is collaborative mass customization. It is the most challenging, difficult and also expensive way, which is based on using customer interaction in specifying product or service features. However, this collaborative model is needed when it is difficult for the customer to express product preferences or when the product comes with complicated specifications, which as a whole form the end-product. Normally even the seller cannot know what the customer eventually wants. Collaborative customization is used by many of the MET enterprises, because their operations have started from a very customer-oriented perspective, producing customers' defined products and leaving production series short.

Collaborative customization also characterizes finely the nature of "Networked sales and marketing systems". Networked sales and marketing activities are interactive cooperation between the enterprise and the (end-)customer, aimed at individual problem-solving.

In the following I consider briefly mass customization through the four resource perspectives.

Financial perspective

From the financial perspective this kind of activities are expensive. In addition, they cannot be carried on forever, at least not for the same customer and the same products. This is because in almost all industries products which were originally customized become eventually more standard and available as mass products with a lower cost. These standard products can replace the previously customized products.

Human perspective

Especially in collaborative and adaptive mass customization the same issues of human perspective are in focus as were discussed in the pursuance of "Networked acquisition

systems": enterprises must have knowledge and highly skilled professionals oriented towards problem-solving, and the help of inter-organizational learning is needed for coping with the complexity of new products. Now the main supplier and the end-customer are contributing complementary knowledge and skills.

In the case of MET_C1 the respondent strikingly described the traditional selling procedure, the nature of which sounds like the opposite to the networked selling process: "*A salesman is selling fantasy…*".

Information technology perspective

From the perspective of information technology it is important to note that different ways of mass customization need different kinds of technologies and different pieces of software. Collaborative customization (and thus "Networked sales and marketing systems") emphasize pre-sales oriented software supporting inter-organizational problem solving, tools such as CAD aimed at product definition, and project management software. Physical networks may be helpful, but again not obligatory elements. In addition some of the enterprises have selling processes lasting at their worst from one up to three years (e.g. MET_C5, MET_C6), and in processes that slow network connections are not of much need.

Informative perspective

In addition to the knowledge of the employees and the need of inter-organizational learning, from the informative perspective the customer relationship data is also on in focus. A "living" relationship between the enterprise and the customer expects knowledge about the needs and the business of the customer. Based on the MET cases, there are certain processes to which the knowledge aspect can be attached, for example, (Riihimaa and Ruohonen 2002):

- Cross-sales and up-sales (using customer knowledge for increased sales, managing lifecycles, having call & contact centers),
- Direct marketing and supplement (managing customer responses, qualifying leads, informing supplement process),
- Customer service, support and invoicing (service request & account management, customer surveys, service agreements, electronic invoices),
- Loyalty and retention programs (customer profiles, knowledge of behavior), and
- Field sales and service (unique service concerning customers' proposals and promises, configuration and localization).

The previous issues were crystallized by the respondent of MET_D4: "*The aim is to emphasize the business processes, so the processes will not sink under the tools. When processes must be diversified for different tools [e.g. for different ICT systems], there is a*

danger that the process is lost in the numerousness of the tools. Knowledge management is something attached to the [business] process. Information can be stored in various places. Knowledge management produces information, which is analyzed, attached to the process and refined. Pure ERP and stand-alone tools alone are insufficient for these purposes".

The result of analysis of "Networked sales and marketing systems"

As the result of the analysis I drafted the refined form of "Networked sales and marketing systems" in the way illustrated in Figure 6.8. I also added Gilmore and Pine (1997) to the enfolding literature concerning "Networked sales and marketing systems" and "Pre-sales systems", as well as some additional literature concerning "Networked product systems" (see Table 6.12). Anyhow, at the end I decided not to include the refined categorization into the emergent theory, and decided to stay on in a little more abstract level to keep the structure clear, more general and parsimonious. However, I wanted to present that draft here as an example of detailed aspects, which might influence and make it possible to increase the sharpness of the categories of the emergent theory.

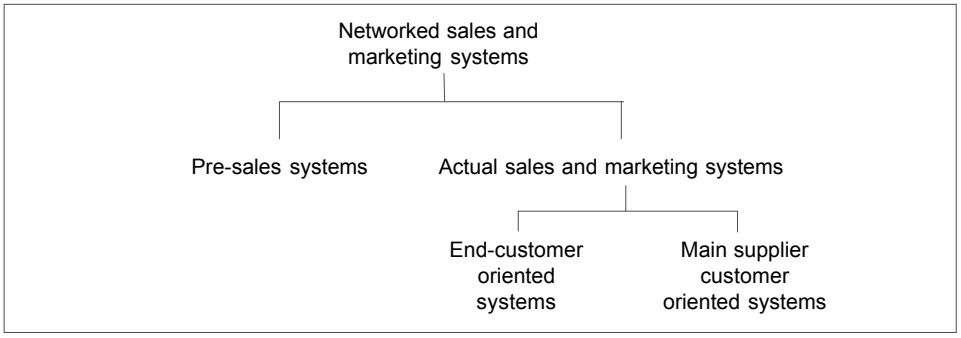

Figure 6.8: *Refined structure of "Networked sales and marketing systems" (draft).*

Table 6.12: *Additional enfolding literature after the MET_A6 analyses.*

System type category	Category description	Enfolding literature (+/-)
Networked product systems	…are final outcomes of the enterprise, produced in cooperation with external partners and including kind of ICTS.	+ Prahalad and Hamel (1990), Cohen and Levinthal (1990), Cross and Smith (1995), Riihimaa and Ruohonen (2002)
Networked sales and marketing systems	… are systems which in continuous reciprocal cooperation with external partners produce triggers from the system environment.	+ Stabell & Fjeldstad (1998), Johannisson (1987), Pfeffer and Salancik (1978), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999), Larsson (1998), A.Järvinen and Poikela (2001), Gilmore and Pine (1997)
Pre-sales systems	… are systems involved in cooperative definition of product requirements.	+ Gilmore and Pine (1997)

6.5.4 Synthesis after the case of MET_A6

The case of MET_A6 was a suitable example for analyzing the categories "Networked product systems" and "Networked sales and marketing systems" more carefully. In the interview the respondent of MET_A6 described an extraordinary model of a networked product with multifaceted features, which in addition to a particular product include also four other layers: service, information, customer relationship and pleasure.

From the financial perspective the networked product may bring new ways of showing a profit, and thus even new business models. Emphasizing the information layer means investing on knowledge which is aimed at developing the work of the end-customer. Physical networks are an essential supporting component of a networked product. They are typically used as tools of communication and ways of diagnosing the delivered products.

In a networked product the information component is multifaceted. It may be represented e.g. by various communicative features of the physical product, by interactive long-lasting after sales services, by knowledge of the end-customer's business processes and consultation activities based on them, by interactive activities of managing the customer relationship based on CRM data, or by shared experiences between the producer and the end-customer.

In the light of the MET cases it seems that the nature of an end-customer relationship differs from the nature of a relationship to the main supplier customer. All types of customers are felt important by the producing enterprise, but communication with the end-customer is on the one hand more focused on "pre-sales" activities and on the other on after sales activities.

I used the idea of mass customization as a lens for analyzing the end-customer-oriented "Networked sales and marketing systems". In the MET enterprises mass customization is mostly practiced in an adaptive and collaborative way.

From the financial perspective this kind of activities are expensive. Inter-organizational learning is needed to help to cope with the complexity of new products. Thus enterprises must have knowledge and highly skilled professionals oriented towards problem-solving. It is also important to note that different ways of mass customization need different kinds of technologies and pieces of software. Physical networks may be helpful but not obligatory elements of "Networked sales and marketing systems".

In addition to the knowledge of the employees, from the perspective of information also the customer relationship data is in focus. A "living" relationship between the enterprise and the customer requires knowledge about the needs and the business of the customer.

6.6 Summary of the empirical part of this study

In this chapter the second empirical part of this study was presented, the MET case set with 40 interviewed production enterprises.

In the first Section 6.1 I presented the process of data-gathering and preliminary analysis, and in the following section the three most representative MET cases on a general level was described. In Section 6.3 the view of "Experimental systems" was supplemented by including some new categories, and in Section 6.4 yet another new category, "ASP network systems", was presented.

In Sections 6.4 and 6.5 I supplemented the view of "Value network systems", or more precisely "Cooperative production systems".

At the end of the chapter I shall present the synthesis of the emergent theory (see Figure 6.9 and Table 6.13). It must be noted that Table 6.13 includes also the additional categories "Pre-sales systems" and "After sales systems", which was presented in subsection 5.3.3, but which I decided to draw back at the end of Chapter 5 (see subsection 5.5.3). Later I supplemented "Pre-sales systems" concerning the enfolding literature, but it was still left as a draft in subsection 6.5.3.

I also sharpened here some of the names of the categories describing the internal systems (originally defined in subsection 5.3.2). "Internal systems" was renamed to be "Internal competitive systems", and "Production systems" to be "Internal core production systems", respectively.

The main result of this study (see Figure 6.9 with Table 6.13) will be discussed and evaluated more in both of the following Chapters 7 and 8. In the next Chapter 7 I shall test the emergent theory against both the ITEP and the MET case sets, and also against the theory of Stabell and Fjeldstad (1998).

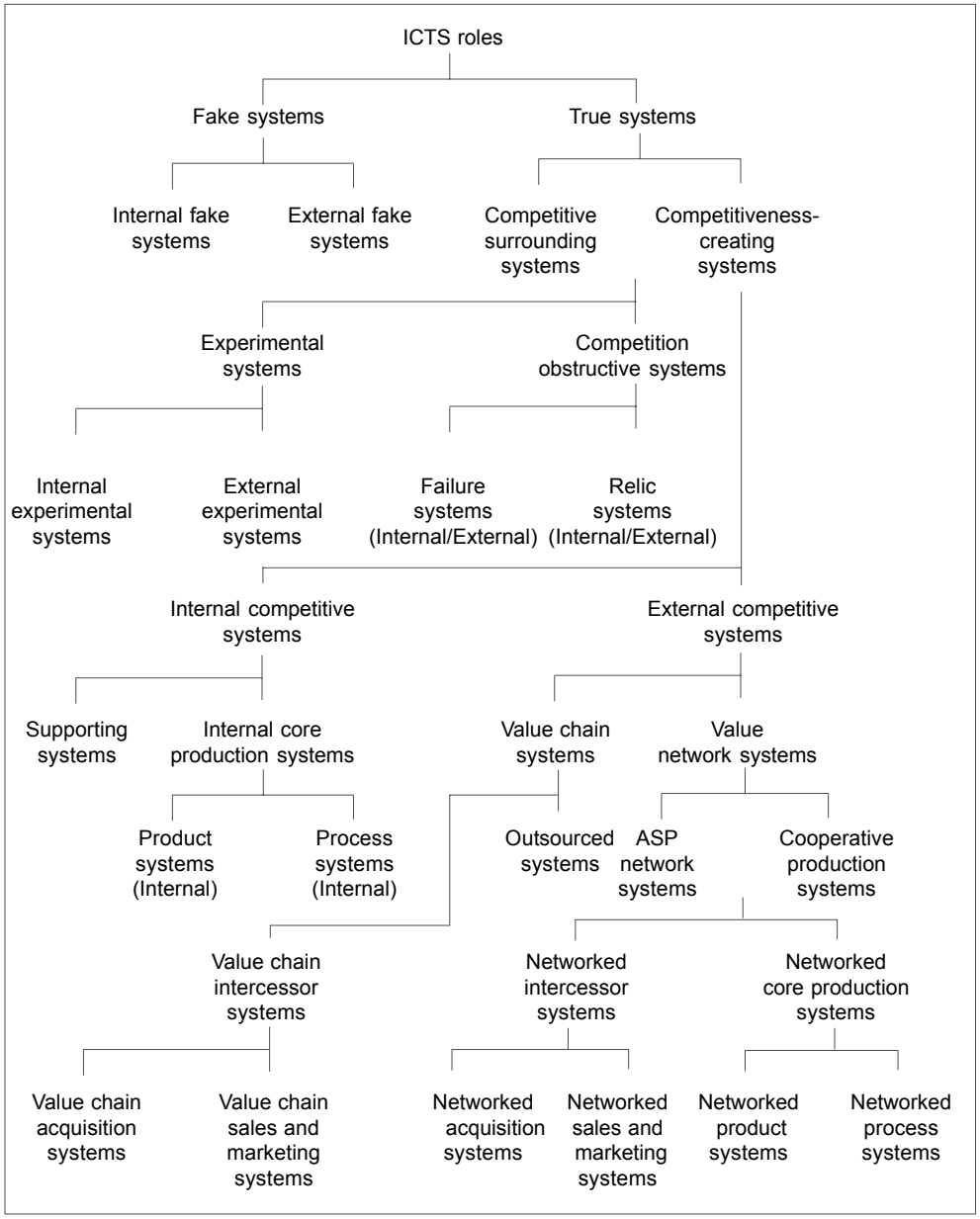

Figure 6.9: *Final emerging theory after all analysis.*

Table 6.13: *The summary of constructs (including also the additional categories of "Pre-sales systems" and "After sales systems").*

System type category	Category description	Enfolding literature (+/-)
ICTS roles	The aim of the ICTS innovations adoption is the financial success and competitiveness of an enterprise, achieving sustainable competitive advantage, or achieving experience of some phenomenon new to the enterprise, or creating a manipulated image for opportunistic reasons.	A priori assumption & case based observations.
Fake systems (Internal / External)	…are systems creating a manipulated image for opportunistic reasons	+ Williamsson (1985): TCT opportunism, costs of cheating - Larson (1992), Uzzi (1979): criticism against TCT opportunism
True systems (Internal / External)	…are systems aimed successfully or unsuccessfully at learning or competitiveness-creating	—
Competitiveness creating systems	…are systems the aim of which is the financial success and competitiveness of an enterprise, achieving sustainable competitive advantage	A priori assumption, e.g. + Barney (1991, 1997), Rockart & Scott Morton (1993), Malone, Yates & Benjamin (1987), Stabell & Fjeldstad (1998), Porter & Millar (1985)
Competitive surrounding systems	…are Experimental or Competitive obstructing systems	—
Experimental systems (Internal / External)	…are systems aimed at having experience of some (new) phenomenon (internal & external with partners)	+ Rogers (1995):innovator,early adopter - Järvinen (1985): R&D
Competition obstructive systems	…are systems which obstruct competitiveness-creating	+ Coombs and Hull (1998), Håkansson and Lundgren (1997), Davis (1988)
Failure systems (Internal / External)	… are systems which are created based on wrong decisions (internal & external in cooperation with partners)	+ Håkansson and Lundgren (1997), Davis (1988): small historical events
Relic systems (Internal / External)	…are historical systems which should be learned away from (internal & external in cooperation with partners)	+ Håkansson and Lundgren (1997), Davis (1988): path-dependent transitions
Internal competitive systems	…are systems having no external links (an SME as an entity).	+ Kerola and Järvinen (1975)
Supporting systems	…are bundled supporting functions, which are included in each information system.	+ Kerola and Järvinen (1975)
Internal core production systems	…are systems which produce the final outcome of an enterprise.	+ Kerola and Järvinen (1975) + Swanson (1994)

Product systems (Internal)	…are final outcomes of an enterprise, including a kind of ICTS.	+ Swanson (1994): IIIb
Process systems (Internal)	…are production processes of an enterprise, which produce the final outcomes.	+ Swanson (1994): IIIa
External competitive systems	…are systems with external interface (an SME in a network).	+ Pfeffer and Salancik (1978) and other mentioned networking theories
Value chain systems	…are value chain intercessor or outsourced systems	+ Thompson (1967), Porter & Millar (1985), Kumar & van Dissel (1996), Stabell & Fjeldstad (1998)
Value chain intercessor systems	…are value chain acquisition or value chain sales and marketing systems	+ Porter and Millar (1985), Swanson (1994): IIIc
Outsourced systems	…are internal systems delegated to external partner to take care of	+ Thompson (1967), Kumar & van Dissel (1996), Porter (1985)
Value chain acquisition systems	… are systems which from the system environment supply/produce necessary raw material, components and other proper facilities required for the production of the final outcomes	+ Porter (1985), Porter & Millar (1985), Kerola and Järvinen (1975), Swanson (1994): IIIc
Value chain sales and marketing systems	… are systems which produce triggers from the system environment	+ Porter (1985), Porter & Millar (1985), Kerola and Järvinen (1975), Swanson (1994): IIIc
Value network systems	…are networked intercessor systems or networked core production systems	- Stabell and Fjeldstad (1998): Value shop + Thompson (1967) + Kumar and van Dissel (1996)
ASP network systems	… are systems of third party service firms which deploy, manage and remotely host software applications through centrally-located services in a rental or lease agreement	+ Currie and Seltsikas (2001) + Peterson and Fairchild (2002)
Cooperative production systems	…are networked operative production systems	—
Networked intercessor systems	…are networked acquisition systems or networked sales and marketing systems	See Networked acquisition systems or Networked sales and marketing systems literature
Networked sales and marketing systems	… are systems which in continuous reciprocal cooperation with external partners produce triggers from the system environment	+ Stabell & Fjeldstad (1998), Johannisson (1987), Pfeffer and Salancik (1978), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999), Larsson (1998), A.Järvinen and Poikela 2001, Gilmore and Pine (1997)

Networked acquisition systems	… are systems which in continuous reciprocal cooperation with external partners from the system environment supply/produce necessary raw material, components and other proper facilities required for the production of the final outcomes	+ Johanson and Mattson (1987), 1988), Johannisson (1987), Pfeffer and Salancik (1978), Nahapiet and Ghoshal (1998), Venkatraman and Henderson (1998), Vesalainen and Strömmer (1999), Larsson (1998), A.Järvinen and Poikela (2001)
Networked core production systems	…are networked product systems or networked process systems	+ Prahalad and Hamel (1990)
Networked product systems	…are final outcomes of an enterprise, produced in cooperation with external partners and including a kind of ICTS.	+ Prahalad and Hamel (1990), Cohen and Levinthal 1990, Cross and Smith (1995), Riihimaa and Ruohonen (2002)
Networked process systems	…are production processes of an enterprise involving cooperative partners, which produce the final outcomes.	+ Prahalad and Hamel (1990), Cohen and Levinthal 1990
Pre-sales systems	… are systems involved in cooperative definition of product requirements	+ Gilmore and Pine (1997)
After sales systems	… are systems involved in producing after sales services.	+ Porter (1985), Porter and Millar (1985)

7. Testing the emergent theory

In this chapter I shall present two verification tests performed with the emergent theory. In the first test I shall compare once again all the cases against all of the categories of the emergent theory (see Section 7.1). The results are presented in a table format and some observations are also commented briefly. In the second test the emergent theory is compared against Stabell and Fjeldstad's (1998) tripartite classification model (Section 7.2)

7.1 Testing the emergent theory against the ITEP and MET data

To enrich the emerging theory I iteratively compared the cases and the theory during the theory- building process. At the end of the process I wanted to testify and verify the usability of the emergent theory.

I went through all the MET cases and built another working-space to compare all of them with all of the categories of the emergent theory to see if all the ICTSs I recognize fit in the categories as they should. That is a technique not particularly belonging to the eight phases of Eisenhardt's (1989) model but to the Grounded theory (Glaser and Staruss 1967). It must be noted that the character of this type of verification test is more of a case-survey (see e.g. Cunningham 1997, also mentioned in Table 4.1/Section 4.6) than of a multiple case study.

That exceptional verification process offered me also another possibility to check whether more new categories would be needed to supplement the emergent theory. The result of the test is presented in a simplified table format in Table 7.1 and Table 7.2. The identified ICTS innovations are marked with "X". There were also some systems which were not directly mentioned in the interviews, or which were mentioned as a part of the past history of the enterprise under other owners. Those systems are marked in parenthesis "(X)".

Table 7.1: *Information systems of the ITEP enterprises.*

Case	Networked process	Internal process	Networked product	Internal product	Networked sales&mark.	Value chain sales&mark.	Networked acquisition	Value chain acquisition	Internal relic	External relic	Internal experiment	External experiment	Internal Failure	External Failure	Internal fake	External fake	Outsourced	ASP
ITEP_A1	X	X	X	X	X	X					X	X						
ITEP_A2	X		X		X													
ITEP_A3	X	X	X	X		X					X	X						
ITEP_B1		X		X		X		X	X		X	X						
ITEP_B2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ITEP_C1	X			X	X	X	X	X										
ITEP_C2	X			X	X	X	X					X					X	
ITEP_C3		X	X	X		X					X	X						
ITEP_D1		X	X	X		X		X					(X)					
ITEP_D2		X	X	X		X		X										
ITEP_D3	X		X	X		X	X	X			X	X						
ITEP_E1		X	X	X		X		X			X							
ITEP_E2		X	X		X	X						X						
ITEP_E3	X		X		X													
ITEP_F1	X	X	X	X		X		X			X	X	(X)			(X)	X	
ITEP_F2	X	X	X	X		X												
ITEP_G1		X		X		X		X			X	X						

Table 7.2: *Information systems of the MET enterprises.*

Case	Networked process	Internal process	Networked product	Internal product	Networked sales&mark.	Valuechain sales&mark.	Networked acquisition	Valuechain acquisition	Internal relic	External relic	Internal experiment	External experiment	Internal Failure	External Failure	Internal fake	External fake	Outsourced	ASP
MET_A1	X		X		X	X	X											
MET_A2	X			X	X		X			X								
MET_A3	X			X				X		X				X				X
MET_A4	X			X	X	X		X		X								
MET_A5		X		X	X	X		X										
MET_A6		X	X		X		X											
MET_A7		X	X	X	X			X										
MET_B1	X			X		X	X									X		
MET_B2	X		X		X		X	X				X						
MET_B3	X		X		X	X	X											
MET_B4		X		X		X		X	X	X		X				X		
MET_B5		X	X			X		X	X		X							
MET_B6	X		X		X		X			X		X						
MET_B7	X			X	X			X										
MET_B8		X		X	X	X		X		X	X	X					X	X
MET_C1		X		X		X		X		X		X						
MET_C2		X	X	X	X	X		X	X								X	
MET_C3		X	X		X			X										
MET_C4	X		X		X	X												
MET_C5	X		X		X	X	X					X						
MET_C6		X		X	X			X								X		
MET_D1	X		X		X		X			X	X							
MET_D2		X	X		X			X			X		X				X	
MET_D3		X		X	X			X			X		X					X
MET_D4	X		X		X	X	X		X		X							
MET_D5	X			X	X	X	X		X								X	
MET_D6		X	X	X	X			X										
MET_D7		X	X		X	X		X		X		X						
MET_E1	X	X		X	X	X	X	X										
MET_E2		X	X		X			X	X		X						X	
MET_E3	X	X		X	X	X		X	X	X								X
MET_E4		X	X		X	X		X										
MET_E5	X		X		X		X											
MET_E6	X		X		X		X					X						
MET_E7		X		X		X		X	X									
MET_E8		X		X		X		X	X								X	
MET_E9	X			X	X		X	X										
MET_E10		X		X	X			X		X	X	X						
MET_E11	X			X	X		X									X	X	
MET_E12		X		X		X		X		X	X							

The test established to me that I was not able to recognize any new types of systems among the case sets, and so there was no particular need for new, additional categories. However, the summary presented in the tables elicits some additional information of interest and also shows some ways of how it is possible to utilize the emergent theory.

I shall describe some of those observations as examples:

a) The categories describing either internal or external systems of an enterprise are not exclusionary. The same enterprise may have both chained and networked systems, depending on e.g. customer priorities, the nature of products, supplier partners etc. Thus the systems may be seen as "building blocks" for the enterprise.

b) In the MET case set, when focusing to acquisition activities, value chain types of systems seem to be dominant, but a shift to networked systems is significant.

c) Quite surprisingly to me, "Networked sales and marketing systems" were the most common networked systems (in the MET case set many of the respondents argued they believe acquisition/procurement activities may offer the largest advantages in the fields of networking and e-business). I believe this kind of result is due to the most customer-oriented enterprise group we interviewed.

d) The role of internal "Product Systems" is quite strong among the MET enterprises. That indicates the need of developing more services attached to products, increasing the intelligence of the products and developing new models of sharing value within the enterprise networks.

e) Outsourced and especially ASPed systems seemed still to be quite uncommon in both of the case sets.

f) There was a kind of contradiction within the ITEP case set. On the one hand "Networked process systems" were quite common, but on the other sales and marketing systems were of the value chain type. Maybe that says there is something to be done in customer relationships to develop them more reciprocal, and also certain new hidden potential to be achieved in products (cf. Melville et al. 2004, the share of the net value of deploying a system depends on the firm's power degree in relation to its trading partners.).

g) Both "Relic/Failure systems" and "Experimental systems" seemed to be more common among the large enterprises. However, according to the case data, SMEs seemed to be more active in suggesting new experiments. Large enterprises have internal organizational sluggishness and large ICT systems difficult to change rapidly.

h) Not many of the "Fake systems" were mentioned. The emphasis of those referred to was on the Internet hype or other common issues, such as "marketing gimmicks". The lack of that kind of references among the cases is natural but does not mean they do not exist in the real life. However, they are probably more likely to be found among enterprises involved in some business that is "in fashion" than among small metal enterprises.

i) Besides the production industries I found it possible to utilize the emergent theory successfully also to other branches of industry in the ITEP case set. However, more tests

should be done, because some industrial branches was represented by only one or a couple of enterprises (see ITEP enterprise descriptions in Tables 5.1 and 5.2, cf. Melville et al. 2004, "The macro environment moderates the degree to which firms can apply IT for organizational improvement.").

j) I found it possible to utilize the emergent theory successfully as well to SMEs as to large enterprises, and also enterprises in different geographical locations.

The verification examples show some of the ways of how it is possible utilize the emerging theory both in research and in practice. As stated, those above mentioned notes were only examples, and more research should be done in the future. That issue I shall discuss later, in the following Chapter 8, Section 8.4.

7.2 Stabell and Fjeldstad's model against the emergent theory

After supplementing the emergent theory there was still the question that emerged in an earlier phase of this study, the question whether there should be more types of categories describing the operational, production-related systems than the current "Value chain systems" and "Value network systems" (see Section 6.2).

When considering the issue from various viewpoints, it began to appear to me that using Stabell and Fjeldstad's (1998) tripartite classification model as "a lens" would be one of the most promising ways of checking the need of additional categories more carefully. The reason was them having presented their own models of Value chain and Value network and also an additional concept of Value shop (Section 6.2). However, it must be reminded again that the term "Value network (systems)" is in this study used in a different, broader meaning than Stabell and Fjeldstad do.

However, I decided to break the back of the question by comparing Stabell and Fjeldstad's model against the emergent theory. Stabell and Fjeldstad describe three business models for producing and delivering value to customers, and thus all the categories of the emergent theory representing operative activities - acquisition, production (including also products), and sales and marketing activities - are the main focus.

The focused categories of the emergent theory ordered as counterparts according to the entity/networking nature are presented in the following Table 7.3.

Table 7.3: *The focused categories counterparts according to the entity/networking nature.*

Entity-natured systems	Networked-natured systems
Value chain acquisition systems	Networked acquisition systems
Process systems	Networked process systems
Product systems	Networked product systems
Value chain sales and marketing systems	Networked sales and marketing systems

7.2.1 Value chain model vs. the emergent theory

The model of Stabell and Fjeldstad is an extension of the classical value chain framework of Porter (1985, pp. 33 to 61). Stabell and Fjeldstad proposed two new models and so a set of three business models for producing and delivering value to customers: chains, shops and networks. The differentiation between these three value configurations utilises different sets of core activities for creating and delivering distinct forms of value to customers, and so each of them has different priorities in its management agenda.

However, first of the models, a value chain, is described according to Porter. Value chains create value by transforming inputs into products. According to the preliminary analysis of the MET case set, several of the interviewed SME's (and large companies as well) had operational activities with a nature of a value chain (e.g. MET_A5, MET_A7, MET_C1, MET_C2, MET_C6).

One of the Porterian value chain model's five primary activities is labelled Operations, which includes all the activities required for transforming inputs into outputs (products and services), and thus it describes the production activities. I took that activity as my starting point for the comparison, because it was exactly the production process of MET_A2 that had caught my attention.

In a value chain, the predecessor of the Operations activity is the primary activity of Inbound Logistics (which involves relationships with suppliers and includes all the activities required for receiving, storing and disseminating inputs). The successor is the primary activity of Outbound Logistics (which includes all the activities required for collecting, storing and distributing the output).

In proportion to the emergent theory, under the category of "Value chain intercessor systems" there is positioned a pair of categories: The category of "Value chain acquisition systems", which I argue to correspond to the activity of Inbound Logistics in Porter's model, while "Value chain sales and marketing systems" correspond to the activity of Outbound Logistics. In the emergent theory the latter category includes also another Porterian primary activity, Marketing and Sales (activities informing buyers about products and services, inducing buyers to purchase them and facilitating their purchase).

The last of the five Porterian primary activities is Service, which includes all the activities required for keeping the product or service working effectively for the buyer after it is sold and delivered. I argue it can be positioned into the category of (Internal/Networked) "Product systems". That interesting domain was discussed earlier (see subsections 5.3.3 and 5.5.3), while I was analyzing the cases ITEP_D1 and ITEP_E2. There I decided to draw back the categories of "Pre-sales systems" and "After sales systems" from "Sales and marketing systems". I also proposed to move "After sales systems" away from "Sales and marketing systems" to "Networked product systems".

I argue that there are two ways of interpreting the Service activity of the Porterian model from the viewpoint of the emergent theory. The value chain model is restricted, because it

does not describe the real phase when the after sales value is added to the product. According to tight interpretations of the chained model it is added at the end of the value chain. If that is true, the after sales services, such as the maintenance of the product, can be seen as a new, independent system, having Inbound Logistics and Outbound Logistics of their own. That means it can be classified into the category of "Internal product systems".

If that is not true, which in my mind is more logical, the after sales value is already added to the product during the Operations (or maybe during the other) primary activities, and there may also be interactive feedback channels to improve the products. For example, in some of the MET interviews (MET_B5, MET_C5, MET_C4) we discussed the important role of spare parts, and the risks pirate spare parts could present. The original spare parts are produced according to the definitions created during the Operations activities, and the added after sales value is the safety when the original spare parts are used.

Correspondingly, in the case of MET_A3 there was a desire to develop shared processes and reclamation practices with the main supplier, concerning the products: "*...the number of reclamations we get is maybe too small. They should be more precise and more documented. There is a need of standardization of those processes. Some people do not yet have a nerve to send reclamations, although they are more guidance than complaints to us.*"

In Porter's model there are also so called "Support activities" (Porter 1985, pp. 40 to 43) described in the following way:

- Procurement - is the acquisition of inputs, or resources, for the firm.

- Human Resource management - consists of all activities involved in recruiting, hiring, training, developing, compensating and (if necessary) dismissing or laying off personnel.

- Technology Development - pertains to the equipment, hardware, software, procedures and technical knowledge brought to support the entire chain in the firm's transformation of inputs into outputs.

- (Firm) Infrastructure - serves the company's needs and ties its various parts together, it consists of functions or departments such as accounting, legal, finance, planning, public affairs, government relations, quality assurance and general management.

According to that, the feedback channel to improve the products should be included in the Support activities / technological development. However, in Kerola and Järvinen's model, which is the background to the emergent theory, the function of research and development has been included into each function (Järvinen 1985). It means that also the feedback channels of technological development are included in "Product systems", and thus this kind of system with interactive feedback channels and an external interface can be classified in "Networked product systems". Otherwise it can be classified in the category of internal "Product systems".

It means that the activities of the value chain model can all be positioned into the categories of the emergent theory. Thus the evaluation of the theories against each other does not bring

requirements of adding any new category to the emergent theory. A summary is presented in Table 7.4.

Table 7.4: *Summary of Emergent theory categories vs. Porter's Value chain model.*

Emergent theory category		Porterian activity
Value chain acquisition systems	→	Inbound logistics, (Support activities / Procurement)
Process systems (Internal)	→	Operations
Product systems (Internal)	→	Operations, (Service)
Value chain sales and marketing systems	→	Outbound logistics
Networked acquisition systems	→	-
Networked process systems	→	-
Networked product systems	→	Service, Support activities / Technological development
Networked sales and marketing systems	→	-
Supporting systems	→	Support activities / Human resource management, Infrastructure

7.2.2 Value shop vs. emergent theory

According to Stabell and Fjeldstad value-chain companies are product-centric, focusing on the key activities associated with making, moving and marketing products. In value-chain companies, the product is the medium for transferring value between the organisation and its customers.

By contrast, Stabell and Fjeldstad argue that Value shops (the term shops is used as in workshops, not retail shops) create value by mobilising resources to create individual, unique solutions to customer problems or to exploit market opportunities. Value shops solve problems and exploit opportunities: "While chains perform a fixed set of activities that enable it to produce a standard product in large numbers, shops schedule activities and apply resources in a fashion that is dimensioned and appropriate to the needs of the client's problem".

The examples given by Stabell and Fjeldstad include professional services, such as organisations in healthcare, law, IT and construction. These services are based on the knowledge and expertise of professionals, they are oriented towards problem-solving and their focus is on problem and opportunity assessment, resource mobilisation and project management. One of the key variables lies in the information asymmetry (cf. Miller 2003, Barney 1997) between the producer and the customer. The asymmetry is the underlying reason for a very high level of contact between the two parties. The expectations of the client are often high since the professionals have the unique competence within their special area (Stabell and Fjeldstad 1998).

The value creation in the value shop model can be described straightforwardly as a cyclical process. In the initiative phase of "Problem-finding and acquisition" the necessary data is collected so that the problem at hand can be defined properly. Next a process of solving the problem is started, aimed at choosing the most suitable solution. After the solution is executed, there is the phase of controlling or evaluating the results. Sometimes new problems are detected during the evaluation phase and the cycle starts over again. However, Stabell and Fjeldstad note: "The flow of activities is not linear, but iterative between activities and cyclical across the activity set". The steps of the Value shop model are presented in Figure 7.1.

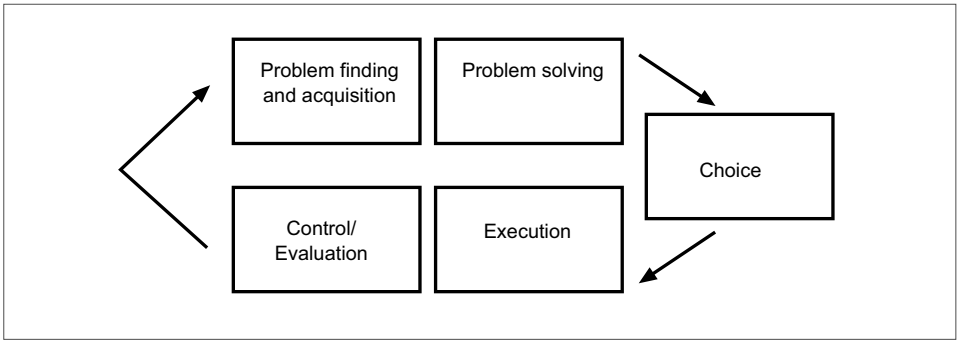

Figure 7.1: *The Value shop (Stabell and Fjeldstad 1998, p. 424).*

It must be noted that some of the phases should also include the task of specification (see Järvinen 2001, pp. 93 to 94, Flood and Romm 1996). With that accommodation the model includes activities guiding the process: (normative) Target state, Choice, and Evaluation. The model also has congruence with e.g. the model of systems construction process (see Järvinen 2001, p. 91), the action research model (e.g. Järvinen 2001, p. 116, ref. Susman and Evered 1978) and the cyclical learning models of Kolb (1984) and Nonaka and Takeuchi (1995).

The case of ITEP_C2 had activities compatible with the value shop model. At first I thought this described the whole production process of ITEP_C2. After analyzing the cases of MET_A2 and MET_A3 (see subsection 6.4.3) I was enforced to go through the case again and sharpen the picture.

I argue that the proper system categories can be found in the emergent theory classification. However, the systems fitting into the Value shop model are positioned in different categories. Among the MET cases there were many examples of the phase of individual problem-finding and acquisition. As presented in earlier chapters (see e.g. subsection 6.5.3), pre-sales activities based on one-to-one relationship in cooperation with the end-customer were the most typical way of defining the products in Finnish metal and electrotechnical industries (see also Riihimaa and Ruohonen 2002, Ruohonen, Riihimaa and Mäkipää 2002, Ruohonen, Riihimaa and Mäkipää 2003). It means that the problem-finding and acquisition phase type of systems of the Value shop model can be positioned into "Networked sales and marketing systems". Among the interviewed enterprises it was also becoming more common (e.g. the cases of MET_A6, MET_E6, MET_D7) that the enterprise is in a (continuous) consulting relationship with the customer and the customer's core business (see also e.g. Engeström 2003, in subsection 2.2.2).

I also argue that in this kind of customer relationships there exists an asymmetry between the producer and the customer. The examples Stabell and Fjeldstad give of professional services must be enlarged. As described in the previous chapters, production enterprises have high skilled professionals oriented towards practical problem-solving (e.g. MET_A5's example of aluminium knowledge. In the case of MET_A5 they have also a networked planning team solving different kinds of planning-phase problems.).

Brown and Duguid (1991) take the community of practice as a unifying unit of analysis for understanding knowledge in a firm. They suggest that often too much attention is paid to the idea of community, and too little to the implications of practice. By re-evaluating work, learning and innovation in the context of actual communities and actual practices they suggest the connections between these three become apparent. With a unified view of working, learning and innovating it should be possible to reconceive of and redesign organizations to improve all three.

Also the earlier example of ITEP_C3 describes that kind of problem-solving with subcontractors, and in the case of MET_A2 the enterprise uses networked partners for various kinds of specialized supply activities, such as e.g. laser cutting, tooling, different types of metal painting or robot-based welding. All these examples mean that the Problem-solving phase of the Value shop model can be seen as a "Networked acquisition system".

Concurrently the Execution phase of the Value shop model is fitting for the previously discussed categories of "Networked product systems" and "Networked process systems". This phase of the Value shop model, as well as the phase of Problem-solving, can be also positioned under the category of (Internal) "Process systems" if the production is done in a single firm or the problem- solving professionals can be found inside it. The type of the resulting product can be either networked (with interactive after sales services) or internal (with no particular after sales services).

What was discussed of after sales services in the previous subsection 7.2.1 handling the Value chains, matches also the Control/Evaluation phase of the Value shop model. I include the phase in "Networked process systems" with possible interactive feedback channels with the end-customer. However, it must be noted that control/evaluation could also refer to internal management, which could be included e.g. in the production process in the form of team management, or it could come also from the top management of the enterprise.

Table 7.5: *Summary of Emergent theory categories vs. Value shop model.*

Emergent theory category		**Value shop activity**
Value chain acquisition systems	→	-
Process systems (Internal)	→	Control / Evaluation (internal management)
Product systems (Internal)	→	-
Value chain sales and marketing systems	→	-
Networked acquisition systems	→	Problem-solving
Networked process systems	→	Choice / Execution Control / Evaluation (Note! Means here the acceptance of the end-customer. Control/Evalution may also refer to internal management function).
Networked product systems	→	Execution
Networked sales and marketing systems	→	Problem-finding and acquisition
Supporting systems	→	-

7.2.3 Value network vs. emergent theory

Stabell and Fjeldstad define Value networks as organizations that create value for customers by linking them together or mediating exchanges between them. This can be direct, as e.g. in a telephone service, or indirect, as e.g. in retail banking where a group of customers are linked together through a common pool of funds. In each case, the customers form the network. The value-network organisation provides a networking service, typically through some form of networked infrastructure.

This is a notably different definition from the common usage of the concept of value network, which typically denotes a network of affiliated companies. As stated earlier in this study, also the emerging theory defines "Value network systems" in a different way. Value networks of Stabell and Fjeldstad refer to organizations the focus of which is on providing services, managing relationships and operating the network infrastructure. The examples they use are just such organizations as telecommunications companies, insurance companies or banks.

The primary activities of a value network are as follows: Network promotion and contract management, Service provisioning, and Network infrastructure. According to Stabell and Fjeldstad among the supporting activities of a Value network, two distinct, but related, activities of technological development are of special interest: network infrastructure development and service development. All these refer to the supporting functions of an organization; it seems Stabell and Fjeldstad do not have any "operations" in a network. That means the activities can also be seen only as "Supporting systems" of the enterprise. In addition, from the viewpoint of an enterprise within the network producing the services, the model may also refer to kind of ASPed services (see subsection 6.4.2) – all activities producing services are outsourced to a network.

The model of Value networks is strongly focused on the roles of the (end-)customer, and the mediating technology according to Thompson (1967) on linking customers who are or wish to be interdependent. In the model of Value networks mediators act as "club managers", and value is derived from service, service capacity and service opportunity. Stabell and Fjeldstad emphasize also such issues as standardization and a layered and interconnected industry structure.

The model of Value networks by Stabell and Fjeldstad should be compared to and supplemented with the model of Cross and Smith (1995), especially the model phases of Relationship, Community and Advocate presented previously (see subsection 6.5.2) with the "Networked product systems". Also the networked product with layered sources of additional value, according to the respondent in the case of MET_A6 (Figure 6.6 in a previous subsection 6.5.2), supplements the model of Value networks, because it emphasizes the entirety of the product or artefact in a more concrete way.

As a result I see the model of Value networks by Stabell and Fjeldstad as a subset of networked operational systems, and I argue that also in a Value network case the proper system categories can be found in the emergent theory classification as presented in Table 7.6. Due to the mediating nature of a business organization the network should be promoted and contracts made both with customers and suppliers. Thus both "Networked acquisition systems" and "Networked sales and marketing systems" reflect different views of the Value network activity of "Network promotion and contract management". Supporting systems are included in "Networked process systems" (emphasizing the perspective of information technology) and "Networked product systems" (emphasizing the financial perspective).

Table 7.6: *Summary of Emergent theory categories vs. Value network model.*

Emergent theory category		**Value network activity**
Value chain acquisition systems	→	-
Process systems (Internal)	→	-
Product systems (Internal)	→	-
Value chain sales and marketing systems	→	-
Networked acquisition systems	→	Network promotion and contract management
Networked process systems (information technology perspective emphasized)	→	Network infrastructure Network infrastructure development
Networked product systems (financial perspective emphasized)	→	Service provisioning Service development
Networked sales and marketing systems	→	Network promotion and contract management
ASP network systems	→	From certain viewpoint may include all Value network activities
Supporting systems	→	From certain viewpoint may include all Value network activities

In summary, the evaluation of the Value network model did not bring requirements of adding any new categories to the emergent theory, but I added the row of "ASP network systems" into the Table 7.6 if compared with Tables 7.5 and 7.4.

7.3 Summarizing the two tests

In this chapter I presented two ways of verifying and testing the emergent theory. In Section 7.1 I compared once again all the cases against all of the categories of the emergent theory. The results were presented in a table format and I also commented some of the results.

In the second test (Section 7.2) the emergent theory was compared against Stabell and Fjeldstad's (1998) tripartite classification model. As a result, I found that neither of the tests brought requirements of adding any new categories to the emergent theory.

In the following Chapter 8 the results of this study will be discussed.

8. Discussion

In this chapter I shall repeat the results of this study (subsection 8.1.1). I also consider the questions of rigor and trustworthiness, or validity and reliability, not forgetting the questions of generalizability and triangulation (subsections 8.1.2 and 8.1.3). Implications of the study are presented in subsection 8.1.4.

The limitations of this study are considered in Section 8.2. Some recommendations to practitioners are given in Section 8.3 and some propositions for future research in Section 8.4.

8.1 Repetition of results and estimation of their importance

The main result of the study is a new theory; a taxonomy describing a classification principle of information and communication technology (ICT) system innovations adopted by small and medium sized production enterprises.

Traditionally organizations are examined as independent units with certain internal functions or processes. An organization has been also seen having some external interfaces, but their role is becoming currently more important due to networked cooperation with other organizations. To this end organizations have various kinds of internal and external ICTSs.

8.1.1 Overview of the study

The original core category of "ICTS roles" was formed by using a classification of SMEs presented in the early phase of this study: "entity"/"in network". I divided the roles of ICTS in an SME into two classes: the category of "Internal systems" to represent systems with no external links (an SME as an entity) and the category of "External systems" to represent systems with an external interface (an SME in a network). That dichotomy between Internal and External systems was included in all of the main categories of the emergent theory.

In this study the a priori aim of an enterprise, and thus the aim of adopting ICTS innovations, was assumed to be the financial success and competitiveness of the enterprise. As I presumed beforehand, the most important focus of the adoption of ICTS innovations in production SMEs was their search for sustainable competitive advantage. However, I also found some other remarkable ICTS innovation roles, systems not directly creating competitive advantage.

I identified two main system categories with external relationships and creating competitive advantage, "Value chain systems" and "Value network systems". In the emergent theory I also separated "Internal competitive systems", a category including systems creating

competitive advantage but having no external interfaces. These systems are attached to the core competencies of the enterprises and to their production systems. Also supporting systems were described (only) under this main category. Another a priori part of the emergent theory was the structure of the supporting functions always describing some certain characteristics of the enterprises' ICTS innovations.

The traditional way of describing issues creating competitive advantage (and thus also describing information systems) is the Porterian (Porter 1985) value chain. This kind of model includes "chained" systems with "one-way" external communication interfaces, such as acquisition systems (communication, such as orders to suppliers) and sales/marketing systems (e.g. marketing communication to customers). In this kind of model the production systems are independently situated in the middle of the value chain, within an individual enterprise, as described above. The products of the enterprise are typically described as mass-products.

If the enterprise operates within a real enterprise network, it means reciprocal, cooperative communication between the parties and between their systems. More external interfaces are needed then. Not only acquisition and sales/marketing systems have reciprocal external interfaces, also production process activities and even the products form networked systems have them.

"Networked process systems" concerning production emphasize issues similar to "Networked acquisition systems", while the nature of the latter category is more focused on the preconditions of production and the former on operational issues. Operative cooperation between production partners is a very important issue, because the activities are typically aimed at cost-effectiveness. Advanced, networked production process systems expect standardized data and processes between the partners. Administrational barriers, such as formal orders, are tried to be diminished.

Accordingly, networked products are not simply produced and sold. The structure of a networked product is layered. The products may first be individually customized in cooperation with the customer ("pre-sales" activities). The product may include long-period after sales services expecting continuous communication and also consultation of how to use the product most efficiently. This kind of knowledge is aimed at developing the work of the end-customer. The "highest level" cooperation can be seen as kind of a community, which is formed around the product. The examples of this kind of community may be brand-loyal drivers of a certain vehicle or, to reflect more the world of Computer and Information Sciences, brand-loyal users of a certain operating system.

It is possible to outsource parts of the value chain systems, which kind of systems also form a particular category of their own. The networked counterpart of the category of "Outsourced systems" is the category of "ASP (application service providing) systems".

The first of the exceptions, systems not directly creating competitive advantage, is attached to the category of "Experimental systems". Some information systems are adopted just to get experience of some phenomenon new to the organization, i.e. ICTS innovations may be

places for learning without any expectations of (at least short term) production values. They are especially adopted when a new phenomenon or technology arises.

The second exceptional ICTs system type is the category of systems obstructing competitiveness. If the above mentioned category "Experimental systems" is a positively loaded term with learning expectations, the category labelled "Competitive obstructive systems" is, in contrast to that, negatively loaded. In it there are two sub-categories. "Relic systems" are old-fashioned, "laggard" historical systems, still used although they should be discharged and learned away from, or systems adopted in a "too late" phase of their innovation life cycle.

Another subcategory "Failure systems" represent types of systems which are created based simply on wrong decisions. In practice it may be difficult to see whether a system really is a "failure", but the subcategory reflects the two explicit forms of path-dependency according to Håkansson and Lundgren (1997) and Davis (1988). Typical examples of that type of systems are investments in an unsuccessful piece of software, or the example described in one of the cases – a large ERP system implemented with the instruction from the main supplier to the SME supplier to take it in use, even if from the SME's angle it was the most inflexible and expensive system.

The third exception is the category "Fake systems", including system innovations adopted to create a manipulated image for opportunistic reasons. In enterprises ICTS innovations may sometimes have the role of a "Potemkin facade". Technology systems may be used when a certain image is wanted to be presented, in the worst case without any original purpose of having real competitiveness but to siphon investors' money into the owner's account. Much more than in the production SME sector that became true in, for example, the Internet hype business at the turn of the 21th century.

It must also be noted that the same enterprise may also have both chained and networked systems, as well as systems from "contradictory" categories, depending on e.g. customer priorities, the nature of products, supplier partners, etc. Thus the systems may be seen as "building blocks" for the enterprise.

8.1.2 Rigor and trustworthiness (validity and reliability) of the research

In this subsection I shall consider the rigor and trustworthiness, validity and reliability, and also the generalizability of this study. Yin (1994) notes that the primary weaknesses of case studies are that there may be a lack of rigor in the study, and study may provide little basis for scientific generalization.

The view of this dissertation research can be characterized as naturalistic, according to the so called "naturalistic paradigm" (Lincoln and Cuba 1985). That is an important point of view, because it leads to considering the questions of rigor and trustworthiness, questions

of validity and reliability, from a different angle than, for example, in the rationalistic research view. Work of Lincoln and Cuba is also based on the Grounded theory (Glaser and Strauss 1967), alike the model of Eisenhardt (1989), which was followed in this study.

It must be also remembered that in this study I recognize categories, not any values concerning them. Thus the problems can be focused on the question whether the identified categories are legitimated appropriately or not. The identified categories can be applied in future research, when they have been founded and legitimated appropriately.

Naturalistic research paradigm

According to the naturalistic research paradigm, the phenomena under investigation is studied as a whole and cannot be separated out of context. The aim of interviews is to provide a more comprehensive picture of each aspect of the study. In this study the networking of enterprises was the fundamental context, and in addition to that the Information society also formed a broader context reflecting networking.

In a naturalistic study it is acknowledged that it is impossible to eliminate the interaction between the researcher and the research subject. Very often the interviewer is an integral part of the phenomenon under investigation. In this study one of the key words was my personal experience, having lived and worked over fifteen years with entrepreneurs and SMEs, most of these representing the production branch.

It is also said that the interview data cannot be used to make generalizations beyond those bounded by the study. When the findings from the interviews are used, they always relate to the particular context. However, the aspects concerning generalization are discussed more carefully in this subsection, based on Lee and Baskerville (2003).

The naturalistic research view also emphasizes the interdependence type of causality, and value-bound type of values, which both were discussed in Chapter 4.

As stated, the concepts of reliability and validity have special counterparts in the naturalistic paradigm (see Table 8.1 below):

Fundamental issues of science	Rationalistic criteria	Naturalistic criteria
truth value	internal validity	credibility
applicability	external validity	transferability
consistency	reliability	dependability
neutrality	objectivity	confirmability

Table 8.1: *Criteria of rigor and trustworthiness (Aaltonen 1989, p. 153).*

Credibility

Credibility is defined as the degree of confidence in the "truth" that the findings of a particular study have for the subject with which, and context within which, the study is carried out (Erlandson et al. 1993, p. 29). Credibility is achieved by such strategies as long-term engagement, continuous observation, triangulation, sufficient reference materials, communication with the respondents, and member checks.

This study has been conducted during a long period of time. One of the starting points was a survey-based study, which I conducted in 1995 (Mäki and Riihimaa 1995). Also the data gathering process of the first case data was prepared already about five years ago. All that time I have continuously observed the case enterprises and their context and also communicated with some of the respondents. For example, the category of "Fake systems" was identified due to that method. The respondents also checked all the used interview data. The concept of triangulation means combining of different viewpoints. The concept in its several forms is in this study described based on Denzin (1978) and Jick (1979) in a separate subsection 8.1.3.

Transferability

Transferability is defined as "the extent to which its findings can be applied in other contexts or with other respondents" (Erlandson et al. 1993, p. 31). Transferability and generalizability are not seen as the same thing. Generalizable findings must apply across all environments while transferability allows knowledge gained to be applied to other environments. Transferability is achieved in two ways: through precise and dense description of sufficient details, which brings the reader vicariously into the environment under investigation, and through purposive sampling guided by the emerging course of the study.

When the data were gathered, it was possible in many phases to focus the sampling. This is described in Chapters 5 and 6. In this study I have also aimed to present all the various phases of the study and my interpretations in sufficient detail, following the framework of Eisenhardt (1989).

Dependability

Dependability as a naturalistic counterpart of reliability is defined as the extent to which, if the study "were replicated with the same or similar respondents (subjects) in the same (or similar) context, its findings would be repeated" (Erlandson et al. 1993, p. 33). Dependability is achieved through a "dependability audit" which includes the construction and maintenance of an archive facilitating access to all documentation as well as a running account of the process of study in the form of researcher databases.

According to Dubé and Paré (2003) a key principle to be followed to increase the reliability

of the information presented in a case study is the maintenance of a logical chain of evidence. As Yin (1994) explained, the principle is to allow an external reviewer or observer to follow the derivation of any evidence from the initial research questions to the ultimate case study conclusions.

In interpretative research the findings are partially based on the researcher's experience and "tacit knowledge". It is therefore not possible, by definition, to document and trace all the phases of the study. In this study the interpretations are based in a unique way on my past experiences of production SMEs and their views of ICTS innovations. Therefore I argue that it is not be possible for anyone else to adopt the same premises, to repeat the same research process and to achieve exactly the same results. It would be impossible even to myself, because it must be noted that due to the iterative and long-lasting nature of the study, it was (and is) also a personal learning process, during which new views were incrementally opened to the same basic data.

Instead of the idea of repeating the study I aimed to increase the opportunities of the reader to trace the sources of interpretations. The case study database which I used was formed by within-case documents in electronic format and by some secondary data. The forms of the data were described in Chapters 5 and 6. Based on this database I have tried to illustrate my interpretations and the phases of the research process as clearly as possible, as well as the theoretical basis and the other background views of this study.

Confirmability

Confirmability of a study is defined as "the degree to which its findings are the product of the focus of its inquiry and not of the biases of the researcher" (Erlandson et al. 1993, p. 34). Confirmability is achieved when constructions, assertions and facts can be tracked to their original sources and when the logic behind their construction leads to an explicit and implicitly coherent and corroborating whole.

According to Yin (1994), an observer should be able to trace the steps of the study in either direction, also from conclusions back to initial research questions. The process should be tight enough so that evidence presented in the case report is assuredly the same evidence that was collected during the data collection process.

Confirmability is achieved via a "confirmability audit" which allows external reviewers to judge the conclusions, interpretations and recommendations of the study. The Dependability Audit and the Confirmability Audit are facilitated by the construction of a research project database. What was said above about the ideal vs. reality of tracing the steps is valid also for the issue of confirmability.

Generalizability

As stated, transferability and generalizability are not always seen as the same thing. When generalizing from empirical statements (as the inputs of generalizing, in this study of the ITEP and MET cases with secondary data) to theoretical statements (as the outputs of generalizing, in this study the emergent theory), it must be noted that this type of reasoning can involve generalizability in two ways: The generalizability of observations, and the generalizability of the resulting theory beyond the domain that the researcher observed (Lee and Baskerville 2003).

Eisenhardt's theory-building framework, which I followed in this study, is a framework for generalizing empirical descriptions to theory. She explicitly subscribes to Yin's case study method, and also to Glaser and Strauss' (1967) Grounded theory.

For empirical descriptions in a case study to be generalizable to a valid theory, Yin (1994) prescribes the use of procedures that involve multiple sources of evidence (cf. data triangulation, Denzin 1978), a case study database and member checking. All these would help to ensure the quality of the descriptions. In this study the views on triangulation are discussed in subsection 8.1.3. The case study database and member checking are presented in Chapters 5 and 6.

It is often argued that a theory generalized from the empirical descriptions in a particular case study has no generalizability beyond the given case. That viewpoint has been carefully considered by Lee and Baskerville (2003). They draw an analogy between case research and statistical research. According to them: "Generalizing beyond the given field setting in case research corresponds to generalizing beyond the given population in statistical research. Sample points may be generalized to sample estimates of population characteristics, but certainly have no generalizability beyond the given population."

Lee and Baskerville (2003) also noted: "In summary, the notion of the generalizability of empirical descriptions to theory is well developed. Hence, criticisms that case studies and qualitative studies are not generalizable would be incorrectly ruled out the generalizability of empirical descriptions to theory."

Walsham (1995a, 1995b) has extended Yin's notion of generalizing to theory. He explains (Walsham 1995b, pp. 70 to 80) that, beginning with the facts of the rich description of a case, the researcher can generalize to concepts, to a theory, to specific implications or to rich insight.

In this study these issues are also fulfilled. As kinds of concepts the various categories of ICTS innovations are presented within the emergent theory in Chapters 5 and 6. The specific implications – or rich insight - of the emergent theory are discussed in the following subsection 8.1.4. Especially the properties of the networked system categories, considered in subsections 6.4.4, 6.4.5, 6.5.2 and 6.5.3, represent possibilities for rich insight offered by the data sets of this study.

8.1.3 Basic types of triangulation

Multiple viewpoints produce a more complete evaluation than a single source. By combining multiple observers, theories, methods or empirical data it is possible to overcome the weakness and problems of the narrow and limited scope that comes from a single data gathering technique, a single method, a single observer or single-theory studies. The concept of triangulation (e.g. Denzin 1978, Jick 1979) means combining different viewpoints, such as different sets of data, different types of analyses, multiple researchers and/or different theoretical perspectives to study one particular phenomenon. These different points of view are then studied so as to situate the phenomenon and locate it for the researcher and reader alike.[35]

The term "triangulation" has been used in multiple meanings. According to Huberman and Miles (1998, p. 199) the origin of the term is probably "multiple operationalism"[36], multiple measures to ensure that the variance reflected is that of the trait or treatment and not associated with the measure. Triangulation is also usually connected to the work of the grounded theorists; a theory generated from one data works not as reliably as a theory based on various data from different sources.

Denzin (1978) identified four basic types of triangulation: (1) Data triangulation or the use of a variety of data sources, (2) Investigator triangulation using several different researchers or evaluators to look at the same phenomena, (3) Theory triangulation where multiple perspectives are used to interpret a single set of data and (4) Methodological triangulation where multiple methods are employed to study a single problem.

Janesick (1994) has suggested augmentation and adding a fifth type, interdisciplinary triangulation. She argued that this kind of new type would help to lift up out of the dominant trench of a certain disciplinary (in her case psychology). However, it seems to be possible to include that into the type of theory triangulation, alike some other kinds of basic features of the research background, e.g. philosophical assumptions, instead having a new type of "philosophical background triangulation".

The summary of triangulation achieved in this study is described in the following text by using the four types of Denzin classification.

35 According to Myers (2001) good discussions of triangulation in information systems discipline can be found in Ragin (1987), Gable (1994), Kaplan and Duchon (1988) and Lee (1991), and an empirical example of the use of triangulation is Markus' (1994) paper on electronic mail.

36 Based on Campbell and Fiske (1959).

1) Data triangulation or the use of a variety of data sources

Collecting different types of data by different methods from different sources produces a wider scope of coverage and may result in a fuller picture of the phenomena under study (Eisenhardt 1989).

Different research settings also help to generalize the results. In this study data triangulation was achieved by using different data sets:

- interviews of 17 representatives of South-Ostrobothnian SMEs (or related, the ITEP project) in the spring of 2000,

- nationwide interviews of 40 metal and electrotechnical enterprises on assignment for the Federation of Finnish Metal, Engineering and Electrotechnical Industries (MET). The first of the MET interviews took place on December 13th 2000 and the last one on March 5th 2001, and

- supportive secondary data described in Chapters 5 and 6 (see subsections 5.1.5 and 6.1.5).

2) Investigator triangulation using several different researchers or evaluators to look at the same phenomena

Multiple investigators have two advantages. First, they enhance the creative potential of the study. Team members often have complementary insights, which add to the richness of the data, and their different perspectives increase the likelihood of capitalizing on any novel insights, which may be in the data. Second, the convergence of observations from multiple investigators enhances confidence in the findings. Convergent perceptions add to the empirical grounding of the theory, while conflicting perceptions keep the ground from premature closure (Eisenhardt 1989).

In this study investigator triangulation was achieved during the data gathering processes by multiple researchers and supporting research teams, where multiperspective debate and evaluations were continuously possible. Another way of have investigator triangulation in this study was the proportioning of the results to the existing literature.

In the ITEP data gathering process the main partner was a development organization, Tampere Technology Centre Hermia. The interviews for that data were done with a consultant of the organization. In addition to this, the project had a very supportive expert group of specialists with various appropriate backgrounds.

The MET data gathering process was planned and carried out in cooperation with a professor of Information Systems, who also has a solid background in economic and management sciences. The Federation of Finnish Metal, Engineering and Electrotechnical Industries had also a cooperative coordinator and experts of their own for supporting the research.

3) Theory triangulation where multiple perspectives are used to interpret a single set of data

In this study various perspectives to information systems were applied, i.e. financial (economic behavior, e.g. the efficient utilization of the ICTS innovation, a short repayment period), human (e.g. social networks, cooperation), technological (ICT) and informative (e.g. databases, knowledge) perspectives.

Within the phases of analysis e.g. various networking theories reflecting the different perspectives of the same subject were used (see e.g. Lee 1989), which was the particular feature of theory triangulation in this study.

4) Methodological triangulation where multiple methods are employed to study a single problem.

The term "triangulation" has sometimes been used as a synonym for methodological triangulation (e.g. Denzin and Lincoln 1994). However, Järvinen's classification framework of research methods adopted in this study guided into the use of appropriate methods in various research settings, and so the need of methodological triangulation is not a very relevant issue[37].

Still according to Morse (1994) two or more (qualitative) methods may be used sequentially or simultaneously, provided the analysis is kept separate and the methods are not muddled (Morse 1994 cit. Stern 1994, see also Niglas 2004)

The presenting of the SME survey represented in this study the description of creating pre-understanding, as did the description of the researcher's personal history.

In this study the method of case-study was used and the Eisenhardt's (1989) eight-step model was applied. According to Eisenhardt, collecting different types of data by different methods from different sources produces a wider scope of coverage and may result in a fuller picture of the phenomena under study. However, when Eisenhardt talks about methods, she means mainly data collection techniques. Otherwise she stresses the significance of data triangulation and investigator triangulation.

The original model of Eisenhardt describes the process of inducting theory using case studies. It includes influences from hypothesis-testing research but the focus is on case-oriented process. The model allows combining qualitative and quantitative data. However, in this study qualitative data is emphasized.

In this study also multiple triangulation was fulfilled, when multiple observers and multiple sources of data were combined. As mentioned above, some of the data of this study was collected at different times, which in my personal experience offers also a longitudinal perspective.

37 It must be noticed that it is possible to understand the term "methodologigal" in various ways, sometimes e.g. as a plain data gathering technique, which is not the case in this study.

8.1.4 Implications

The whole innovation research field is extremely wide, but especially within the IS innovation discussion there is a need for better definition of the taxonomies of ICTS innovations and more exact characterization of innovation types. The nature of ICT is different from the nature of many other technologies, which makes the phenomena complicated to study. New classification principles will help to position the future research. The emergent theory offers a new type of theoretical constructs for identifying and distinguishing between different ICTS innovations.

Due to the comprehensive view with detailed presentation, I argue that the emergent theory reflects the ICTS innovation phenomena in an organizational context more closely than the earlier theories presented in the literature about IS and organizations. The emergent theory covers more ICTS innovations categories and it also includes the organizational networking view (cf. Swanson 1994). It also recognizes a separate informative resource type, which has typically not bee noticed. To my mind informative resources will in the future explain the differences in performances between enterprises when, for example, firms' data bases, possibilities of the Internet, and various types of knowledge resources are utilized more (cf. Barney 1997, Melville et al. 2004).

This study follows one of the recognizable IS research literature lines, which has identified various emphasized characteristics of IS adoption as an organizational innovation (e.g. Kwon and Zmud 1987, Tornatzky and Fleischer 1990, Damanpour 1991, Grover 1993, Swanson 1994, Thong 1999). However, the previous organizational innovation theories in the IS research field have reflected the reality of the enterprises inaccurately. The information systems of organizations are mostly studied as entities of a single organization, and typically from the viewpoint of a large organization. In this study the networking of enterprises was a fundamental context, and the role of production SMEs was particularly in focus.

The results of this study form a comprehensive view of ICTS innovations focusing on the context of networked organizations. The emergent theory views ICTS as an organizational innovation. That provides an understanding of the role ICTS innovations can and will play in the organizational context. Just as Swanson (1994) argues: "No theory of IS innovation in its particulars is distinguishable from organizational innovation in general".

As the number of SME organizations is large they do play the most important role in the modern economy's competitive position and job creation. They are also a remarkable group to adopt new information and communication technology. That is why it is important that their role is noticed also in the field of IS innovation research, like I did in this study.

One of the most fundamental and most referred works categorizing IS innovations so far is presented by Swanson (1994). Also his context is organizational. Some of the latest studies aiming to extend the work of Swanson on IS innovations (e.g. Grover 1997, Lyytinen and Rose 2003a, Lyytinen and Rose 2003b) have not touched to the most essential weakness of Swanson's model, the restrictions in ways it demonstrates inter-organizational, networking innovations between organizations. In Swanson's original model the interfaces between

organizations, and thus the important reciprocal communication channels, are left with minor attention. Especially this networking viewpoint of ICTS innovations was improved in the current ICTS innovation categorizations of the emergent theory.

The emergent theory also paid attention to a reverse side of the ICTS innovation. I identified systems aimed at creating a manipulated organizational image for opportunistic reasons, old- fashioned systems, which should be discharged and learned away from, and also other types of systems, obstructing, not creating competitiveness. That type of aspects have so far been seldom discussed in the IS research field, even though they should need more attention.

Within the organizational networking research area the results of this study are also important, because they emphasize resources essential to information systems and the role of the resources in networking development. Networking is cooperation between both individuals and organizations, and ICTSs lay not only the technical platform for the cooperation, but also financial, social and informative terms for competitive advantage creation.

From the viewpoint of researching the Information society the dissertation is a quite narrowly focused contribution, but the results may be utilized by testing the emergent theory in other industry branches and other types of organizations.

8.2 Limitations

While building the theory I was also forced to make some exclusions or restrictions on expanding it. Some of these types of issues were already discussed in this chapter, in subsection 8.1.2.

In addition to those, the iterative nature of theory creating means that the order in which the cases are selected may affect the results. My personal learning process may change, and thus the structure or the emphasis of the emergent theory could be different, but when they were iterated my observations were compared to all of the cases. That iteration I also supplemented with the test described in Chapter 7 (see Section 7.1).

It might be possible also to find some overlapping classifications by changing the viewpoint. For example, adopting a time-dimensional point of view would give some differing results. If nothing else, in the "Value chain"/"Networked sales and marketing systems" the collective bargaining agreements took varying lengths of time in different enterprises – getting some of the agreements took from one to three years, some were decided immediately by the end-customer. It means that the systems supporting sales and marketing activities are different, and thus the analysis might lead to different result. However, these kinds of restrictions are possible to overcome by refining the divisions within the categories.

Just as mentioned above, it might be possible to refine the divisions in some of the categories. For example:

- "Networked sales and marketing systems" may include both pre-sales, after sales, and "normal sales" activities,

- I identified different types of customers, which were not included in the final emergent theory (such as the main supplier customer vs. the end-customer, see subsection 6.5.3, Figure 6.8)

- "ASP network systems" may include different variations according e.g. to Currie and Seltsikas (2001), and thus some new categories may be needed

- there were various types of experimentations, which might form new categories (see subsection 6.3.2).

Neither did I analyze some other categories, such as "Fake systems", "Failure systems", or "Relic systems" in a very detailed way. However, all these above mentioned restrictions were done to keep the theory parsimonious.

Another limitation exists due to the functional nature of the theory basis. It was not possible to describe relations between the systems or transitions from one system to another. That would be necessary particularly while discussing the networked operational type of systems (acquisition, production process, product, sales and marketing), because they seemed to be intertwined, process-natured systems. I argue that the selected functional way still does not prevent from building processes, but this would expect a more precise definition of system frontiers and interfaces.

Some may also claim that not all information systems are innovations. That is true, but while gathering the data I aimed to focus on ICTS which do have the nature of innovations in the enterprises by which they were mentioned. While the analysis went on I was also able to identify exceptional kinds of systems, e.g. the category of "Relic systems", and so to reveal also the reverse side of the ICTS innovations.

8.3 Recommendation to practitioners

The results of this study guide the practitioners to look at organizations as system based entities. As noted by Swanson (1994), a good ICTS innovation theory allows managers to shape their organizations better with respect to realistic expectations of ICTS innovation. It will also give managers guidelines for considering when it is the appropriate time for the organization to adopt new ICTS innovations. Sometimes it is better to be among the first adopters, but it might as well be wise to be among those who follow, and just to learn from the accumulated experience of the predecessors.

To the SMEs operating in practice within the enterprise networks and adopting in practice new technologies the results of this study will give guidelines to understanding better the bases of the adoption issues, and also some advice on allocating their small resources more efficiently. I hope that the enterprises will in future ask for more standard software solutions,

such as compatible interfaces of software packages or databases to help SMEs to connect and share their systems with their cooperative partners.

To information systems practitioners the results illustrate the different roles of information systems in enterprises and guide them to develop software and system solutions supporting better the cooperative activities between enterprises.

A current example, which could have benefited from system thinking, was a piece of news of a firm having descended into serious trouble because of the large ERP system forming the fundamental database of the consolidated corporation. When one of the companies was sold out of the corporation it was not possible to split the database and share the information/ knowledge property. This type of example emphasizes the importance of an informative resource and system view.

Further, from the perspective of information technology one particular form of "Product systems" innovations enabling also networking properties, is the mechatronics. Also active and intelligent materials such as shape memory alloys (Ullakko et al. 2002) can be used. These types of product system innovations offer a great potential to the production enterprises. However, the layered nature of a networked product must be remembered (see subsection 6.5.2). It must be also noted that the nature of ICT is different from the nature of many other technologies, and it is not necessarily as easy to utilize. Among the interviewed enterprises I noticed attitudes underestimating that complexity.

An extremely important aim for the production SMEs in the middle of a supply chain/ network is also to create their own system innovations or parts of innovations, which include either end-customer oriented pre-sales or after sales services. Without these kinds of service components, or alternatively other new value-sharing agreements, the additional value and also the profits are raked in by the main supplier which manages the end-customer relationship.

The results of this study should also motivate enterprises to carry out experiments. Enterprises of different sizes may be very keen on the new ideas, and new innovations are actively searched for. As some of the ITEP respondents had noticed, "we got our best ideas from outside our industry branch". However, the new innovations should be tested within the enterprise's own context, its own branch. New organizational innovations are accommodated slowly into the working culture and methods. It must be also noted that experiments concerning ICTS innovations should be done in a networked environment, in cooperation with other enterprises. If the experiments concern issues of standardization, which should be very important for the strengthening of the informative resource view in information systems, the whole industry branch should be involved in one way or another.

The practitioners should also recognize varying, competition-obstructive systems, such as "Failure systems", "Relic systems, "Fake systems" etc. They should not believe that all ICTSs are useful or create sustainable competitive advantage.

Information society practitioners, such as regional development organizations, may have some ideas about how many-sided and long-termed the issues attached to enterprises' adoption of information system innovations are. The role of local development organizations has became more important in Europe due to the development models of the EU, and all over the world national Information society related programs are being published. Research will give some knowledge also of these activities when the motives of the entrepreneurs and the aspects of the adopting process of ICTS innovations are presented.

8.4 Recommendations to researchers

There are some proposals I would like to submit as future research topics.

Firstly, it is proposed that the emergent theory should be tested in various environments, for example, in different types of enterprise networks or in different industry branches. During the research process I have discharged some raw data, which was gathered from e.g. the wood industry branch and from the food industries. These types of research would be interesting, because the cultures between the industries, and sometimes within the them, seemed to differ. The effect of the industry's culture on ICTS innovation should be researched.

Secondly, I propose it would be interesting to refine the divisions of some of the categories of the emergent theory, for example, in a way which was presented in Section 8.2. That kind of research might reveal some new aspects and bring in new ICTS innovation categories.

Thirdly, the emergent theory can be developed further. In this study I applied only a part of the possibilities the methods based on the Grounded theory may offer. It would be important to define more precisely the system frontiers, the interfaces and the relations between the system categories. Also alternative differentiations between the categories could be found, or a new way to form the categories.

Fourthly, the research based on the varying, competition obstructive system categories, such as "Failure systems", "Relic systems, "Fake systems", should be important. Not very much has been said about the "reverse side" of the innovation systems. Such issues as cheating by using ICTSs, opportunistic aims, unlearning information systems or changing wrong decisions should be studied in future.

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APPENDIX 1
ITEP-project

Interview presentation material
(modified, translated from Finnish into English)

SEINÄJOKI

HERMIA

Name of Company	Contact	

Telephone	Telephone	Business idea

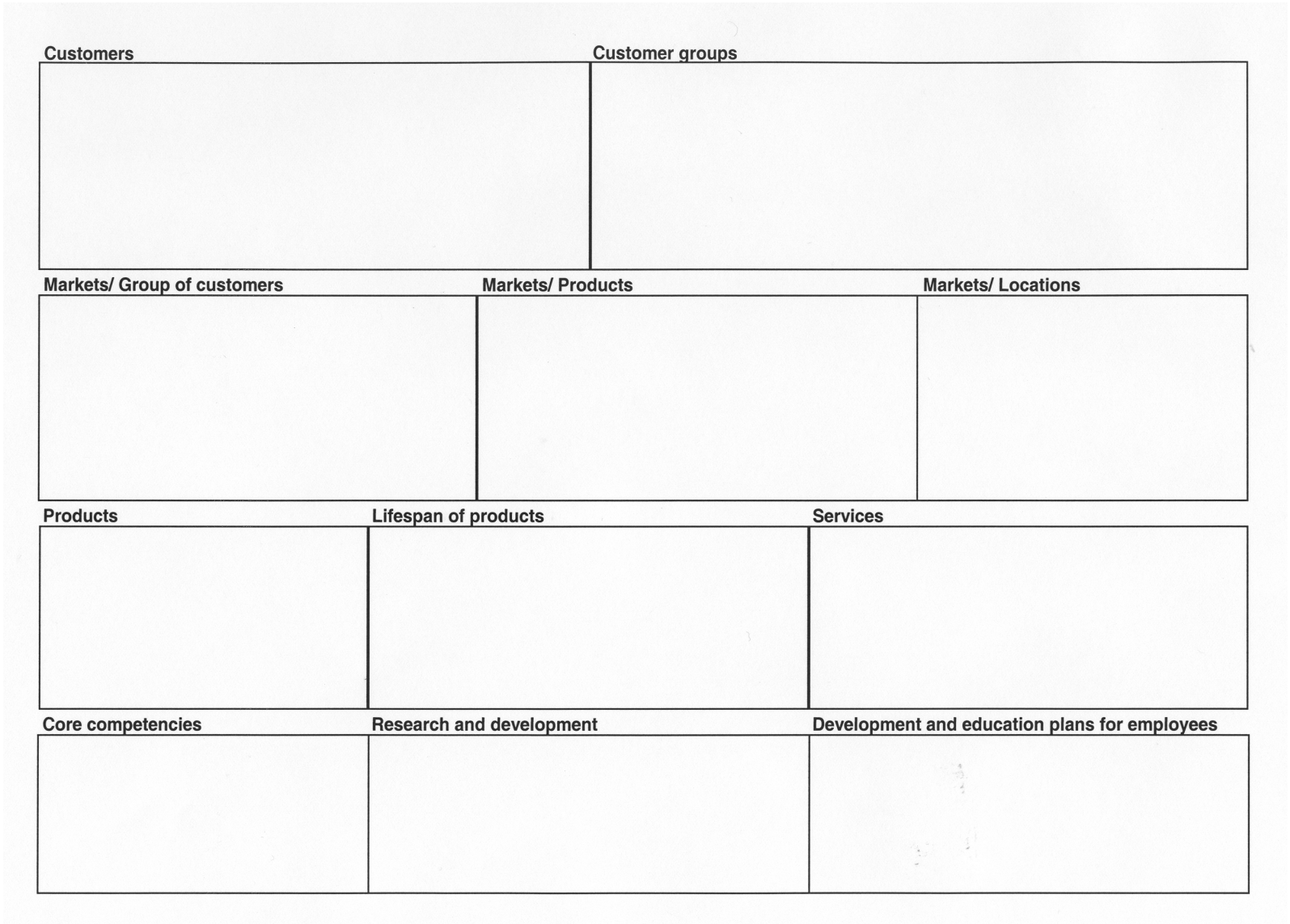
Telefax	Telefax	

Street address	Street address	Company's lifespan

Postcode	Postcode	

Town	Town	

Number of personnel	Turnover in 1995, 1996...		Areas of business	Personnel's professional and educational qualifications
	1995			
	1996			
Turnover	1997			
	1998			
	1999			


Customers
Customer groups
Markets/ Group of customers
Markets/ Products
Markets/ Locations
Products
Lifespan of products
Services
Core competencies
Research and development
Development and education plans for employees

Research and development investment in relation to the turnover of the company	Special skills; a specific interest in a branch

Local educational cooperation (with TYT, SeAMK)	Local research cooperation (with TYT, SeAMK)

Interest in local cooperation to develop business activities	Future plans, what is the position of the enterprise in five years

Interest in IT-development - / technology center

Advantages	Possibilities	Disadvantages

APPENDIX 2

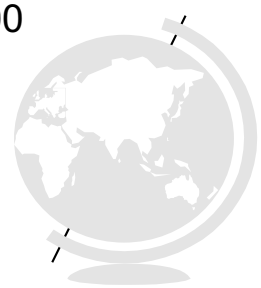
A Pilot Study of Electric Business Transactions
in Metal and Electronic Industry 2000 - 2001

The Orientation and Questions of the Interviews
Dec 2000

Interview presentation material (modified,
translated from Finnish into English)

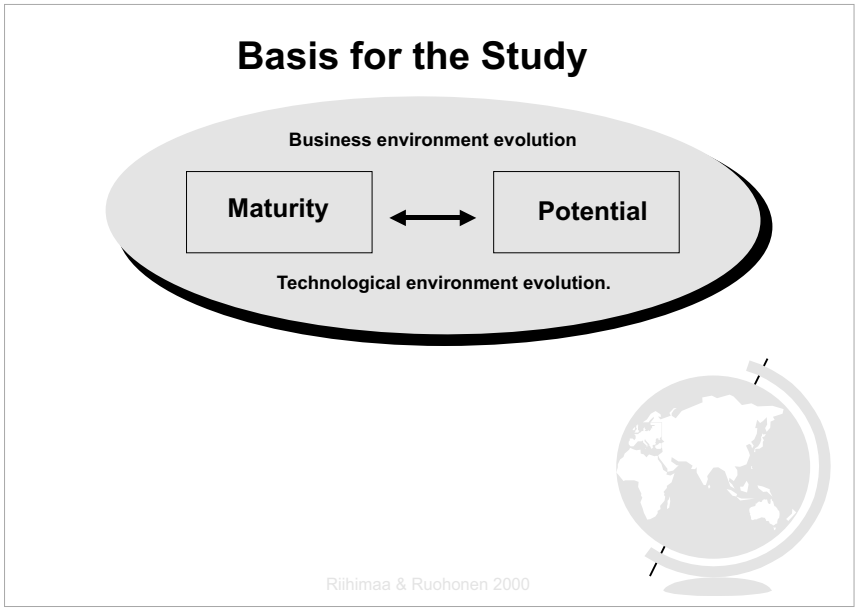
A Pilot Study of Electric Business Transactions in Metal and Electronic Industry 2000 - 2001

The Orientation and Questions of the Interviews Dec 2000



Aims

- Interviewing the management at 30 to 40 enterprises
- Recognizing three to five clusters and their plans for development
  - electric business transactions as an enabler of new and unique concepts of products and business
  - special attention paid to concepts of products and marketing and to applications that utilize mobile Internet connections (remote supervision, remote services etc.)



E-business: The use of information and communication technology (ICT) as a basis for communications, operations and management of an organization and as a driving force for having business changes.

M-business: The use of wireless data and communication platforms as part of communication, operations, management and changes in the business changes.

Mass customizing: Observing the needs of a particular customer or a group of customers in the strategies of products, customer service or production.

General questions:

1. What is meant by E-business or M-business in your organization?
2. What kind of possibilities do you generally see for starting E-business activities in the near future?
3. What are the requirements for the organization in your view (processes, job descriptions, new structures, management)?
4. What kind of threats and possibilities in developing your business and technology do you see in the near future?

Evaluating Maturity

- Organizational maturity
  - attitude and preparedness especially at the customer interface
  - separateness of administration and production
  - dynamism
  - planning in real time
  - have there been try-outs/failures?
  - products, their communication
  - openness, networks, transferring knowledge

Riihimaa & Ruohonen 2000

What is your view of the readiness of your organization for converting to E-business?

Does E-business have benefits? If so, what kind of benefits do you expect to have?

What kind of outer pressures influence your making use of E-business?

How capable for cooperation is your present line of business, how much of it is based on confidential business connections?

Evaluating Maturity

- technical maturity
  - IT standards and following them, data security, Internet choices, realizations
  - the role of human components in the know-how
  - systems used
    - self-made
    - bought
    - partial unities
    - large concepts

Riihimaa & Ruohonen 2000

IT abilities

Added value from generating innovations (new models for producing values)

Supporting the processes of IT personnel (knowledge management)

Producing data platforms for supporting the business (flexibility)

Operative excellence (supply chain management)

Managing alliance networks (marts)

What kind of experiences does the enterprise have of
- closed / open environment
- relationship to suppliers

What is your technical realization of the ADP systems?

Correspondence between the data systems of the management and the production

What kind of E-business knowledge does the enterprise have
- personnel
- try-outs
- networks / third parties

What is the data component of the products, how is it managed?

Evaluating Maturity

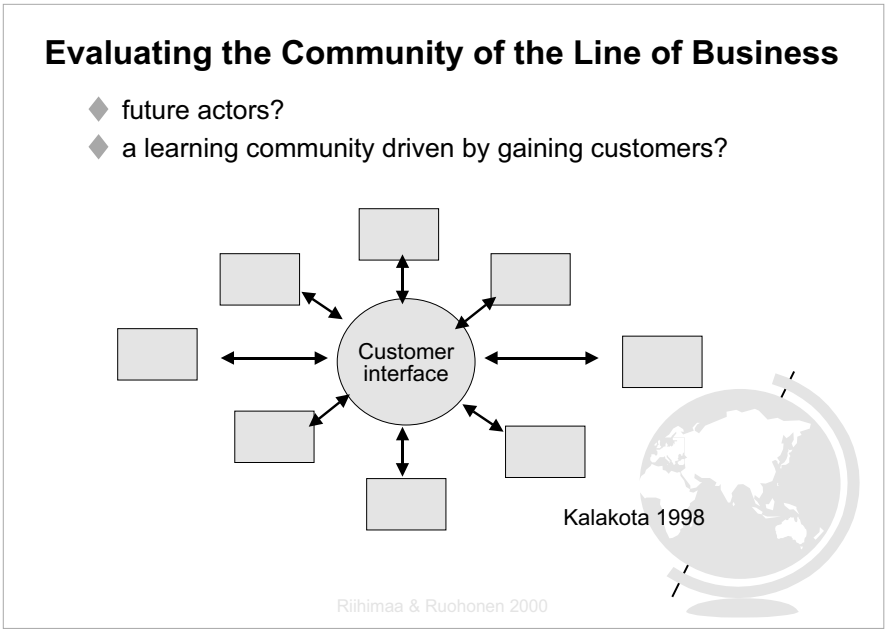
- management maturity
  - visions/views
  - IT internationally from the enterprise's point of view
  - IT culture's arrival at the metal and electronic branch
  - time for innovations
  - the enterprise as a product?

Riihimaa & Ruohonen 2000

How is the managing of E-business arranged in your organization (consult, IT integrator, separate unit, ADP department, within the functions)?

What kind of effects does the international business environment have on your adopting new ways of operating?

What kind of experiences does your organization have of E-business projects?



Has the competitive situation in your field remained stable, what structural changes do you expects to see (new products, services and competitors)?

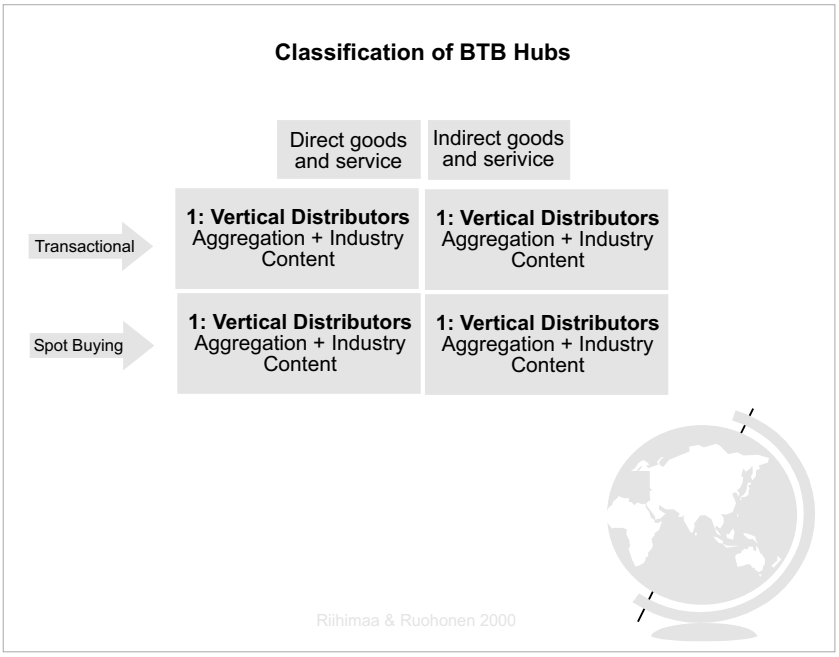
Is there any major changes happening or in view in your field, for example actors from other fields entering your markets or creating new ones?

What are the expectations of the customers in addition to your traditional way of business? Do they, for example, expect new qualities or services that can be produced by the means of E-business? What can those be?

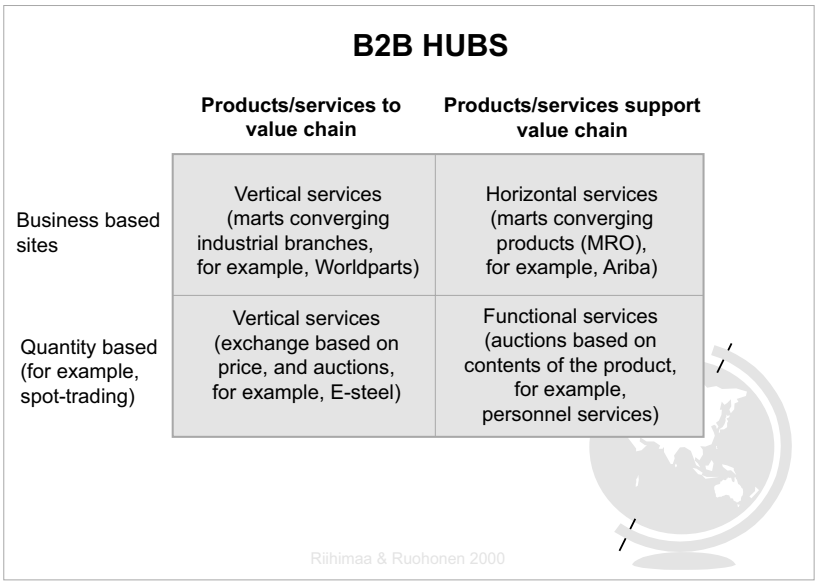
Can the customers be offered/sold new products/services that are not necessarily part of the nucleus of the organization's knowledge? If so, what is the best way of selling and distributing?

How cooperative is you present field of business? Any examples?

B2B HUBS



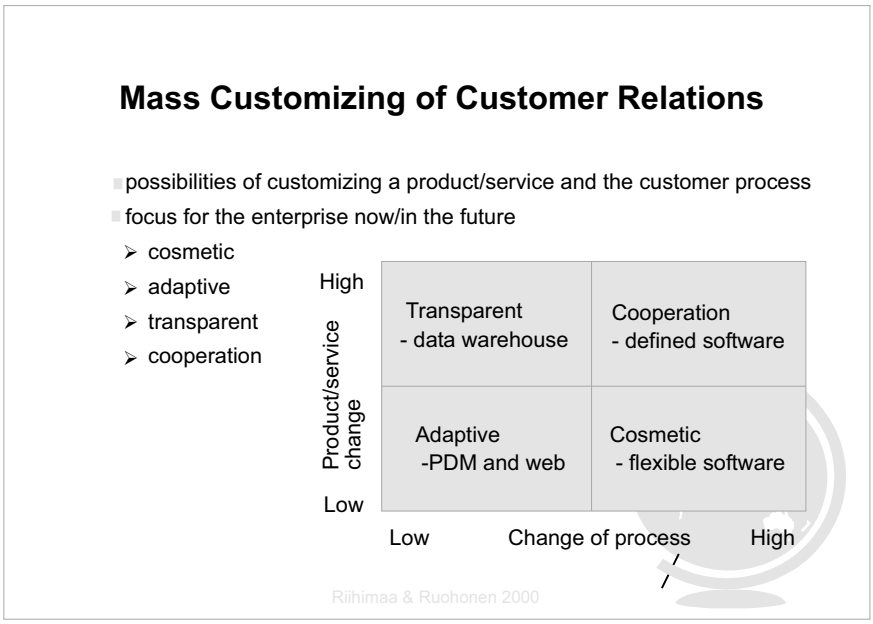
Please note the questions on the following page.



What kind of E-business sites of your field have appeared on the net, by whom are they administered?

- sites based on acquisition (set up by buyers, for example GE, car manufacturers)
- sites based on selling and marketing
- sited administered by a third party (for example Avnet)

In what way has your organization seeked a foothold on electric markets and what is your future strategy?

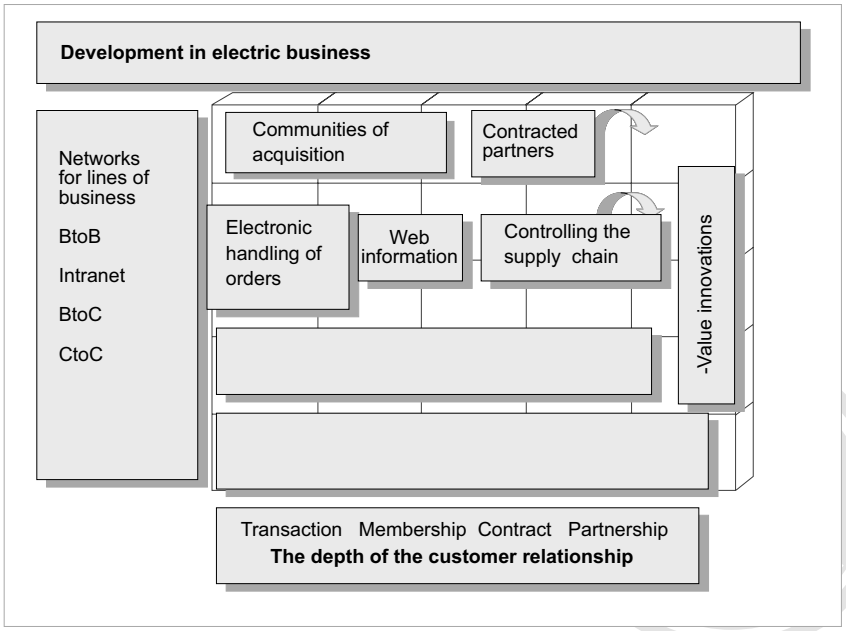


Do you have more need for customizing, in what way should it be done?

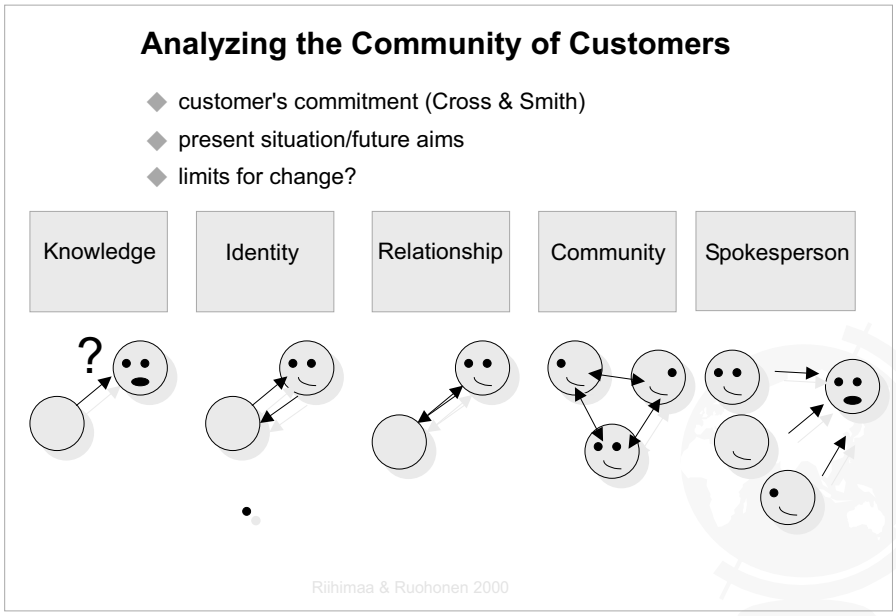
What is your mass customizing situation at the present, are there differences in individual products/services?

What data systems do you use as mass customizing tools?

Electric Business Framework



Please mark your position in the adjoining figure. Is your E-business based
- on placing orders via the net
- on managing a parallel service channel for registered customers
- on producing additional value by an electric channel



How ready or committed for accepting E-business are your customers/network of suppliers, any new groups of customers? Any differences between them (segments, geographical differences)?

What changes do you aim for, why? Your schedule? With whom?

What are he biggest obstacles in your view?

If you placed yourself either within a community or as an advocate, what are the data systems you use to support the customer relationship?

Mobile Business BtoB

- mobile control of the chain of delivery (time critical orders and logistics)
- telemetry (support and diagnostics)
- mobile commissions (customizing mobile work)
- control of hardware
- mobile control of customer relations
- support from mobile representatives
- mobile e-mail, intranet, ERP, ASP

Riihimaa & Ruohonen 2000

How big changes do you expect the wireless business to bring to the practices and processes of your organization?

What chances for applications do you see in the near future (see the list)?

Is your IT infrastructure ready for the changes required by M-business (job descriptions, processes, technical aspects)?

Are the tools offered by M- (or E-) business concepts ready enough for your needs? If not, what more is required?