VALUE-CREATING NETWORKS: AN ANALYSIS OF THE SOFTWARE COMPONENT BUSINESS

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Abstract

Theoretical discussion concerning value creation has been popular in recent years in business studies, at both relationship and network levels. However, the body of research on value creation still clearly exhibits a dearth of empirical studies, especially at the level of networks. In this study, value-creating networks are empirically explored in a specific dynamic industrial setting, the software component business. The purpose of the research is to build an empirically grounded model that provides the elements that are involved in carrying out value creation processes related to software component business networks. Through the empirically grounded elements of the model and variations identified within them, a typology of value-creating networks related to the software component business is aimed to be provided as an empirical outcome of the study.

First, a preliminary model of value-creating networks is built based on theoretical elaboration on the value creation and business network literature. The model is built upon the three interrelated elements of perceived end customer value, core competencies, and relationships. The preliminary model is then applied to the selected industrial setting. Based on the empirical findings, a fourth element is added at the heart of the model, namely the value system router. This fourth element characterise the importance of understanding the role of so-called system architecture in studying value creation and network structures in the software component business.

System architecture provides the layered framework for integrating different components and subparts in order to build an effective total system solution for the end customer. System architecture acts as a value system router, as it gathers value streams from several suppliers at different system layers and then leads the value stream through the integration process to the end customer, which sees the system solution provided as being one value-creating entity. Although system architecture is not a new concept or area of consideration in the fields of technology and industrial management, its role both as a rationale for the specific value network structure and as a tool for understanding actor positioning, competence linking, and supplier portfolio management has not been taken into account in earlier studies.

Keywords: business relationships, networks, software business, software components, value creation

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Tampere, November 2004 Nina Helander

List of symbols and abbreviations

ARA	Activity–resource–actor model
ASP	Application service provisioning
COTS	Commercial off-the-shelf (software)
CRM	Customer relationship management
ICT	Information and communication technology
IMP	Industrial marketing and purchasing
IPR	Intellectual property rights
IT	Information technology
MOTS	Modified off-the-shelf
ODM	Original design manufacturer
OEM	Original equipment manufacturer
R&D	Research and development
SBU	Strategic business unit
SCM	Supply chain management
SI	System integrator
SME	Small and medium-sized enterprises
SWE	Software engineering
TEKES	National Technology Agency of Finland
VCS	Value creation system
VSC	Value system continuum

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Part I Introducing the research setting

1 Introduction

Increasing global competition is a driving force pushing toward a networked way of doing business, as companies are forced to search for efficiency through co-operation with other companies. The underlying question is that of how well the companies combine and co-ordinate their value activities with other companies in order to together create an entity that is able to produce value for the end customer. These kinds of entities – namely, value-creating networks – are the focus of the present study.

In this first chapter of the thesis, the aim is to provide answers to the questions 'What is this study about?', 'Why has this study been carried out?', and 'How has this study been carried out?' In other words, this chapter sheds light on the research process, providing the starting point of a discussion that opens the background and motivation for the research to the reader. After that, the purpose of the study and the research questions are presented, followed by a discussion of the scope of the study. The scientific approach and research strategy of the study are covered before the chapter is concluded with a clarification of the key concepts and an overview of the structure of the dissertation.

1.1 Background and motivation for the study

This study is about exploring value-creating networks in a specific industrial setting, the software component business. In the sub-sections that follow, the background and motivation for the choice of value-creating networks as the research phenomena and the software component business as the empirical context are explained to the reader. A factor influencing both of these choices has been the potential for contributing something new to add to the previous research. These intended contributions are also identified in the following sub-sections.

1.1.1 Why another study of value-creating networks?

Value as a concept has received increasing research interest in recent years in marketing and management studies. Value and value creation have been given particular focus in the field of consumer marketing, but they have gained increasing popularity also in business-to-business marketing. Studies about value creation largely concentrated on the customer's perspective at first, but more recently the supplier's perspective has been taken into account as well. That has led further, toward studies addressing joint value creation in buyer/seller relationships (see, e.g., Forsström 2003, Ramirez 1999).

In business-to-business contexts, value creation has been explored at different levels as well. Value creation has been studied both at the level of dyadic business relationships (e.g., Hirvonen & Helander 2001, Möller & Törrönen 2000, Anderson & Narus 1999, Anderson & Narus 1998, Lapierre 1997) and, increasingly, at that of business networks (e.g., Thomas & Wilson 2003, Möller *et al.* 2002, Kothandaraman & Wilson 2001, Wedin & Johanson 2000, Parolini 1999).

Research concerning value creation at the level of business networks has gained worldwide interest: studies have been carried out among scholars representing different disciplines and theoretical backgrounds, and the phenomenon studied here has been labelled in various ways by the different scholars – as, e.g., value creation networks, value-creating networks, value creation systems, or value systems. However, one area of commonality among these studies is that they have been mainly theoretical in nature. As stated by Ulaga (2001), there is still a lack of *empirical studies* concerning value creation in networks in industrial contexts. Although there are some recent exceptions – empirically-oriented studies of value creation at the level of business networks (e.g., Svahn 2003, Törmänen & Möller 2003, Törrönen & Möller 2003) – there still exists an empirical research gap, which the present study aims to help fill.

In fact, the present study aims at local theory-building by bringing existing concepts and theoretical models describing value-creating networks into a certain, specific industrial setting. As already stated, studies concerning value-creating networks have been carried out by several scholars representing different fields, interests, and theoretical backgrounds. Nonetheless, two main avenues of research can be described: the industrial marketing and purchasing (IMP) approach focused on studying industrial networks that are not manageable in the strict sense of the word and, secondly, the North American angle concentrating on studying strategic alliances and intentionally managed business networks. The main difference between these two approaches is their underlying assumption about the manageability of a business network. Such differences do not, however, take away the possibility to utilise both of these approaches for theoretical bases of the same study. In fact, the question of network manageability can be dealt with as a matter of different units of analysis, net-level study and network-level study (see, e.g., Möller *et al.* 2002), and they can be taken as supplementary views of the same phenomenon: the value-creating network.

The present study is based on both of these main approaches to research, although with an emphasis on the IMP approach as the main theoretical underpinning. In both of these main avenues of research, various concepts and theoretical models have been developed to describe, conceptualise, and analyse value-creating networks, but their applicability to a particular industry and industrial setting has not been at the core of these previous studies. *The present study may be distinguished from previous studies by its clear empirical focus*: the purpose is to build an empirically grounded model for increasing our understanding of value-creating networks in a chosen, specific industrial setting.

1.1.2 Why the software component business as the empirical context of the study?

It has been pointed out (see, e.g., Easton 1995) that business networks *per se* are impossible to research out of context, as organisations cannot be removed from their setting. Furthermore, the phenomenon of value creation in business networks would not behave naturally out of its context, according to the view that context and action are inseparably intertwined (as seen in, e.g., Pettigrew 1992). Thus, the choice of a specific industry as the context of the study is highly important when studying value creation in business networks, especially when the phenomenon is to be examined empirically.

The possible industrial settings for empirical study of value creation in business networks are numerous. For example, one could consider whether to study the phenomenon through exploring well-established industries or instead to choose a new and emerging industry. Additionally, the nature of the product or service could be considered: for example, whether to study an industry involving physical goods or one that is more service-oriented. To take an example, the automotive industry as a representative of a more traditional industry would have been one possible option, an area in which there already exist rather well-structured networks, and the value creation logic within this industry's networks would certainly have been interesting to research. In addition, the industry has held general interest for industrial marketing and management researchers for a long time now, yielding a body of knowledge[1] about business network structures specific to the industry. At the same time, there still is need for updating the existing body of knowledge, as the network structures and value creation logic within the industry are changing due to the general trends toward globalisation and digitalisation. A similar situation is found in the other 'traditional' industries.

However, there are also some younger industries where a similar kind of body of knowledge has not had enough time to be developed yet. In the present study, one of these younger and more non-traditional industries, in which the body of knowledge, particularly concerning business networks and value creation logic, is still largely non-existent, was selected for exploration. The industrial setting chosen for the study is the software component business; reasons for the choice of this particular industry, one that is still in the early stages of development, are explained below.

Most importantly, the software component business acts as a fine representative of a networked way to do business, as software components are not valuable in the eyes of the

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[1] The existing body of knowledge refers here to conceptual systems that are able to describe and analyse industry-specific network structures. These kinds of conceptual systems have already been developed for the automotive industry, as it has been the empirical focus of several studies by different researchers.

end customer as standalone applications but merely as part of wider system solutions consisting of multiple interrelated components produced by several suppliers. Thus, in the software component business, it is reasonable to study value creation as a process embedded in a set of interconnected exchange relationships – i.e., to study value-creating networks.

Furthermore, with the object of exchange in the industry as intangible and abstract in nature as software is, the value related to the object of exchange is difficult, but at the same time very important, to understand for the actors in the industry. In fact, software companies are currently facing the challenge of determining if it is valuable for them to move toward development and/or utilisation of commercial software components instead of developing the software in projects charged by the hour as they are used to doing. These kinds of problems in understanding the value created through utilisation of commercial software components have hindered the development of the software component business, despite the fact that the business's development could play an important role in the development of the whole software industry.

Additionally, as already mentioned, a value-creating-network study can add utility and relevance for the software component business, as the number of network studies, and even the number of industrial marketing and management studies in general, is rather limited in this field.

Thus, the selection of the software component business as the empirical context of the study allows for a special contribution to the rather scarce literature concerning the software business and this sub-field in particular. Although a number of studies focusing on the software industry (e.g., Tyrväinen *et al.* 2004, Messerschmitt & Szyperski 2003, Hyvönen *et al.* 2003, Kuivalainen 2003, Sallinen 2002, Warsta 2002, Tähtinen 2001, Hoch *et al.* 1999, Athey 1998, Torrisi 1998, Greenstein 1997, Mowery 1996) and even on the emerging software component business (e.g., Ulkuniemi 2003, Seppänen *et al.* 2001, Niemelä *et al.* 2000) have recently been published, the number of studies that specifically address value-creating networks in the emerging software component business is very limited (e.g., Helander *et al.* 2002).

1.1.3 Why the ICT cluster and industrial automation sector play a role in the study?

The chosen industrial setting of the software component business is not a segment of industry in its own right; rather, it is a rather inseparable part of the software industry and the information and communication technology (ICT) cluster as a whole. The structure of the ICT cluster and the role of the software industry within it are discussed in more detail in Chapter 2. However, for clarification of the empirical context of the study, Figure 1 is provided as an illustration of the software component business, software industry, and ICT cluster and its sub-sectors.

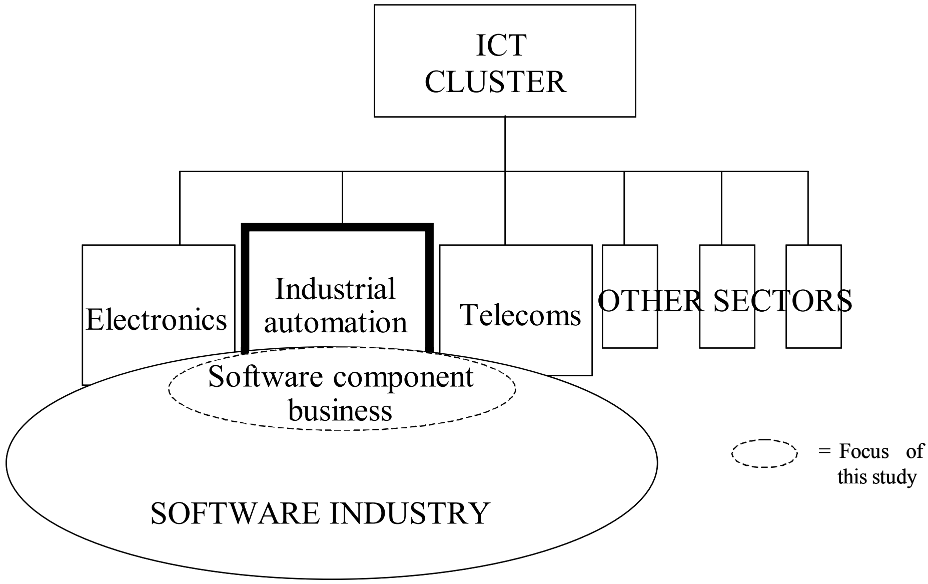

Fig. 1. Illustration of the empirical context of the study.

The ICT cluster can be seen to be divided into several sub-sectors, of which the electronics, telecommunications, and industrial automation sectors (see Figure 1) are the main ones. However, the borders between the various sub-sectors are somewhat blurred; for example, the industrial automation sector is at the intersection of several other sub-sectors (see, e.g., Meristö *et al.* 2002, Paija 2001). The software industry is illustrated in the figure as a separate segment of industry but also as something that is dependent in part upon the other segments of industry forming the ICT cluster, as argued recently in a research report provided by Tyrväinen *et al.* (2004) concerning the Finnish software industry. Accordingly, software offerings are increasingly provided by representatives of many other industrial segments, too, as opposed to just pure software companies. Tyrväinen *et al.* (2004) base this reasoning on empirical findings, which show that many of the industrial segments that have been viewed mainly as customers of software companies have in fact entered the software business themselves in the role of software producers.

As the entire software industry is leveraged through the different industrial segments within the ICT cluster, the case of the software component business is similar: it can mostly be seen as a smaller part of the software industry as a one way to do business with software. But on the other hand there are also other industrial segments than just the software industry in the ICT cluster that have begun to develop commercial software components on their own and in this way certainly play an important role in the software component business.

The rapid growth and change of the ICT cluster (see, e.g., OECD 2003, OECD 2002, Pilat & Lee 2001, Meristö *et al.* 2002, Jansson *et al.* 2001, Mankinen 2001, Hoch *et al.* 1999, Kajanto 1997), especially the growth of the software industry as part of this cluster during the 1990s (see, e.g., Tyrväinen *et al.* 2004, Messerschmitt & Szyperski 2003, Tarjanen & Ruusunen 2003, Hoch *et al.* 1999, Nukari & Forsell 1999), and the remarkable influence of these firms on the Finnish economy have indeed gained the attention of several researchers. Both the success factors behind the growth and the potential pitfalls have been studied.

Although in Finland the ICT cluster can still be seen as quite inchoate, general trends of convergence and networking have been identified (Meristö *et al.* 2002, Jansson *et al.* 2001, Tieke 2001). This offers an interesting area for research. Companies involved in this development must not only understand the structure of the surrounding environment but also position themselves in it. The question is not merely the traditional outsourcing (see, e.g., Nellore & Söderquist 2000) dilemma, whether to make or buy; the third option, 'to connect', exists also (Meristö *et al.* 2002, Parolini 1999), leading toward varying interdependencies between companies and complex networks. Companies need to constantly consider what their core competencies are and decide on that basis which activities to carry out in-house and which to outsource.

The trend of outsourcing due to the desire to concentrate on core competencies can be seen in many industries (as described by, e.g., Toivonen 2000, Kasouf & Celuch 1997, Alajoutsijärvi 1996, Paliwodi & Bonaccorsi 1994), and not just in the ICT cluster. In particular, when large industrial customers start to outsource, they often look for turnkey solutions and complete system deliveries. It can be argued that this leads to an increasing role for system solution providers, also called system integrators (SI) or original equipment manufacturers (OEM). In the ICT cluster, the growing importance of system solution providers has been identified both at the national level (Meristö *et al.* 2002) and at the global level (Hoch *et al.* 1999).

It is a challenge for an SI to manage the product development and integration of comprehensive, usually quite large and complex solutions. The challenge is even greater in the ICT cluster, where most system solutions offered include not only hardware[2] but also *software* and related media content and services. In physical product development, such concepts as product platform and components have been visible for years in the attempt to improve the effectiveness and manageability of product development (see, e.g., Soininen 1997, Ullrich & Eppinger 1995, Wheelwright & Clark, 1992). More recently, these concepts have been adapted to the field of software, too (see, e.g., Dobrica & Niemelä 2000, Kuikka 1999, Niemelä 1999, Sääksjärvi 1998). Thus, it is not a surprise that software platforms and components and their potential benefits have been a central topic of discussion in the area of software engineering (SWE). Software components have also attained attention in business-oriented studies (e.g., Meyers & Oberndorf 2001, Seppänen *et al.* 2001, Niemelä *et al.* 2000, Hoch *et al.* 1999). For example, Hoch *et al.* (1999, 228) have identified *software componentisation*, as they term the use of standardised software components, as one of the main future opportunities for the software business. However, they also point out that software componentisation includes many uncertainties and risks, too. Meyers & Oberndorf (2001, 14-19) and Niemelä *et al.* (2000) have listed both elements of promise and pitfalls of software components, concentrating especially on the utilisation of commercial software components, and not

[2] Hardware refers to the portion of information technology that is based directly on physical laws, such as those of electronics, magnetism, or optics (Messerschmitt & Szyperski 2000).

just on internal software componentisation (i.e., component-based SWE within one company).

In fact, intra-organisational software reuse emerged quite rapidly in the 1990s, based on proprietary software components and platforms. On the other hand, rather little has happened when it comes to systematic reuse of commercial software components, although the idea of large-scale reuse of standard software components was introduced as early as in the late '60s. Thus, it can be argued that utilisation of commercial software components – i.e., the software component business in the sense of recognisable markets consisting of customers and sellers – is still in its early stages of development, although the impact of software components on industrial SWE is already evident. There are shortcomings both in component technologies and in component-based software processes (see Niemelä *et al.* 2000), but other apparent reasons behind the slow development can be identified from the business perspective, such as issues of defining the coming roles of actors in the markets and problems in developing and managing interactions between software component sellers and buyers, in practice. Most importantly for the present study, it is not obvious what kind of value is created in the interaction between component sellers, buyers, and possible intermediaries, let alone how.

However, there are some industrial segments within the ICT cluster that are already more advanced in utilising commercial software components than other segments are; for example, the industrial automation sector is a more advanced industrial segment within the ICT cluster (see Niemelä *et al.* 2000). What also makes the industrial automation sector an interesting representative of the ICT cluster from the viewpoint of the present study is its position within the ICT cluster: the industrial automation sector stands at the intersection of several other industrial segments in the ICT cluster and thus can yield a rather multifaceted view of the ICT cluster as a whole (Taskila *et al.* 1995).

In this study, the software component business is subdivided further, with study focusing on the industrial automation sector. This specification of the empirical context, limiting it to the industrial automation sector instead of the whole ICT cluster, has enabled increased manageability of the study. Additionally, the network analysis could be carried out in greater depth and detail.

1.2 Purpose and research questions of the study

The purpose of the research is to build an empirically grounded model for increasing our understanding of value-creating networks related to the software component business. Thus, the research problem of the study can be described as follows:

> *How can one best describe and analyse value-creating networks related to the software component business?*

The solution to this research problem is generated through finding answers to the following questions:

1. What are the constituent elements that describe value-creating networks in the software component business?

2. How are these elements related to each other?
3. What are the specific features of the software component business that influence the structure of value-creating networks?

Both the first question, 'What are the constituent elements that describe value-creating networks in the software component business?', and the second, 'How are these elements related to each other?', are theoretical and empirical in nature. The first question provides *the concepts* through which a value-creating network can be described and its structure analysed; the second question provides *the propositions* that describe the functional relationships among the concepts (see, e.g., Zaltman *et al.* 1982).

Answers to the questions are at first sought through a literature review addressing the concepts of value creation and business networks. The search for the answers is started by discussing the concepts of value creation and business networks separately. Then, these concepts are linked through reviewing models and previous theories on value creation at the level of business networks. Several studies that have dealt with the issue were found, and these are reviewed, discussed, and evaluated. Based on this method of conceptual analysis, a preliminary model of value-creating networks is then developed. The model rests on three constituent elements: perceived end customer value, core competencies, and relationships. Each of these components and their relationship to each other are explored in a more detailed manner in order to clarify their contents and to make sure that their multifaceted nature is taken into account in the analysis.

After theoretical analysis, answers are sought through an empirical study, which is a single-case study with two interrelated levels of analysis, the network and focal net level. These two levels of analysis form two separate but highly interrelated parts of the empirical study, and together they enable multiple ways of viewing the research phenomenon. The first part of the empirical study is a general study of the industrial automation sector that is carried out from a holistic network perspective. By clarifying the characteristics and network structures typical of the software component business that exist in the industrial automation sector, this first part of the empirical study acts as a foundation for the analysis at a more detailed level of a particular focal net within the industrial automation sector. The second part of the empirical study is the more detailed analysis of a focal net surrounding a system integrator company in the industrial automation sector. The network is at this point studied from a single actor's point of view. Although the scope of the focal net under study is defined through the SI company operating in the industrial automation sector, the nearest actors for the SI are also studied, as is characteristic for a focal net study. The other actors studied are the main software suppliers and main customers of the focal SI. The empirical material is analysed by using the preliminary model developed for value-creating networks as an analytical tool – i.e., as eyeglasses – in order to describe and analyse the focal net.

The third question, 'What are the specific features of the software component business that influence the structure of value-creating networks?', and the answer to it provide a synthesis of the theoretical and empirical parts of the work. This third question is the 'glue' of the whole study, as it provides meaning for the concepts and propositions introduced as applied to the specific industrial setting. The answer to this third question is presented in the form of the empirically grounded model of value-creating networks. The model is built in three steps. Firstly, the preliminary model is developed based on the conceptual analysis of existing theories. Secondly, the empirical study is conducted and the empirical data are analysed through use of the preliminary model. Then, as the third step, the findings from the empirical material are used to revise the preliminary model into the form of an empirically grounded model of the value-creating networks related to the software component business. In other words, through the empirical study the preliminary, theoretical model is developed into a model that better takes into account the specific characteristics of the software component business.

The model developed for value-creating networks provides *the elements that are involved in carrying out value creation processes* related to software component business networks. Based on these empirically grounded elements and variations identified within them, a *typology of value-creating networks related to the software component business* can be provided as an empirical outcome of the study.

1.3 Scope of the study

The scope of the present study can be described through the following characteristics:

- Research phenomenon: Value-creating networks
- Theoretical basis: Industrial marketing and management literature concerning the concepts of value and networks, with an emphasis on the IMP literature
- Empirical context: The software component business, specifically studied through the industrial automation sector

Value has been a particular focus of study where consumer marketing analysis touches the topic of customer value (e.g., Donath 1998, Lapierre 1997, Storbacka & Lehtinen 1997, Donath 1996), but more recently a number of studies about value creation in industrial markets have been carried out, too (e.g., Naudé & Holland 2000, Blankenburg-Holm *et al.* 1999, Ford & McDowell 1999, Anderson & Narus 1998). Furthermore, especially among the researchers making up the loose IMP (industrial/international marketing and purchasing) Group, recent years have seen such studies dealing in particular with the topic of value creation in *nets and networks* (e.g., Svahn 2003, Thomas & Wilson 2003, Törrönen & Möller 2003, Möller *et al.* 2002, Kothandaraman & Wilson 2001, Wedin & Johanson 2000). In the present study, the roots of the concepts of value and network are examined as presented in the industrial marketing literature, with a special focus on the IMP tradition.

As there is still a paucity of empirical studies about value-creating networks in the industrial marketing literature, the present study has among its purposes to empirically explore the relevant phenomena in the industrial setting of the software component business. However, as the software component business is not a separate industry segment but instead is leveraged across different sectors in the ICT cluster, the Finnish ICT cluster as the larger empirical context is taken into account in the study. However, the industrial setting of the software component business is explored from the standpoint of one specific industrial segment within the ICT cluster, the industrial automation sector.

Network studies can be carried out to varying extent and in different degrees of depth; thus, the scope of a network study can vary rather a lot. In the present study, the scope of the network study is defined through the following steps:

1. the software component business is chosen as the industrial setting because there exist problems related to the kind of value and how the value is created →
2. interest in studying industrial networks in which commercial software components are developed and utilised →
3. such networks are found in the ICT cluster →
4. in order to perform more in-depth network analysis, the empirical context is narrowed from the entire Finnish ICT cluster to one of its specific industrial segments, the industrial automation sector →
5. through the perspective of the system integrators, the width of the actors included in the network analysis is defined, as SIs have been recognised in the literature as playing a central role in the software component business[3]

Based on the above reasoning, the scope of the network analysis carried out in the present study is defined as involving those value creation systems found in the industrial automation sector in which commercial software components play a role. The actor perspectives that are included in the scope of the analysis are those of the SIs, their suppliers, their customers, and possible intermediaries between these actors. It would be possible to broaden the scope of the analysis, starting even with the first suppliers of materials and extending so far as to end with the individual end consumers. Thus, there are several tiers as one looks either upstream or downstream within a value chain, which all could be covered in a network analysis, at least in principle. However, in the present study, the scope is extended to cover the SIs, their main suppliers (i.e., suppliers in either the first or second tier), and their direct industrial customers. Next, Figure 2 illustrates the research area of the study.

[3] See the discussion in Section 1.1.

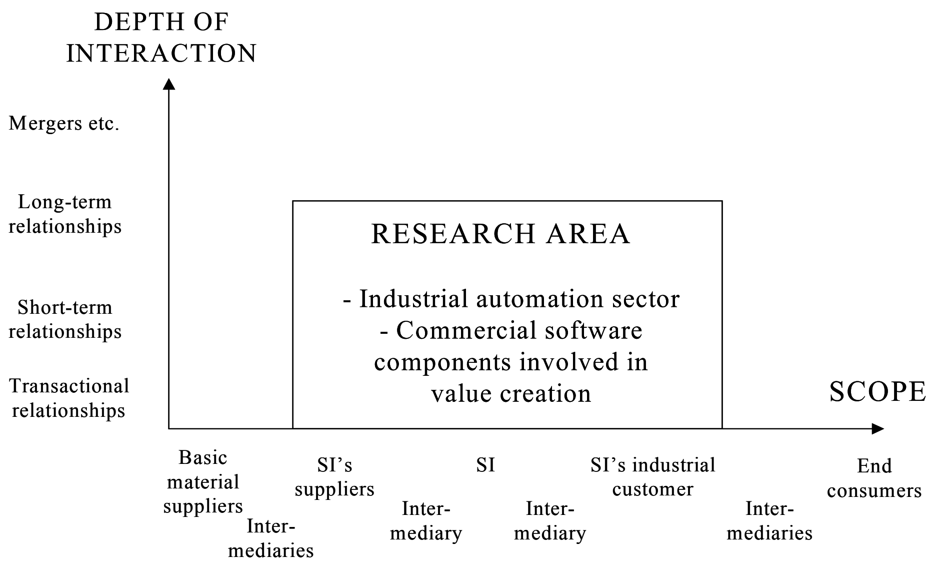

Fig. 2. Research area of the study (modified from Kothandaraman & Wilson 2001).

Figure 2 indicates in its summary that the scope of the network analysis in the present study is limited to the actors of the SI, its suppliers and customers, and possible intermediaries between them. Furthermore, the depth of interaction taken into account in the analysis varies from transactional exchange relationships to long-term relational exchange, leaving out only the most extreme forms of vertical integration, such as mergers and acquisitions. In the middle of the figure, the industrial setting of the software component business as studied through the industrial automation sector is highlighted as the empirical research area of the present study.

1.4 Scientific approach and research strategy

This section starts with a general discussion of different research traditions and scientific approaches relevant to the study, with an aim of positioning the present study among them. Additionally, the research strategy of the study is highlighted.

Referring to Uusitalo (1991), in many cases research tasks have characteristics related to several research archetypes and avenues of research, and often the boundaries and characteristics of different archetypes are not so clearly defined. However, this does not mean that the researcher should not be aware of the different possible orientations and the context of the main philosophical and scientific approaches adopted in the study (see Pihlanto 1994). Below, the scientific approaches utilised in this study are explained to the reader, although the discussion will not provide any single 'label' for the present study as a clear representative of one specific research approach.

Burrell & Morgan (1979) offer a fruitful approach to positioning one's own research in the larger context of the social sciences and organisational studies, by identifying four different philosophical assumptions about the nature of the social world. These assumptions relate to ontological, epistemological, human, and methodological nature[4]. The first three assumptions, about ontology, epistemology, and human nature, have direct implications for the question of methodology. Based on these assumptions, the authors present a scheme for analysing assumptions about the nature of social science, as illustrated in Figure 3.

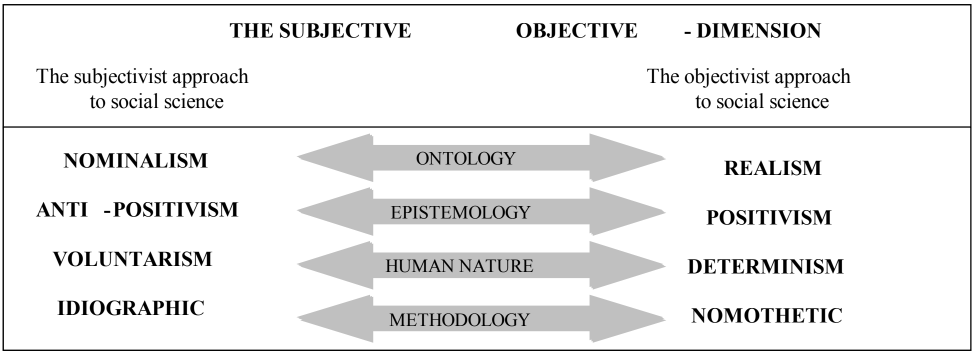

Fig. 3. A scheme for analysing assumptions about the nature of social science (Burrell & Morgan 1979, 3).

It needs to be noticed that in Burrell & Morgan's (1979) scheme the nominalism–anti-positivism–voluntarism–idiographic approach refers to the tradition of German idealism and hermeneutics, whereas the other extreme, the realism–positivism–determinism–nomothetic approach, refers to the tradition of sociological positivism. Additionally, the scheme stresses subjective and objective approaches to social science. The subjectivist approach stresses the importance of subjective experiences of individuals in the creation of the social world. The main concern is with understanding the way in which the individual creates, modifies, and interprets the world in which he or she lives. This approach emphasises the relativistic nature of the social world and the utilisation of qualitative research methods. The objectivist approach, on the other hand, treats the social world as hard, external, and objective reality. The main concern is with the identification and definition of these elements and with the discovery of ways in which they can be expressed. This approach emphasises searching for universal laws that explain and govern the reality being observed. Additionally, quantitative research methods are favoured. However, these two approaches represent the extremes of a continuum, not the only possible alternatives.

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[4] Ontological nature refers to the very essence of the phenomena under investigation; epistemological nature includes assumptions about how one might begin to understand the world and communicate this knowledge to other people; human nature refers to those assumptions that pertain to the relationship between human beings and their environment; and methodological nature describes the way in which one attempts to investigate and obtain knowledge about the social world (Burrell & Morgan 1979).

On this subjectivist/objectivist continuum, the present study is positioned toward the subjectivist side. The aim is to interpret and understand the phenomena under study rather than to arrive at law-like generalisations[5]. The aim is to gather first-hand knowledge and to achieve understanding from inside rather than from outside, by utilising qualitative research methods. Thus, this research follows idiographic research methodology, as opposed to nomothetic research methodology (see Pihlanto 1994, Neilimo & Näsi 1980, Burrell & Morgan 1979).

Closely related to the research methodology is the choice of inductive and deductive ways of drawing conclusions and building theories; induction is based on empirical evidence, whereas deduction is based on logic. In other words, a researcher applying induction draws theoretical conclusions based on empirical observations while deduction involves formation of hypotheses based on laws and theories before testing of the hypotheses by gathering facts. Although these seem to be opposite approaches, they can both be utilised in the same study. (Ghauri *et al.* 1995)

In fact, although in this study one aim is to add, based on findings from the empirical data, to the general knowledge on value-creating networks, information on and a framework for considering such new aspects as are needed in studying software-intensive industries – and the software component business in particular – this study cannot be labelled purely inductive. There are also deductive characteristics present because the empirical data are viewed in a certain theoretical framework.

Additionally, Alasuutari (1995) discusses the cyclical movement between theoretical and empirical considerations in qualitative research when he distinguishes between movement to a local explanation from a theoretical framework and vice versa, from a local explanation to theoretical ideas. The theoretical and empirical parts of this study are in a dialogue: the empirical information is analysed through a preliminary model based on previous research, but then the model is revised based on the findings and new ideas emerging from the empirical material.

The dialogue between the theoretical and empirical viewpoints forms the core of the research strategy of the present study. Figure 4 illustrates this research strategy.

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[5] Law-like generalisations are such generalised conditionals as have empirical content, exhibit normative necessity, and are systematically integrated into a body of scientific knowledge (Hunt 1991).

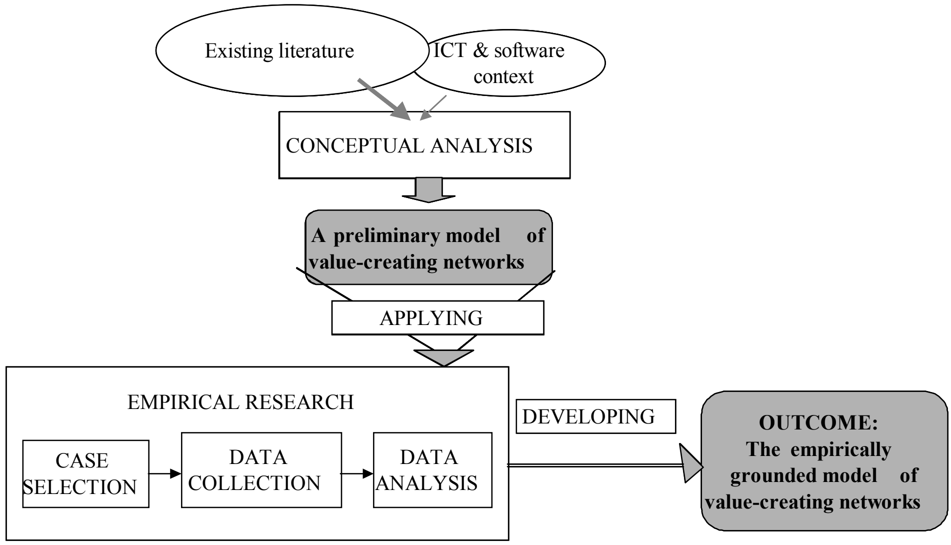

Fig. 4. Research strategy of the study.

The empirical study that is discussed in the third part of the thesis is a single-case study with two interrelated levels of analysis: network and focal-net-level analysis. According to Yin (1994), a case study strategy is appropriate when the research problem is of the 'how' or 'why' type. As the present study has an interpretative orientation and aims to understand and interpret the phenomenon from inside rather than outside, also the research problem of the study represents a 'how' form. Furthermore, as the phenomenon of value-creating networks is a contemporary one; it is investigated within its real-life context; and the boundaries between the phenomenon and context are not clearly evident, the case study strategy was a suitable research strategy to adopt. (Yin 1994) The reasons for choosing a singe-case study with more than one level of analysis are explained to the reader in Chapter 5's discussion of the empirical research design.

The positioning of this study as interpretative and with idiographic orientation is in line with the metatheoretical profile of the network approach, which is utilised as the main theoretical basis of the study. Here, the network approach refers to the Nordic tradition of studying relationships and networks – i.e., to the work of the researchers forming the loose IMP (Industrial/International Marketing and Purchasing) Group. The IMP Group was formed in 1976 by researchers from five European countries. The group's first work was a large-scale comparative study of industrial marketing and purchasing across Europe. Results from that study were published in 1982, in *International Industrial Marketing and Purchasing*, edited by Håkansson. (Gadde & Håkansson 2001)[6]

According to Möller (1995), the network approach for studying inter-organisational marketing exchange emphasises the *understanding* of complex systems of relationships from positional and network perspectives. Understanding of the phenomena as the

[6] For a brief discussion of the history of the IMP Group, see, e.g., Olkkonen *et al.* (2000).

ultimate aim of the research leads toward the methodological choice of an inductive, interpretative, and idiographic orientation. Additionally, the network approach emphasises a subjectivist orientation, basing the analysis on the opinions and views of the actors inside the phenomenon studied, the network (cf. Tikkanen 1998, 1996).

1.5 Clarification of the key concepts

Next, the key concepts and terms of the study are explained as they are understood and utilised in this dissertation. The concepts are the following: value, business relationship, business network, core competence, software, and software component.

Value. Value is one of the central concepts in this study. Varying views on the concept have been presented (see, e.g., Möller & Törrönen 2000, Anderson & Narus 1999, Anderson & Narus 1998, Lapierre 1997, Normann & Ramirez 1993). According to a rather general view, the concept of value can be regarded as *the trade-off between benefits and sacrifices* (Parolini 1999, Walter *et al.* 2001). Some authors define value purely in *monetary* terms, whereas others use a broader definition also including such *non-monetary* benefits as competence, market position, and social rewards (Walter *et al.* 2001). In this study, the broader definition of value is applied. The role of software in larger systems would be extremely difficult to characterise in purely monetary terms because there are no standard means to calculate the value of a piece of software incorporated into a larger system. A 'small' program can be of vast importance for the system, such as in the case of a novel machine control algorithm or a greatly improved process parameter measurement function.

Furthermore, value is in this study seen as *differentially perceived* (see, e.g., Parolini 1999). Differential perception means that value is measured *in the customer's mind in relation to that of other comparable value-creating solutions*.

Core competence. Core competencies are understood in this study as *resources* (see, e.g., Prahalad & Hamel 1990) that are *strategic* (see, e.g., Sanchez & Heene 1997) in nature. In other words, they enable creating differential and superior value for the customer (Alajoutsijärvi & Tikkanen 2000). Although core competencies are *organisationally embedded* (see, e.g., Seppänen 2000) *knowledge and skills* (see, e.g., Sanchez 1995), they should be regarded as free from rigid organisational boundaries in a value network context. In other words, emphasis is on competencies that the network actor is able to *utilise*, not on competencies that the actor *possesses* (Lowendahl & Haanes 1997).

Business relationship. A business relationship refers in this study to *an exchange relationship* between two *organisational parties* (see, e.g., Möller & Wilson 1995). In other words, the concept of business relationship chosen for use in this study refers not only to long-term relational exchange but also to short-term dyadic relationships. This choice is based on Webster's (1992) classic model of the relationship continuum, which illustrates different kinds of interactions in which organisations may be involved. Accordingly, not all business relationships are close and oriented toward the long term; rather, relationships vary along a continuum with pure market transactions at one end and fully integrated hierarchical firms at the other. Thus, the *full range of exchange* *relationships from transactional to partnerships* between two organisational parties is covered in this study under the term '*business relationship*'. The types of relationship on the continuum presented by Webster (1992) differ from each other especially as regards the intention of the parties to develop a more enduring relationship (see, e.g., Möller & Wilson 1995) and in the significance of relational exchange between the parties in the relationship. However, characteristic of all of the relationship types is that *exchanges of different kinds of attributes* and *interaction*, at least in some form, do occur between the parties.

Business network. It is natural to define the concept of business network right after defining the concept of business relationship, as business networks are formed from a set of exchange relationships. Thus, relationships are the building blocks of networks. Möller & Wilson (1995) use the term 'network' to refer to exchange relationships between multiple companies that are interacting with each other, whereas Axelson & Easton (1992) define the concept as referring to any group of organisations or actors that is interconnected via direct and/or indirect exchange relationships. Based on these definitions, in the present study both *indirect exchange relationships* and *direct exchange relationships* are seen as important elements of business networks. Moreover, the exchange relationships forming the network are here not understood as referring to only close and *long-term relationships*; instead, they can also refer to those that are *short-term and more transactional in nature*. Such a definition is directly derived from the definition of a business relationship as used in this study.

Business networks have been widely discussed, particularly in the industrial marketing and management literature. Network studies have differed from each other in, e.g., their unit of analysis, prescriptive/descriptive orientation, structural/dynamic approach, methodology and network components (Easton & Håkansson 1996), and alternative perspectives hidden by the use of different metaphorical concepts (Alajoutsijärvi *et al.* 2001). Additionally, differences between 'network organisations' (i.e., micro networks) and 'networks of organisations' (i.e., macro networks) have been emphasised, based on assumptions as to whether or not the network could be set up and managed by a single actor (Möller *et al.* 2002, Tikkanen 1998). In this study, the difference between the terms 'networks' and 'nets' is noted, and their definitions are understood in the present study as following the usage of Möller *et al.* (2003), Tikkanen (1998) and Möller & Wilson (1995). Accordingly, the concept of *network* is a broader one than that of *net*; while networks are viewed from the macro level, nets are viewed from the micro level, usually from the viewpoint of a single actor. Furthermore, networks cannot be designed and managed by any one actor, whereas nets are often characterised by the importance of the focal firm or the hub company that is able to drive the formation and management of the net (see, e.g., Doz & Hamel 1998, Tikkanen 1998, Webster 1992, Jarillo 1988).

Software. Software refers to computer programs, procedures, and associated documentation and data pertaining to the operation of a computer system (cf. IEEE 1998). Software can be subdivided into software products and components, enterprise solutions, and tailored software (Hoch *et al.* 1999). A *software product* refers to a complete system of computer programs, procedures, and associated documentation and data designated for delivery to a user, whereas *tailored software* will often be unique, for a specific application, and will be produced on a one-off or volume basis. The latter will typically have the potential for future modification by the acquirer to meet changing needs. As a result, most of the documentation will be specific to the project (with the exception of the supplier's standard documentation for the operating system, many standard application packages, and common programming languages). (IEEE 1998) The most distinctive characteristics separating a software product from tailored software are the volume of sales and the customisability. However, sometimes software products are still tailored more or less to the requirements of the customer, as in the case of enterprise applications; thus, the distinction between software products and tailored software is not always so clear. Additionally, the concept of *embedded software* is utilised in this study, to refer to the utilisation of software in controlling computerised devices and systems (Seppänen *et al.* 1996). Embedded systems consist of both hardware and software; a well-known example of a product based on embedded systems is a modern mobile phone.

Software component. Software components are the central area of interest in this study. A software component is usually understood as a reusable and independent computer program that is accessible through specified interfaces (see, e.g., Meyers & Oberndorf 2001, Szyperski 1998). Due to their reusable and independent nature, software components are expected to make software development more effective by offering cost and time savings as well as quality improvements[7]. The component-oriented view of software needs is in part justified by the emerging standardisation and modularity of industrial systems. Because industrial SIs integrate and assemble systems from individual parts and products purchased from external vendors, the component-based approach to software fits well with their business logic. For example, most automation systems are already based on standard mechanical, electrical, and hardware components, and the same is very likely to happen with software. Depending on the granularity of the software components, it may be reasonable to speak of products rather than components. However, the fact that these products are usually not standalone software applications should be kept in mind. Additionally, whether one speaks of a software product or a software component can often be context-sensitive. For example, companies producing software components may prefer to speak of software products while the customer organisations, especially the SIs, buying the piece of software as part of a system product they will later sell, may find it natural to talk about software components.

Software components have been divided into commercial off-the-shelf (COTS) software and modified off-the-shelf (MOTS) software[8]. *COTS software* is stable and is normally well defined in terms of documentation and known capabilities and limitations. It usually comes with 'how to operate' documentation. COTS software is defined by a market-driven need. It is commercially available, and its fitness for use has been demonstrated by a broad spectrum of commercial users. Also, the COTS software supplier does not usually advertise any willingness to modify the software for a specific customer. *MOTS software* is in fact quite similar to COTS software; however, there is advertising of services for tailoring the software to acquirer-specific requirements.

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[7] There is no clear consensus in the literature as to whether software components can at the moment fulfil these promises (see, e.g., Meyers & Oberndorf 2001).

[8] Open-source components can be regarded as forming their own unique group of software (see, e.g., Meyers & Oberndorf 2001), as they are components whose specification is open, fully defined, available to the public, and maintained according to group consensus. However, open-source components are not included in this study's analysis in any detail, as utilisation of open-source components was identified during the research as non-existent or highly infrequent at the companies studied.

(Meyers & Oberndorf 2001, IEEE 1998) COTS software and MOTS software are later in this study differentiated from each other if doing so is relevant from the point of view of the research objective, but this distinction has not been made in most parts of the study.

Based on the above comments about software components, the definition of a software component as applied in this study can be summarised by the following subdivided description:

a) a reusable computer program
b) that is accessible through specified interfaces,
c) is integrated into a larger software-based system solution as an individual operational part, and
d) is not valued by the end customer as a standalone application

The last point in the list, that a software component as understood in this study *is not valued by the end customer as a standalone application*, means that although the software components have independent characteristics in which they form individual operational parts of the overall system, they do not have value in the eyes of the end customer unless they are part of the overall system solution. Additionally, it needs to be pointed out that the rest of the software required for the system solution can either be developed by the SI itself (or developed using subcontractors paid an hourly rate) or can contain other commercial software components.

1.6 Structure of the dissertation

The thesis is divided into four interrelated parts: the introduction, theoretical material, empirical portion, and concluding part. The structure of this thesis is illustrated in Figure 5.

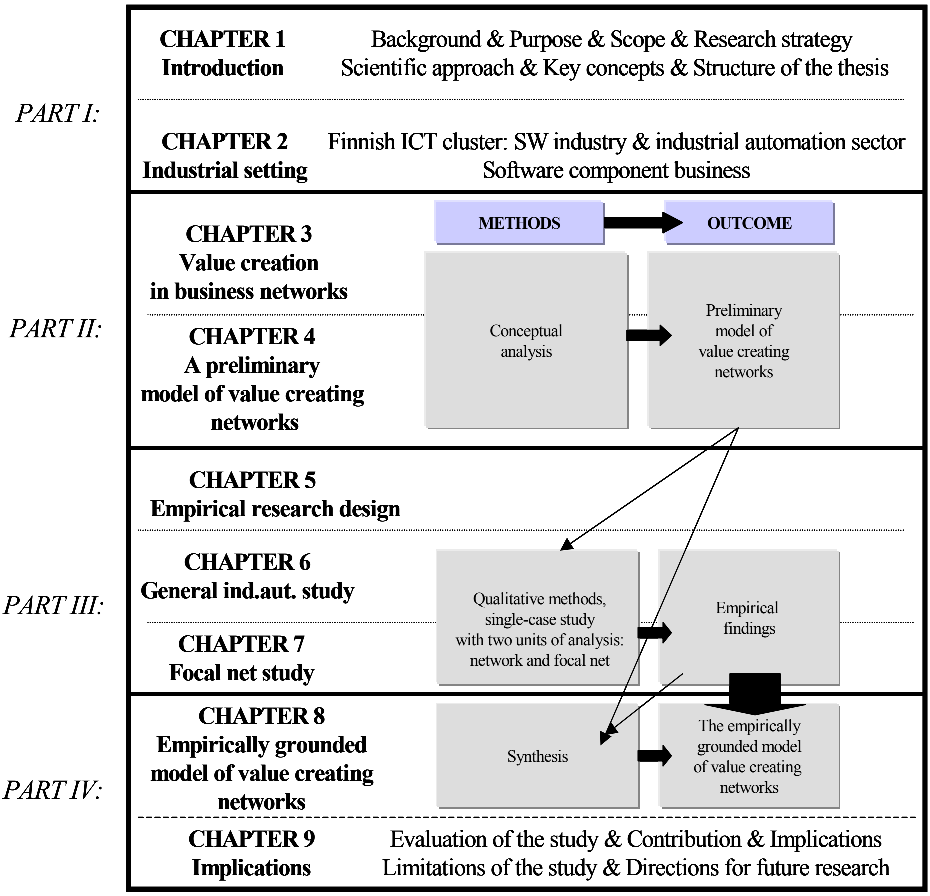

Fig. 5. Structure of the thesis.

The four parts of the thesis are organised as follows:

Part I: Introducing the research setting: Chapter 1 has provided the introduction to the study, presenting background on and motivation for the study and describing the purpose of the research and the research questions. Furthermore, it has included a discussion of the scope of the study as well as shed light on the scientific approach and research strategy employed. Additionally, the key concepts utilised in this study have been defined. Chapter 2 provides a description of the industrial setting and empirical target of the research – i.e., the software component business, as seen in particular from the industrial automation sector point of view.

Part II: Elaboration on value-creating networks: Chapter 3 starts the theoretical part of the work, by discussing the concepts of value creation and business networks individually, then joining them together by discussing the different models and theories concerning value-creating networks. Chapter 4 continues this discussion by presenting the development of the preliminary model of value-creating networks as a step-by-step process, adding one element after another to the model. The chapter concludes with presentation of the preliminary model developed for value-creating networks.

Part III: Empirical research on the software component business in the industrial automation sector: Description of the empirical part of the study starts by presenting the empirical research design and the methodological choices made, in Chapter 5. This chapter also introduces the case studied. Chapter 6 is formed around the first part of the empirical study: network-level analysis of the industrial automation sector, in which the aim is to see the elements of the framework – the 'big picture' – of the industrial sector in question as bases for more focused focal-net study. The focal-net analysis of an industrial automation integrator company is presented and discussed in Chapter 7 as the second part of the empirical study.

Part IV: Conclusions: The last part of the thesis contains the conclusions of the study. Chapter 8 summarises the main findings of the study by presenting the empirically grounded model for studying value creation in business networks. Chapter 9 continues the concluding discussion by evaluating the study and by pointing out the theoretical contributions and management implications of the study. Additionally, this chapter addresses the limitations of the study and avenues for future research.

2 The software component business as the industrial setting

In this chapter, the software component business as the industrial setting of the study is presented. However, as already indicated in Chapter 1, the software component business is not an independent segment of industry; instead, it is dependent partly upon different industry segments forming the so-called ICT cluster. For this reason, this chapter begins with an overview of the Finnish ICT cluster, including also brief consideration of the software component business as one part of the ICT cluster. After that, the software component business is discussed in greater detail through highlighting different perspectives on software components, then the role of architectures and standardisation in the software component business, and finally the claimed benefits and pitfalls of commercial software components. In order to provide a clearer picture of the position of the software component business within the larger context of the software business and furthermore within the ICT cluster, the chapter concludes with a discussion of the different actor roles related to the software component business within the ICT cluster.

2.1 Foundation for the software component business: the Finnish ICT cluster

There is no exact definition for ICT as an industry because the whole industry is still rather unstructured and it is hard to draw firm lines that distinguish it from other industries (Meristö *et al.* 2002). However, a loose definition of the ICT industry can be arrived at by referring to the common base of information and communication technology (Ali-Yrkkö 2001, Baldauf *et al.* 2001) and the product, service, and content production that are directly related to that technology base (Meristö *et al.* 2002). For purposes of this study, it is not important to define the ICT industry as having any strict borders with other industries. This is due to the applied network perspective, which adopts a broader view of the phenomena under study. Thus, it is more natural to talk about the ICT cluster than the ICT industry. According to Meristö *et al.* (2002), the ICT cluster includes not only key industries but also related industries, as shown in the structure of the ICT cluster presented by Paija (2001) and depicted in Figure 6.

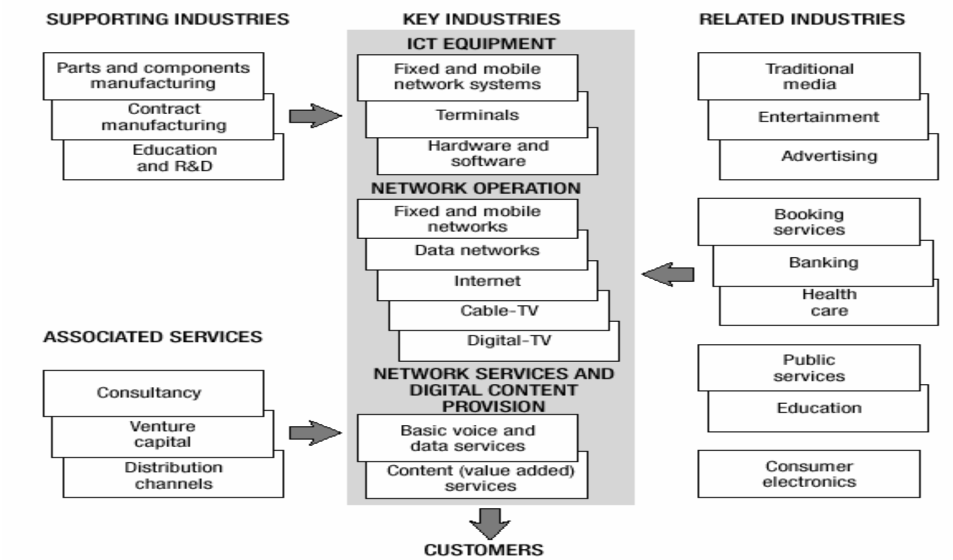

Fig. 6. Structure of the ICT cluster (Paija 2001).

The cluster consists of the key ICT industries, supporting industries, related industries, and associated services, as well as the customers who are the buyers and appliers of the solutions provided. As can be seen from the figure, ICT equipment, network operation, and network services and digital content provision have been identified as the key industries of the ICT cluster. Software is shown in the chart as one part of the ICT equipment industry. In addition to such a product-based classification of the ICT cluster, it is also possible to create a more consumer-oriented classification. The latter divides the ICT cluster into services, the industrial sector, telecommunications, and digital communications (Meristö *et al.* 2002). Software is in this classification scheme positioned under the ‘services’ category along with system solutions, professional services, and consulting. ‘Telecommunications’ refers to network operations, such as network-building and maintenance, whereas ‘digital communications’ refers to all program and content provision that is not dependent on any specific channel of distribution. ‘Industrial sector’ is not a very illustrative term, but this sector contains, e.g., computers, consumer electronics, and automation and measuring instruments. An illustration of the structure of the ICT cluster has already been provided, as Figure 1 in Chapter 1, for the purpose of clarifying the empirical context. The main emphasis in that classification was on identifying the key industries forming the cluster and the software industry’s role within the cluster. Other related and supporting industries and services were not included in the classification for reasons of clarity.

However, none of the classification schemes should be regarded as immutable, owing to the dynamic nature of the cluster. The classification systems can play the role of illustrating the cluster as it is currently, or, more precisely, as it was a moment ago, in particular in Finland. However, most likely they will not remain valid in illustrating the future status of the cluster, because the cluster is facing considerable transformations due to changes in the value chains (Kajanto 1997), increasing networking (Jansson *et al.* 2001), and convergence of technologies and related industries (Meristö *et al.* 2002) embedded in the ICT cluster. This will lead to even more blurred lines within the ICT cluster.

Additionally, what is predicted as characteristic of the ICT cluster in the future is the growing role of SIs that cannot be strictly positioned under any single industry or sector within the cluster. Typically, SIs are large system houses that utilise pieces produced by the service, industrial, and communications sectors in order to provide system solutions for their customers. Figure 7 illustrates this growing importance of SIs.

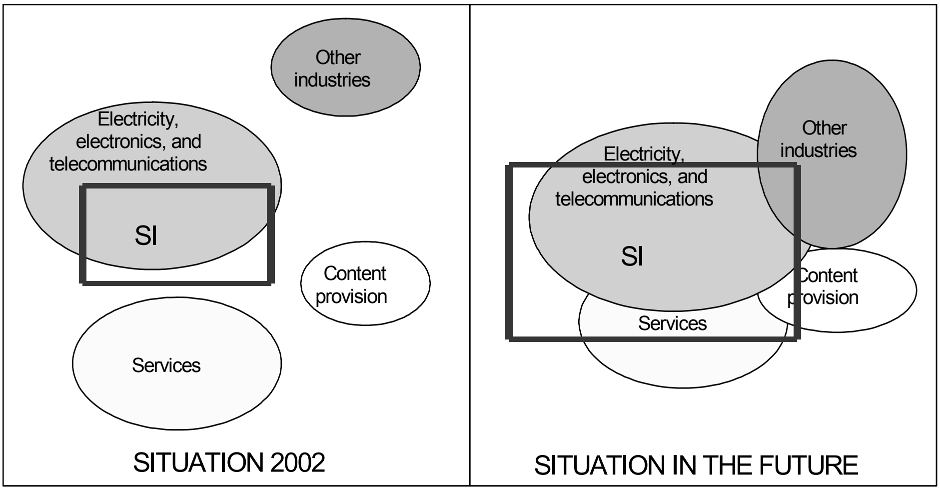

Fig. 7. Growing importance of SIs in the ICT cluster (based on Meristö *et al.* 2002).

Figure 7 shows the structure of the Finnish ICT cluster ‘now’ and ‘in the future’. The basic assumption is that the industrial sectors that are currently rather separated from each other will converge in the future. As a parallel phenomenon, the role of system houses – e.g., SIs (illustrated in the figure by a square) – will grow rapidly. Overall, the shift in the ICT cluster is toward more horizontally oriented and networking-based businesses as opposed to vertically integrated structures. Networking and horizontal orientation are not, however, new phenomena. In several studies of Finnish industries (e.g., Hienonen 2000, Lehtinen 1996) it has been recognised that companies are often more horizontally oriented and committed to strategic partnerships than their major international competitors are. In fact, such an orientation can be seen as one of the major building blocks for the phenomenal growth of high-technology-related industrial sectors in Finland (see Baldauf *et al.* 2001, Hienonen 2000). When companies are free from strict vertical integration, technological changes do not tie the principal manufacturers only to those technologies that they possess themselves, and this allows more rapid application of new, emerging technologies. When one speaks of the phenomenal growth of new technologies, the Finnish ICT cluster is a fine example even at an international level (see, e.g., Mankinen 2001, OECD 2001, OECD 2000). It is not a surprise that the ICT cluster plays a remarkable role in the Finnish economy[9], as a consequence of the rapid growth of the cluster during the 1990s.

In considering the growing role of the software component business within the ICT cluster, the specific features of and trends in the cluster and its sub-sectors should be taken into account. For example, the electronics industry as one major industry representative within the ICT cluster is characterised by technological entry barriers, unpredictable speed of growth and change, hierarchy of actors, strong networking, flexibility of production, a high level of product tailoring, and a clear aim of succeeding in the global markets (Laine *et al.* 2000). However, the unpredictable speed of growth and change, strong desire for networking, and future needs for considerable product tailoring are characteristic of the ICT cluster in general, too. The cluster is seen as a turbulent one in which situations change so rapidly that it is not easy for individual companies to decide which business they should be in and which business they should refrain from entering.

It can be argued that the unpredictable speed of growth and change along with the need for flexibility in production are trends that favour the use of external software components. In a turbulent environment, companies need to have several ways to adapt, for example, their production volume. Using components acquired outside the company enables this kind of adaptation. Attaining success in global markets usually requires partnering and strategic alliances, because few companies – if any – have enough resources to conquer the world markets by themselves. However, at the same time, companies are also afraid to build strong alliances and to place parts of their business in the hands of others because they fear giving away parts of their business processes that could become the most valuable ones in the future.

Additionally, in mapping the future growth potential of the software component business in the ICT cluster, an important question is the need for product customisation. Such final products as industrial machinery, telecommunications network equipment, and industrial automation systems may be customised. However, the components of the products do not necessarily have to be customised; they can also be standard ones while still including a wide range of options and variants. (Lehtinen 1996) Usually the computing infrastructure on which the products are based is built of rather standard hardware and software parts, depending on the need for integration – for example, most handheld electronic devices do include customised, application-specific components. In telecommunication products as well, the communication protocol platform may be standardised to a large extent. Such applications as the control of certain types of mechanical machines or industrial processes are often a mixture of customised and standard solutions. A good example of a standard part of many applications is a database management system needed to store and manage application-related data.

However, in most cases, some components of the final ICT products have to be customised due to the changing needs of the end customers. This is often done by

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[9] For more information about the significance of the ICT cluster for the Finnish economy, see, e.g., Meristö *et al.* (2002), Jansson *et al*. (2001), Tilastokeskus (2001), and Mankinen (2000).

following some sort of a product family approach based on software, which is the most malleable part of the whole product (cf. Sääksjärvi 1998). For successful customisation, close communication and interaction is needed between the suppliers and their customers. In the case of the software industry, customer involvement may be more important than it is in many other industries, due to the abstractness of the material from which components are being made (Hoch *et al.* 1999). A software component supplier may or may not interact with the end customer buying the product, depending on the buyer's purchasing policy and the use of the component in the product.

2.2 Overview of the software component business

Although the definition of software components that is followed in this study was provided in Chapter 1, broader discussion is useful due to the lack of consensus and several interrelated aspects of the emerging software component business. Thus, this section starts with a discussion of software components in general and then continues by discussing software architectures and standardisation, as important matters related to the software component business. The section is concluded by a short review of the predicted benefits and pitfalls of commercial software components.

2.2.1 Perspectives on software components

It is not an easy task to define a software component, because even the more unified concept of software itself is not that straightforward. The main reason is that software is nonmaterial and does not have any physical appearance. Furthermore, although software is valued for what it does, it needs other tools for realisation of its intentions, especially computer hardware. (Messerschmitt & Szyperski 2000) These basic characteristics of software lead to a situation where it is not even clear whether one can talk about software as a product or if it should instead be treated as a service.

However, when it comes to software components, they should perhaps be treated more as products than as services[10], especially when one is referring to COTS software components. This is due to the desire of the software component developer to achieve a position in which it provides standard and reusable solutions to several customers. On the other hand, when a company is dealing with the MOTS type of software components, which are characterised by customisation, the software component business has more of the characteristics of a service business in addition.

As can software in general, software components can be developed for two main purposes, either as solutions to support processes or as components that are going to be integrated into larger products or system solutions that are sold on. Naturally, software

[10] It is noteworthy that software components can be utilised in creating not only software-based *products* but also *services*; e.g., software components can be used in producing mobile services. However, this is a matter of the product/service nature of the *system solution*, of which the component is a part, not a matter of the product/service nature of the *component* itself.

components can also be developed for own internal use in addition to commercial purposes. Figure 8 illustrates these different manners of utilisation.

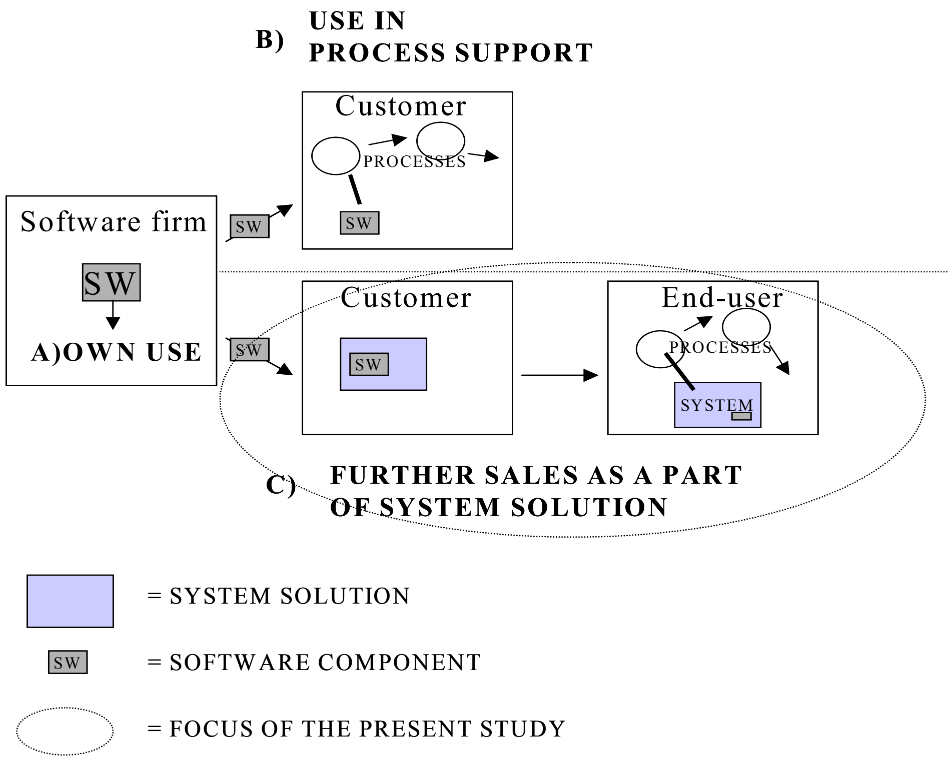

Fig. 8. Different ways of utilising software components.

In this study, the focus is on software components that are developed for commercial purposes and that the customer organisation is acquiring for purposes of further sale as part of larger systems (alternative C in Figure 8). Thus, software components for own internal use (alternative A in Figure 8) and for process support (alternative B in Figure 8) are not included in the focus of this study.

According to Brereton & Budgen (2000), there are several definitions of software components, of which some are stricter, especially in a technical sense, whereas others are broader and more general. What is important to keep in mind as a guideline is to distinguish monolithic, hard-to-integrate applications that have been loosely termed components from components that have been specifically designed to be adaptable and easy to both integrate and reuse (Sprott 2000). Based on this and as stated earlier, the definition of a software component as *a reusable and independent computer program that is accessible through specified interfaces* is used in this study. This rather general definition is in line with the following definitions provided by several different authors:

A software component is

- a unit of composition with contractually specified interfaces and explicit context dependencies only; also, the requirements of reusability and independence are related to software components (Niemelä 1999)
- a reusable, executable, self-contained piece of software that is accessible only through well-defined interfaces (Kuikka 1999)
- a reusable, autonomous, and executable portion of software that is used through defined interfaces (Niemelä *et al.* 2000)
- a type, class, or any other work product that has been specifically engineered to be reusable; related closely to the term 'encapsulation' (Jacobson *et al.*1997).

The terms 'encapsulation' and 'independence'[11] refer to the idea that a software component should be as self-contained a piece of software as possible and can be reused in such a way that a buyer and integrator of the software component would not even know what is inside the component – it would be enough to know only the external interfaces and the functionality offered by the component. However, such true encapsulation is not found with all software components, as in quite a few cases it is hard to develop such an independent component.

In fact, true encapsulation can in a strict sense be used to refer only to so-called black-box software components, in which only the external interfaces of the component are visible and acknowledged by the software component buyer/integrator. In addition to these black-box components, so-called white-box software components, offering a rather open view of their contents to the buyer, can be identified. Between these two extremes, the category of grey-box components has been developed. (Kuikka 1999, Jacobson *et al.* 1997) In any case, although the inner workings of a software component can be treated also as within a black box, its external interfaces must always be explicitly defined (Brereton & Budgen 2000).

Another important classification related to software components is that of COTS and MOTS[12] software components. As stated in Chapter 1, COTS software is stable and is normally well defined in terms of documentation and known capabilities and limitations. It usually comes with 'how to operate' documentation and is commercially available to several potential customers. Due to the potentially large number of customers, its fitness for use and thus its operational quality have been demonstrated by a large group of users. A supplier of COTS software components usually has no willingness to modify the software for the needs of a specific customer. In fact, MOTS software is otherwise rather similar to COTS software, with the difference between the two lying in the willingness of the component supplier to perform modifications and tailoring at the request of a specific customer. (Meyers & Oberndorf 2001, IEEE 1998) Thus, 'MOTS' refers to tailored software components, whereas 'COTS' refers to standard solutions. In comparing these two classes of software components from the software business standpoint, COTS is

[11] The term 'independence' does not necessarily mean that the component has no dependencies on other components; rather, it means that those dependencies are generic enough that the component can still serve several different purposes (Brereton & Budgen 2000).

[12] As a comparable term concerning the development of MOTS software components, the term 'OCM' (original component manufacturing) has been used by Seppänen *et al.* (2001).

strictly comparable with the activities of the software product business, whereas MOTS components include to at least some extent certain characteristics that are typical of the software project business.

Besides these two classifications related to the degree of encapsulation and modifiability, other classifications can be also made – e.g., related to the platform- or language-independence of the software components (Brereton & Budgen 2000). These kinds of dependencies between components and platforms are related to software architectures. Therefore, in the following section, a brief introduction to software architectures is provided.

2.2.2 The role of software architectures in the software component business

Why are software architectures important to understand where the software component business is concerned? We can understand the importance of software architectures better if we use a concrete analogy, such as house construction. It is essential for a construction worker to have a certain kind of plan of the building before he can start the actual construction phase. In that plan, at least such issues as what materials are going to be used and in what way they are going to be used are addressed. Furthermore, the interdependencies between different materials and construction components are taken into account beforehand in order to create a functional entity.

A similar kind of situation holds for software architectures: in order to be able to construct a functional entity from several building blocks – i.e., software components – the constructor needs to have some kind of framework or plan for specifying what kind of components are needed and how they interact with each other. Such a relationship between software architectures and components is visible also in the following definitions of the concept of software architecture that are provided by different authors:

Software architecture is

- the structure or structures of the system, which comprise software components, the externally visible properties of those components, and the relationships among them (Bass *et al*. 1998)
- the structure of component in a program or system, their interrelationships, and the principles and guides that control the design and evolution over time (Shaw & Garlan 1996)
- an abstract and overall design description of a system integrating elements addressing different issues that are separate but have a contrary influence on each other; it is noteworthy that a software architecture is a system that seeks balance between understandability, functionality, and economy and that it provides the basis for independence and co-operation of software components (Niemelä 1999)
- a specification of the mapping of functionality and connectivity onto software components (Meyers & Oberndorf 2001).

As can be seen from the definitions, a central feature of a software architecture is that it specifies relationships between software components. Although a software system is built from independent components, there are always dependencies between the components. Thus, an important question in software componentisation is what impacts a component has on the developed system as a whole. The purpose of the software architecture is to deal with this important question. For example, at the architectural design level, different ways to limit the influence the component can have on the whole system can be identified. One possible approach is known as component wrapping, which means putting a software layer around the component to limit what it can do (see, e.g., Kuikka 1999).

There are various ways to illustrate software architectures, but usually the architecture is in some way layered, in order to achieve better manageability. A three-tiered product line[13] architecture design is described by Niemelä (1999) as an example in discussion of the tiers of subsystem framework, component system architecture, and product family. The contents of each of the tiers are as follows:

– Subsystem framework: a first-tier component architecture that defines the styles, patterns, and components for a specific application domain; it can also be called a domain-specific framework.
– Component system architecture: a second-tier component architecture that consists of a set of platform decisions, component frameworks, and interoperation design for the component frameworks. It mediates between the subsystem frameworks; it can also be called an integration framework.
– Product family tier: a third-tier component architecture that focuses on the variability and commonality of a systems family and represents a business viewpoint on the distributed systems; it is an overall design of the systems in a product family.

A rather similar kind of layered structure is presented by Jacobson *et al.* (1997) and illustrated in Figure 9. The top layer is the so-called application systems layer, in which software components usually do not play a significant role. However, the role of componentisation is larger at the lower layers. Three different component layers can be identified: business-specific components, middleware components, and system software components. The layer of business-specific components contains those components that are reusable only for a specific business or application domain – e.g., banking, insurance, health care, or automation. These are known as domain-specific software components. This layer is comparable with the first-tier architecture of the subsystem framework in the classification of Niemelä (1999).

The middle layer in Figure 9 includes those components that provide interfaces to other established entities. Thus, middleware components handle the activities and features needed for interfaces. Moreover, they provide interfaces that are not dependent on any single platform. Again, this layer can be seen as comparable with the second-tier in Niemelä's model. The lowest level, system software components, refers to the components that are nearest to hardware and thus provide interfaces to the computer platform. A good example of such a system software layer is an operating system.

[13] In the context of software, a product line can be defined as a group of software products sharing a common, managed set of features that satisfies specific needs of a selected market (Bass *et al.* 1998).

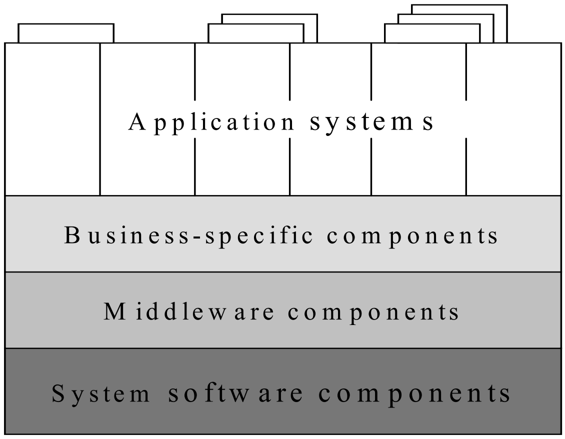

Fig. 9. A typical layered architecture for software components (Jacobson *et al.* 1997).

Quite commonly, the uppermost architectural level is called the application level, whereas the lowest levels are called system software or enabling technologies. Figure 10, drawing from the work of Messerschmitt & Szyperski (2000), illustrates this. All elements of the lower layers are complementary, whilst each layer is dependent on the layers below. Thus, all the layers are needed to support the application used by the end customer. However, Messerschmitt & Szyperski point out that there exist different kinds of logic in the upper layers (application level) and the lower layers of the architecture (enabling technologies). They argue that applications and enabling technologies tend to diverge (cf. the right-hand side of the figure). The middle layer of the architecture should define a set of common and universal representations and services, in order to act as an integration layer between the application and the enabling technologies. Still, the different logic of the application layer and the enabling technology layer may cause problems in management of the overall system solution. One way to overcome these problems is for the solutions to be modularised further at each of the architectural layers, using components (cf. the left-hand side of the figure). However, modularisation principles and the use of in-house or external components may vary greatly between the different layers.

Thus, it can be concluded that different complementary and interdependent layers often go into the construction of a total software solution. Although these layers are interdependent, they may vary greatly in their ability to make use of software components. In other words, the number of software components may be quite different at the different architectural layers.

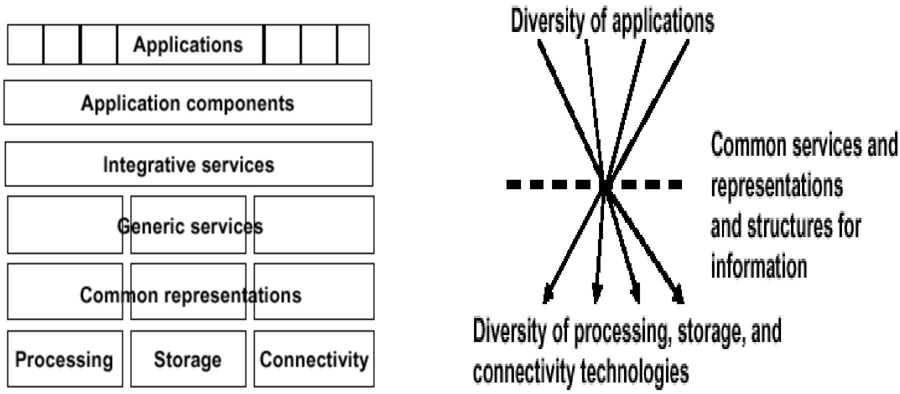

Fig. 10. Modularisation of complex systems (Messerschmitt & Szyperski 2000).

The above discussion of software architectures is rather general and may thus give an overly simplistic picture of software architectures. In fact, the situation is anything but simple; appropriate design and use of software architectures is not an easy task. Furthermore, the definition of a product line is not as clear in the context of software products as it is in the case of physical products. This is due to the fact that software architecture is quite an abstract concept (Sääksjärvi 1998).

However, for the purpose of this research, the most important thing is to understand any software architecture as something that provides a framework for utilisation of software components whilst limiting the features required of the components, their footprint in the overall system solution, and the interfaces and interdependencies between them. Thus, software architectures and components are concepts that are tied closely together.

From a business perspective, a multilevel, tiered software architecture provides the possibility to view software markets both horizontally and vertically; whilst vertically segmented markets stand for the overall system offering, horizontally segmented markets involve separate customer groups for each of the architectural layers. This kind of segmentation of software markets is presented in Figure 11, based on Niemelä *et al.* (2000) and reprinted from Niemelä & Seppänen (2000).

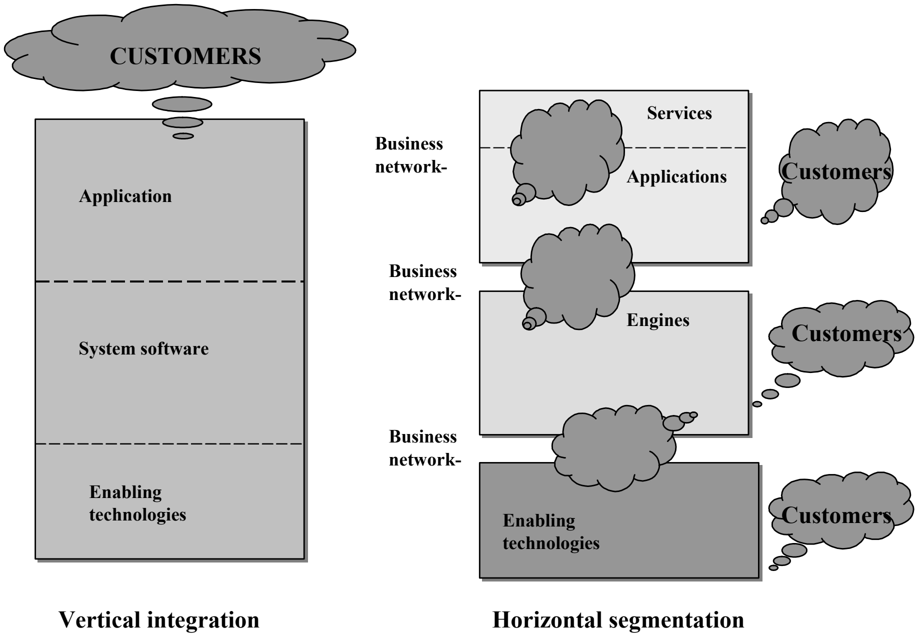

Fig. 11. From vertical integration to horizontal segmentation: view of software markets (Niemelä & Seppänen 2000).

From the standpoint of this study and its focus on the software component business, Figure 11 provides an interesting basis for a discussion related to the role of the system integrator (SI) in the component business. If an SI is regarded only in the traditional sense, as the actor acquiring and integrating software components from the markets and then selling them in overall system solutions, the SI represents the left-hand side of the figure, vertical integration. At the same time, there are companies that act as component developers and suppliers and usually operate at only one level of the overall system architecture. For example, a company may provide enabling technologies for customer companies. If the components are industry-specific, the supplier company is not operating in horizontal markets, in the very essence of the term. But if the components are general ones, the supplier company can sell the same component to several different vertical segments, therefore acting in horizontal markets. On the other hand, it might be possible for the SIs to also start to operate in horizontal markets when it comes to software components, if they want to sell their own software components to customers. This would require, naturally, that their vertical system solution include general enough pieces of software that either other vertical customer segments or their competitors in the same vertical segment would be ready to buy them.

2.2.3 The role of standardisation in the software component business

Another important element related to software components, especially to the utilisation of commercial software components, is standardisation. In brief, standardisation can be seen as an activity creating an extraordinary level of consensus that should reduce the difficulty of integrating components from diverse sources (Sprott 2000). The consensus is achieved through co-operation between different actors in the market. Thus, standardisation is an essential part of the collective development activities in networking in the software business (David & Shane 1990). According to Meyers & Oberndorf (2001) '*a standard is a publicly available document that defines specifications for interfaces, services, processes, protocols, or data formats and that is established and maintained by group consensus*'.

It is usual to form consortia inside an industry for developing a commonly followed standard for some specific field. Competitors may participate in the same consortium, but it is also possible for two or more coalitions to form that support competing standards. In such a case, it is usually difficult to achieve any shared, industry-level standard even if one would be beneficial for the whole industry. An important issue is also that, although quite often standardisation consortia are run by non-commercial organisations, there are strong commercial forces and large corporations behind the consortia.

From the software components standpoint, the purpose of standardisation is to formulate general and commonly followed rules that enable the utilisation of commercial software components. It is typical to, for example, standardise interfaces, which then allow the interoperability of different components acquired from different component suppliers. According to Messerschmitt & Szyperski (2000), an open industry standard is a commonly agreed, well-documented, and freely available set of specifications that are not tied to any intellectual property restrictions. When there is a desire to acquire software components from multiple sources and from different suppliers, an industry-level standard is very much needed. Open standards allow mixing and matching of different components and, furthermore, encourage competition and specialisation in the markets. Increased competition and specialisation can be argued as advancing not only the availability of different components but also the costs and quality of the components.

Alongside that of industry standards, the role of so-called *de facto* standards is also quite strong in many industries. *De facto* standards arise through market forces, in contrast to the rather formal process behind industry standards, and are interfaces or data representations that are widely used in the industry (Messerschmitt & Szyperski 2000). Thus, a *de facto* standard is a specification that emerges as a standard because it is in popular use.

Naturally, proprietary solutions bring money to their owners, and that is often the reason behind the slow development of open industry standards in certain fields. Although there are unquestionable benefits in developing open industry standards from the customer's point of view, there may be key actors in the industry that want to maintain closed and proprietary solutions, especially if their solutions are initially in a leading position in the market.

2.2.4 Pitfalls and benefits of commercial software components

Besides that of standardisation, there are many other questions to be resolved before the true growth of the software component business can start. According to Niemelä *et al.* (2000), the most important technical obstacles to be resolved involve techniques for specifying the features of and requirements for components accurately, validation techniques for software architectures and components, documentation of product-line architectures and components, and the management of the evolution of software components.

These technically-oriented problems are in some respects closely related to business-oriented problems. For example, problems in specifying accurately enough the features of the software component and what is required of the component from the customer's point of view are closely connected to the way the interactions and communication are handled by the parties in the relationship. Of course it is also a concern of internal software development to consider how well and in what way the features of and requirements for software components are documented. Those features and requirements need to be stated clearly enough to the other party, too, or the result is going to be most likely the component's inability to meet special expectations of the customer. Other business-oriented risks in the software component business listed by Niemelä *et al.* are the following:

- The issue of where to find a replacement component after the component supplier finishes production of that specific component
- Component maintenance concerns
- Poor quality of a component not noticed until the integration phase
- Lack of management commitment and the difficulty of making demanding process and organisational changes.

Also, Meyers & Oberndorf (2001) have created their own list of pitfalls related to commercial software components. Their list is rather similar to the obstacles pointed out by Niemelä *et al.*, but they have taken into account more specifically the possibility of higher costs:

- Higher cost: unexpected costs – for example, if the component supplier gets its share from each of the components sold as part of a system product that is sold in large volumes.
- Higher risk: less control over the specifications, no control over the quality of the component, problems fixing sudden problems because of lack of access to the source code.
- Inability to meet special requirements: an especially important issue in mission-critical systems, in which the commercial components acquired should meet strict performance and security requirements.
- Conformance problems: conformance describes the condition that exists when a component is integrated into a larger system entity and thus copes properly with the interfaces of other components. Conformance issues usually involve many kinds of problems that are hard to take into account in advance and are thus one reason appropriate conformance and integration testing is needed.

- Support problems: the question is who will take care of the support of the component – e.g., when the end customer faces a problem. Additionally, it can be quite hard to identify which specific component is causing the problem in a large system solution. Also, the supplier may argue that the problem is with the way the component is utilised and integrated with the larger system, not with the component itself.
- Increased amount of continual investment: using commercial components may force the company to upgrade one or more products in the overall system solution when a new version is released. Also, new versions may have higher quality or valuable new features that are desired.
- Requirement for a new management style: when everything is done in-house, it is easier to trace where a bug is and who is responsible for it than it is with commercial software components.

In addition, one important precondition for the growth of the software component business is for the legal issues related to commercial software components to be investigated thoroughly and appropriate solutions developed. For example, software component licensing is a relevant area to take into consideration. As Chavéz *et al.* (1998) have pointed out, assumptions regarding the size, quality, and flexibility of software components are different from those typical of software licensing in general. Thus, these different assumptions have an influence on the form of licence granted, payment, ownership, liability, warranty, maintenance, and confidentiality terms, which further point to the need for improving general software licence agreements in the direction of a form more suitable for software component licensing agreements. In particular, IPR questions are difficult, even critical, in the software component business due to their rather shattered nature in terms of the owner's rights. Based on the study of Niemelä *et al.* (2000), the most critical juridical questions in the software component business are the following:

- The establishment of an appropriate legal protection strategy for the components as at variance with the following: free-use public domain, shareware, grant-back, or more specifically regulatory licence stipulations.
- The identification of copyright protection questions.
- The identification of patent protection questions.
- Classified patent applications.
- The IPRs and licensing agreements for customised components (the difficulty here is: if some other party than the original developer makes the necessary changes to the component, who owns the rights to the revised component?).
- IPR management of components that are developed by a network of actors.
- Questions of maintenance and guarantees.

Although in this study no deep analysis of the IPR issues related to software components is provided, it can be pointed out that one of the most interesting items in the above list is the IPR management of components that are developed by a network of actors. This management issue requires specification of which actor(s) in the network take legal responsibility for jointly developed software components.

What, then, are the claimed benefits of commercial software components, and what can be identified as the key drivers behind the development of the software component business? Development of supporting technologies[14] is one major factor that has acted as a driver for software reuse. Other keys to success for the software component business have been listed by Niemelä *et al.* (2000) and include the latest know-how, familiarity with the application domain, the development of cost-effective international business operations, effective and well-managed software development, and an ability to meet the growing demand for comprehensive solutions and technological changes. Other prerequisites for successful development of the software component business are product platforms, more open product interfaces, the intention of subcontractor firms to move toward the product business, the desire of firms utilising software components to move toward wrapped competence, and the development of information networks.

As there was a long list of the claimed pitfalls of the software component business, so too the expectations concerning the software component business are manifold. Niemelä *et al.* mention reusability, rapid application development, and better quality, among others. Again, Meyers & Oberndorf (2001) provide a rather similar list of expected benefits:

- Lower costs: monetary savings are achieved when components can be bought from several competing suppliers and when the suppliers are able to keep the normally high software development costs down by having several customers that are buying the same standard solution.
- Shorter development schedule: it is common for internal software development to take longer that was planned at the beginning of the project, affecting the project's milestones as a result. This is not the case with commercial software components, as they are ready-made.
- Better-tested products: the large user base ensures that the components are already widely tested and proven to be functional.
- Increased portability: portability stands for the ability of software to be transferred from one environment to another. Usually, the portability increases when the software is developed to industry standards.
- Increased interoperability: interoperability means the ability of two or more systems or elements to exchange information and to use the exchanged information. Thus, interoperability allows the integration of components. Interoperability is guaranteed in commercial software components by following of industry standards and by the multiple suppliers that produce varying components that all conform to a single specification; it is easier to find appropriate solutions from among a large number of alternatives than from a narrow range.

Some of the expected benefits of software components are the other sides of the claimed pitfalls, like the lower/higher costs and better-tested products/higher quality risks (Meyers & Oberndorf 2001, due 2000). This, in practice, leads the actors in the software component business towards tough decision-making situations. For example, an SI needs

[14] Important technologies in software componentisation include CORBA (Common Object Request Broker Architecture), COM (Component Object Model), and EJB (Enterprise Java Beans). These technologies differ from each other in, among other things, their dependency on certain programming languages and platforms. For example, COM is provided by Microsoft and thus is tied to the platform solution provided by Microsoft. (For further information, see, e.g., Meyers & Oberndorf 2001, Brereton & Budgen 2000, Gritzalis *et al.* 2000, and Coffee 1999.)

to create tools that will help in determining whether it is more beneficial to utilise in-house solutions or to acquire commercial software components. If there is high pressure for short time-to-market, the utilisation of commercial components might be beneficial. However, what if the system solution is going to sell in high volumes and the component supplier wants to receive a set amount for each of the final systems sold? Is the commercial component utilised then going to take too big a share of the profit margin? These are important and strategic-level questions for the SI to take under careful consideration when deciding whether to make or buy a certain piece of software.

2.3 Different actor perspectives on the software component business

What should be noticed in the discussion of the benefits and pitfalls of commercial software components are the different perspectives on the field. These include the viewpoints of the component developer, the component integrator (i.e., the SI), and the end customer, at least. These three different actor perspectives must all be taken into account in a network analysis, in contrast to concentrating on only, e.g., the perspective of the integrator as was done in the work of authors such as Meyers & Oberndorf (2001) when they focused on the process of acquiring commercial software components. However, in the work of Niemelä *et al.* (2000), discussed above, and Brereton & Budgen (2000), both the component developer's and component integrator's point of view have been taken into account.

Brereton & Budgen (2000) have even identified issues that are relevant from the end customer's point of view, too. According to them, there are issues that are product-related, process-related, business-related, or people-/skills-related in particular. For example, important product-related issues from the component developer's point of view are granularity and portability, whereas from the component integrator's point of view the most important product-related issues are component selection, interoperability, combining of quality attributes, and maintenance. Both the developers and the integrators are also concerned with such product-related issues as component description and predicting limits. The end customers are for the most part concerned only with the specification of requirements. These kinds of differences between the major concerns of different actors concerning the software component business naturally cause tension in the relationships between the component developer and the integrator and, further, between the end customer and the integrator and its component suppliers.

While four aspects of software componentisation have been identified (the product, process, business, and 'people' aspects), in the work of Brereton & Budgen (2000), the business-related issues have a major role. Business-related issues cover such areas as component security, distributed execution, and payment models, which are relevant not only for the component developers and component integrators but also for end customers. However, the authors argue that, while component developers' biggest business concerns are internationalisation decisions, quality control, component marketability, and the choice of operating in horizontal and/or vertical markets, component integrators' business concerns are more or less related to their supply strategies and supply management, including management of a range of contract structures, development of trust and confidence in suppliers, and identification of cost/risk trade-offs. Naturally, one of the most important business concerns of the component integrators is measurement of productivity. They go on to argue that end customers are mostly concerned about such business-related questions as long-term maintenance and acceptance procedures.

The work of Brereton & Budgen is interesting from the standpoint of the present study. This is due not only to the identification of the main roles of the actors in the software component business but also to the key issues that the authors have listed as most important from the viewpoints of the three different types of actors. These issues are in line with the findings in the work of Niemelä *et al.* (2000); thus, both of these works provide guidelines for the further analysis of the software component business.

It needs to be noticed that there are various terms utilised in the literature to describe the three different actor perspectives on the software component business. The component developer is called in this study the *SI supplier*, referring to the actor also known as the component supplier, component provider, or component seller. The component integrator is in this study understood as being the *SI (system integrator)*[15] and could also be called the component distributor, buyer, acquirer, or just customer organisation. The third perspective is the *end customer*'s, which could be viewed also as that of the integrated system customers or end users, or as representative of common needs. In the material that follows, the software industry in the role of software component supplier and the industrial automation sector as playing the integrator's role as dealt with in this study are discussed in greater detail. Potential end customers are harder to specify as long as they remain leveraged to multiple industries, but a rough illustration concerning potential end customers is provided in the summary in Section 2.4. However, it needs to be pointed out that these roles of software industry as the software component supplier representative and the industrial automation sector as the SI representative are far from clear ones; for example, software components can be produced also by other companies than just pure software companies (see, e.g. Tyrväinen *et al.* 2004). Although the researcher is aware of the blurred nature of the different actor roles within the ICT cluster, the rough role division has been done in the following subsections for the sake of clarity.

[15] 'Original equipment manufacturer' – i.e., 'OEM' – is another term that has been utilised to describe a company that operates as an integrator of components and sub-parts in order to build a larger system solution for the customer. However, the term has been utilised mainly in the field of marketing channel studies (Kotler 2000, 496; Chisnall 1995). In this study, the terms 'SI' and 'OEM' are used interchangeably, although some researchers have made a distinction between them. For example, Helander & Seppänen 2001, drawing on the work of Seppänen *et al.* (2001), differentiate an SI from an OEM based on the amount of in-house product manufacturing: an SI is considered to be a pure component integrator, whereas an OEM has its own manufacturing functions, as well. Additionally, the term 'original design manufacturer' (ODM) is close to the term 'SI/OEM' not only literally but also as both represent manufacturer types. However, their difference is important to bear in mind for the purpose of the present study. The terms 'SI' and 'OEM' describe companies that produce, market, and sell their designs under their own brand name to *end customers*, whereas the term 'ODM' refers to such companies as design and manufacture end products for *SI/OEMs* who are their direct customers. Thus, ODMs operate as suppliers to the SI/OEMs, and they don't have their own brand visibility in the eyes of the end customers. ODMs differ from another type of SI/OEM supplier, the contract manufacturer (CM), in their design operations; ODMs are contract manufacturers with product design capabilities. (cf., e.g., WTEC 1997)

2.3.1 Software component suppliers: the software industry

The software industry has grown rapidly, keeping pace with the general growth of the ICT cluster. Even though the predicted growth rates of the Finnish software industry (see, e.g., Nukari & Forsell 1999) have not quite been reached in the last couple of years[16], the industry is going to encounter significant growth if even some of the predictions are accurate. However, measurements regarding the software industry and its size, importance, and growth rates are not easy to make when it is not always clear what can be labelled part of the software industry and what cannot. For example, some large Finnish companies (e.g., Nokia, Metso) are included in official statistics for other industry segments but nevertheless employ a large number of software engineers and perform software development as an essential part of their operations[17]. Furthermore, the software industry is not always even recognised as a distinct industry, and it is often viewed as an inseparable part of the ICT cluster. However, recent years have seen the publication of several research reports in which the software industry has been considered independently, due to its growing importance as an industrial sector in its own right (e.g., Toivonen 2002, Rajala *et al.* 2001, Autere *et al.* 1999, Nukari & Forsell 1999).

Subdivision of the software industry. However, one possible way to better capture the essence of the software industry is to divide the software industry into smaller segments, which helps to understand more clearly the different ways of doing business related to software and the position of the software component business in relation to them. One rather commonly used way to break down the business is to consider embedded software, professional software services, enterprise solutions, and packaged mass products as involving separate kinds of business, as suggested by Hoch *et al.* (1999); see Figure 12.

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[16] The Finnish software industry saw a 15% growth in revenues in the years 2000-2001 (Tekes 2003).

[17] For a comprehensive discussion of the software business and evaluation of its relationship to other ICT cluster segments, see Tyrväinen *et al.* (2004).

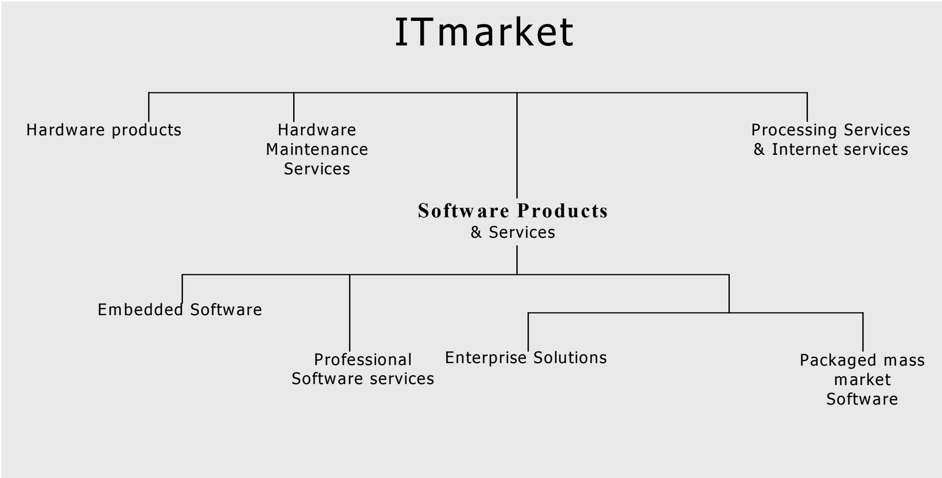

Fig. 12. Software business subdivision (Hoch *et al.* 1999).

As stated above, Hoch *et al.* (1999) divide the software products and services industry into four sub-segments. Embedded software refers to programs integrated as inseparable parts of system products that include also hardware other than standard computing platforms. Professional software services refer to the work of the software project business (see, e.g., Alajoutsijärvi *et al.* 1999a) or to tailored software (see, e.g., Tähtinen 2001), for which the customer organisation is usually charged an hourly rate, not a fixed price for the software products or components provided. Enterprise solutions include software that is produced for the needs of customer organisations, which usually are quite specific, based on general technological solutions and often also on standard application frameworks. Well-known examples of enterprise solutions are the kinds of industrial automation systems studied in this thesis. Lastly, packaged mass-market software refers to software products that are provided as they are to several customers.

A similar kind of classification has been presented by Nukari & Forsell (1999) in their discussion of software products, tailored software, and embedded software. The difference between these two classification systems is that Hoch *et al.* (1999) separate out enterprise solutions whereas Nukari & Forsell (1999) do not make such a distinction. It can be argued that in many cases it is not an easy task, or even relevant, to distinguish between professional software services (i.e., the products of the software project business) and enterprise solutions, or between packaged mass software (i.e., software products) and enterprise solutions (see, e.g., Hyvönen *et al.* 2003). Quite often, enterprise solutions have characteristics of both professional software services and the work done in the software product business. In particular, the line between enterprise solutions and packaged software products is amorphous and context-dependent. Based on the work of Hoch *et al.* (1999), one could say that the choice between enterprise solutions and packaged software products involves the kinds of differences shown in Table 1.

Table 1. Comparison of enterprise applications and software products (Hoch et al. *1999).*

Issue	Enterprise applications	Packaged software product
Software development	Customer-specific solutions. Developed in co-operation with the customers.	Must be generic. Must be appropriate for many technical environments. Must have thorough usage documentation.
	May involve considerable customisation.	Low level of customisation.
Level of productisation	Core application (product platform) 'productised'.	High. Versioning based on releases.
Installation & set-up time	Long. Requires supplier/customer interaction.	Short, but product may require support.
Customer base scope	Fewer customers. Strongly segmented markets.	Mass markets. Only localisation may be provided.

Moreover, even boundaries between the software product business and project business may not be clear-cut, because companies in the project business are seeking productisation while at the same time companies in the product business quite often need to do some kind of customisation for their products, in order to meet customer requirements.

In fact, the software product and software project business should be regarded as the endpoints of a continuum that includes also combinations of product and project business modes (Sallinen 2002, Alajoutsijärvi *et al.* 1999a). For example, Sallinen (2002) has developed a typology of software supplier companies, which contains five categories: resource firm, resource firm with supporting projects, system house, software product firm with supporting projects, and pure software product firm. These five types of software suppliers in the ICT cluster can be positioned along the axes of key customer dependency (high – low) and the way of operating (resource-hiring – production in internal (sub)projects – independent production of software products/modules). Intuitively, this typology offers a more fruitful way to classify software business models than the previous, simpler classifications. However, although different combinations of the product and project businesses can be identified along the continuum, it is also good to point out the differences between the two sets of extremes. Referring to the work of Alajoutsijärvi *et al.* (1999a), differences can be identified at least in central capabilities, object of exchange, production, customer base, nature of markets, branding, nature of exchange, and type of organisation. Table 2 summarises the main differences between the software project business and software product business, as they are seen in Alajoutsijärvi *et al.*

Table 2. The software project business versus the software product business (Alajoutsijärvi et al. 1999a).

Issues	Project business: tailored systems	Product business: packaged software
Central capabilities	Project marketing and management.	Productisation, channel management, alliance-building with strategic partners in the industry.
Object of exchange	Unique project designed and implemented in co-operation with the customer; designed for a certain hardware environment, service content high.	Standard and/or modular products, designed for several different operating systems and hardware environments, service content low.
Production	Activities within projects, production 'after sales', connection between all functions of the company, discontinuity of the projects, deadlines crucial.	Duplication, the production of 'updates' or 'versions', production 'before sales', production function rather independent of other company functions.
Customer base	Narrow. Well-known customers.	Broad. Faceless end customers.
Nature of markets	Familiar, local/domestic, closed and networked.	Distant & international, open, competitive.
Branding	Not important, market assets concentrated on key individuals.	Central area of interest.
Nature of exchange	Interactive, mutual, multifaceted, long-term-oriented, project-related exchange.	Opportunistic, simple, short-term-oriented, product-related exchange.
Type of organisation	*Ad hoc* project organisation.	Market, product, or matrix organisation.

At the end of the 1990s in particular, it was argued that the software product business is more profitable than the project business is (e.g., Autere *et al.* 1999, Nukari & Forsell 1999). In fact, it was even argued that the Finnish software industry would not achieve the predicted growth rate without development of global software products. The desire to move toward the software product business was also seen in practice among Finnish software companies, while quite a few of them started to develop their own software products along with project business. However, it is not a straightforward conclusion now, nor was it then, that the software product business is a more appropriate model than that of the project business.

In this study, both project and product suppliers are regarded as potential software component developers. It might be argued that many software product firms can in fact be regarded as software component producers because their products may be sold as inseparable parts of larger system products without being separately branded, rather than as independent software products. However, it can also be argued that a shift from software projects toward the product business would be easier if the company were first to develop software components rather than independent software products, due to, e.g., an initial lack of branding and mass distribution skills. Referring to McHugh (1999), in software business models where partners and other kinds of distribution channels are emphasised instead of in-house direct marketing, there is no great need to possess competencies that are required for managing the sales cycle and installation and deployment activities in order to achieve a working solution based on the software product. These kinds of competencies are, however, required of, for example, SIs, who own the brand and the customer base, and who act as software and system integrators. In Section 2.3.3, the perspective is shifted from the software industry as representing potential software component suppliers toward software component integrators where the industrial automation sector is concerned.

The software industry versus more traditional industries. In order to shed more light on the software industry, a brief discussion concerning the similarities and differences between the software industry and more traditional industries is justified. The discussion pays particular attention to the issue of whether the software business is something special compared to other businesses or is just business as usual.

It may be impossible to find a straightforward answer, but some guidelines can firstly be drawn from the discussion in the literature of information/digital economy versus traditional/industrial economy and high technology versus low technology. Varying views have been presented on this issue. For example, Shapiro & Varian (1999) argue for the similarities of the more traditional economy and the digital economy, when pointing out that although technology changes, the basic economic laws remain the same. As an opposing view, several studies concentrating on analysing the differences between high-tech markets and low-tech markets (e.g., Gronhaug & Möller 1999, Moriarty & Kosnik 1989), between software and hardware products and between the corresponding areas of business (e.g., Rajala *et al.* 2001, Messerschmitt & Szyperski 2000), and between the information society and more traditional society (e.g., Parolini 1999, Shapiro & Varian 1999) can be found. The different views provide fruitful ground for this research: to some extent, the general theories and models drawn from the industrial marketing and management literature can be applied directly in the empirical context of the software business, although there is a need for some modifications, too, due to the special characteristics of software (cf. Messerschmitt & Szyperski 2003, Sallinen 2002, Messerschmitt & Szyperski 2000).

One major difference between the software industry and more traditional industries is that the software industry is much younger. The industry may not be as ready for structuring in SI-style marketing channels as the more traditional industries are. For example, the development in Western automotive businesses from competitive supplier relationships toward more stable, closer buyer/supplier relationships has taken several decades. It could be argued that the software industry is not yet ready for SI-type business, in the very essence of the concept. The emerging component-based software engineering approaches will certainly pave a road in this direction, but in the end the question of flourishing SI-type relationships is business-related, not merely technical.

Another important question is whether the software industry will ever be ready for close relationships between the SI and the component supplier, due to the strong role of knowledge and competence[18] in the buying and selling industries and the abstractness of software. When there are continuous and rapid changes in the industry, predictions of

[18] The software industry is seen as a knowledge-intensive and competence-based industry in which the management of personnel and social capital plays a central role (see, e.g., Helokunnas & Laanti 2003).

future markets are difficult. This can lead to a situation where the buying companies are not ready to give away any parts of their business because they do not know which part of their business is going to be successful in the future. They may decide to hire more software engineers themselves rather than invest in software supplier relationships.

Such a fear of losing future opportunities can prevent the development of close supplier/buyer relationships: it has been argued that in technologically turbulent industries, such as the ICT cluster in general, neither the suppliers nor the buyers want to become deeply engaged with any specific partner. However, the high turbulence often also means scarcity of resources in times of heavy demand for end products, and in such cases, it might be worthwhile to take the risk of trying to develop more co-operative relationships.

Also, the questions related to product architectures differ between more traditional industries and software-intensive industries: the architecture of physical products is simpler and less abstract than that of software products (Sääksjärvi 1998). It can be argued that the complexity of product architectures in software-intensive industries could delay the full utilisation of commercial software components. However, in spite of the complexity, the entire software industry will move progressively toward utilising component architectures over the next five years, according to many predictions (e.g., Sprott 2000). Many software companies adopted a product-family-based approach in the '90s and will include software architectures and components as part of that approach in the next few years.

2.3.2 Software component integrators: the industrial automation sector

The industrial automation sector is at the juncture of several industries, as it makes use of, e.g., hydraulics, pneumatics, electronics, electricity, and computing solutions. Because of this relatedness to many other industries, exact data concerning the automation sector and its economic development are hard to find from official statistics. (Taskila *et al.* 1995) In some statistics, the industrial automation sector is regarded as part of the electronics and electrotechnical industry; statistics elsewhere group it as its own industry. However, it can be quite straightforwardly positioned under the ICT cluster as a separate sector. Referring to the classification of the Finnish ICT cluster as consumer-oriented (Meristö *et al.* 2002), industrial automation will mainly fall under the 'industrial sector' classification, for which automation and measurement instruments are mentioned. However, large SIs operating in the industrial automation sector have been moving more toward the roles of service and software solution providers, too. Thus, they are related also to the 'services' grouping in the breakdown of the ICT sector.

Despite the above-mentioned problems of classification within the ICT cluster, the industrial automation sector can be characterised as a so-called high-tech business (see, e.g., Rogers 2001, Gronhaug & Möller 1999, Möller & Rajala 1999, Rajala 1997). As it is considered a high-tech industry, several studies can be found that shed light on the industrial automation sector from a business point of view. This is due to the fact that high-tech industries have been studied from different angles – including the industrial network perspective (Lundgren 1993, Håkansson 1987), marketing perspective

(Gronhaug & Möller 1999, Rajala 1997, Virden 1995), new product development perspective (Lynn *et al.* 1999, Jassawalla & Sashittal 1998), legal perspective (Maurer & Zugelder 2000), and business strategy perspective (Covin *et al.* 2001, Berry 1998, Berry & Taggart 1998, Erickson *et al*. 1990, Eisenhardt 1989b). These different perspectives notwithstanding, such basic questions as 'What is characteristic of a high-tech industry?' and 'What differentiates a high-tech industry from a low-tech industry?' have been addressed in many studies.

This study follows the definition of 'high-tech' provided by Rajala (1997, 15); he considers high technology to be leading-edge technology involving a high level of knowledge intensity and enhancement of value for the customer by providing either better quality or better usability. Thus, a company can be classified as a high-tech one if it either creates or uses leading-edge and knowledge-intensive technology. In the definition provided by Rajala, the term 'better' is utilised in reference to the assumption that a high-technology solution is usually in some way more advanced than existing solutions. Also, Gronhaug & Möller (1999, 4) emphasise such a comparison of existing and new solutions, and they add 'novelty' to the key elements of high technology.

Due to the central role of knowledge intensity and novelty, high-tech industries are usually characterised as turbulent and unpredictable, or even uncertain (e.g., Gronhaug & Möller 1999, Heide & Weiss 1995, Moriarty & Kosnik 1989). Of course, the more traditional industries are also characterised to some extent by unpredictability and turbulence, but these characteristics are more apparent in the high-tech industries. Clearly, some basic differences can be found in comparing high-tech and low-tech industries. Gronhaug & Möller (1999, 12) have listed, e.g., the importance and development rate of technology, the nature of market knowledge, the length of planning periods, and the structure of marketing organisations.

As is typical for high-tech companies, industrial automation companies provide a wide range of devices and systems based on integration of computing into electromechanical components and products. Thus, they develop system solutions that are based on successful integration of technologies. In general, the customers of industrial automation companies seek to improve their operational effectiveness by using automated machines, systems, and processes. Traditionally, discrete parts manufacturing and machine and process automation systems have been separated from each other, although this is changing due to the common underlying technologies used in most systems. Moreover, the sector is facing considerable changes due to the growing amount and importance of computer software – not just hardware and electromechanical parts.

In the classification of software products and services (Hoch *et al.* 1999), the industrial automation sector would mainly fall under the embedded software business segment. However, due to the amount of software in automation system deliveries, there is a clear shift toward a more independent role for software and even software products provided by automation companies. As stated earlier, such shifts offer an interesting subject for research where the software business is concerned. Most industrial automation companies are not yet familiar with the business logic of software buying and selling (Seppänen *et al.* 2001). Therefore, one of the present managerial challenges in the sector is how to both acquire and sell commercial software, as opposed to merely developing software in-house. However, because software will over time play a more and more central role in automation systems, the border between the automation sector and other ICT sectors is becoming blurred. Ultimately, automation companies may for this reason indeed need to decide not only how to buy software but also how to start selling their own software products. These kinds of changes in the behaviour of the actors and in their business logic will most likely cause transformation in the business networks in which automation companies are embedded.

2.3.3 Intermediaries in the software component business

In the context of the software component business, different types of possible intermediaries and their tasks and roles are especially interesting topics for further discussion; in this context, software as one type of digital and intangible product offers possibilities for new kinds of brokering methods that are based on the utilisation of the Internet as the sole marketing and delivery channel. In fact, so-called *software component brokerage* as a special kind of intermediary business is a growing trend. The idea of component brokering is that standard or semi-customised components can be marketed to other companies with similar needs (Hoch *et al.* 1999) by utilising the Internet as the marketing and delivery channel. There already exist a few virtual software component marketplaces on the Internet, such as Component Source (http://www.componentsource.com). Their purpose is to facilitate component supply and to provide a reliable and branded channel for buying and selling software components – i.e., to facilitate the processes employed in acquisition and support of software components. (Sprott 2000)

Development of information systems for trading of software components over the Internet is also underway. There is a growing need for systems that collect information about software components worldwide over the Internet and provide electronic catalogues of components. This could help potential buyers to screen and evaluate components and their suppliers. Component buyers need, for example, information about purchasing and licensing conditions, the functionality of the components, interfacing, and performance issues – such as execution time and minimal memory required by the components (Aoyama & Yamashita 1998).

One special type of intermediary in the software business is the application service provider (ASP). The concept of application service provisioning is not very clear yet; it has been used with a variety of meanings in different contexts. However, one common interpretation is that an ASP is a company that offers access to application programs on a network basis. It can also be said that ASPs typically allow businesses to offload their application maintenance obligations, including those for staff and equipment, for a monthly or usage-based fee that covers rental of software applications that, for example, many small businesses could not otherwise afford. (Grice 2000, Sound Consulting 2000)

Therefore, the basic point behind an ASP company is to rent application programs to other companies or individuals, using the Web as a distribution channel. ASPs offer an alternative for companies in the process of deciding whether they should outsource applications or maintain – or even build – them in-house. It can be said that acquiring a piece of software for use from an ASP company becomes an outsourcing situation. The ASP model should allow the customer companies to get their applications installed and running for customers more quickly than more traditional channels allow. Moreover, the customer organisations should avoid the complexity and cost of establishing an infrastructure on which to base the application and of having an organisation to manage it – just by avoiding the staffing costs, customers can save a lot of money. Yet another important business driver is the fact that, in an ideal situation, an ASP company can provide an 'end-to-end solution' for the customer; in other words, it can provide a comprehensive, integrated, one-source offering (Blackwell 2000). In conclusion, ASPs create value for customers by offering a faster and easier way to install and update their software applications (Paul 2000). For software component suppliers ASPs provide a new channel for sale of applications to broader segments of the market on a steady-stream-revenue basis rather than a one-time-licensing basis.

Regardless of all these benefits, there remains something that ASPs cannot offer. Potential customers of ASPs should be aware that the ASP model might not always offer lower software purchasing costs. However, the customers may save a lot in costs over the product life cycle, since equipment and staff requirements are reduced. With regard to the latter, an ASP cannot usually offer any tailoring for the software that it provides; the customers do not have the option of modifying the application. Nor may they be able to use third-party products from anyone outside the ASP's selected group of suppliers, unless they accept the cost of developing the necessary interfaces themselves. (Blackwell 2000)

The lack of tailoring possibilities and the need to develop the necessary interfaces are issues that may prevent or at least slow down the utilisation of ASPs as an intermediary in the software component business. This is due to the fact that usually the SI relationship is characterised by tailoring of the supplied components and products at least to some extent. In the case of software components, the end customers' ability to use the products as parts of the larger applications made available by the ASP is central. This is not possible without partnering with several software suppliers.

Partnering is also needed because many customers demand a single-contract ASP solution (Grice 2000). In fact, partnering is so popular in ASP markets nowadays that most ASPs are actively seeking to team up with independent software vendors, resellers, telecommunications network providers, ISPs, and hardware vendors. However, the ASPs should carefully consider with whom they are going to partner, because partnering needs differ depending on what kinds of services are to be provided. It is also important to understand that the members of a partnership consortium should together constitute a functional unit. For example, when an ASP company partners with a software vendor, there is a danger of the ASP concentrating on building online distribution while the software vendor provides technical expertise, with nobody specialising in sales. On the other hand, if the ASP partners with a value-adding reseller or service-oriented partner with an existing sales training infrastructure built in as part of its core business mix, there will not be such a problem. (Fusco 2000)

When ASPs choose to sell to customers indirectly – in other words, through resellers and agents – they usually opt to serve the SME market. On the other hand, when they concentrate on large customer companies, it is usually more reasonable to choose the direct sales approach (Sperling & Gage 2000). Therefore, the need for an ASP to partner with dealers is greater when the ASP concentrates on doing business with smaller enterprises.

As regards ASPs as possible intermediaries in an SI relationship, one major problem is the question of whether it is reasonable to rent software components via the Internet. The price of buying rather than renting such components may not be that high, at least in the case of ‘small’ components. In this situation, the costs of renting and licensing components may not differ much. Furthermore, IPR considerations can prevent the emergence of ASPs as intermediaries in the SI software business.

2.4 Summary: overview of the empirical context

Above, an introduction to the software component business as part of the ICT cluster has been provided. The software component business was discussed through defining software components, by considering the roles of standardisation and software architectures in the software component business, and especially by pointing out the claimed benefits and pitfalls of the software component business. It was argued that there are many expected benefits when one utilises commercial software components but that, on the other hand, there are also many problems that need to be solved before real growth of the software component business can happen. Although some of the risks and pitfalls are purely technical in nature, there are also several business-related factors that need more careful analysis. The most interesting business-related problems related to the purposes of the present study are the problems in understanding *what kind of value is created* and *how the value is created* when utilising commercial software components instead of producing the needed software in a more traditional manner via project-based software subcontracting. In other words, the importance of understanding what kind of value can be created by moving toward buying and selling software as components, and of how it can be created, is evident.

Also, the software component business was discussed in this chapter through identifying the different actor roles related to it. The software industry, as mainly representing the software component suppliers, was discussed in terms of different classification schemes, while the industrial automation sector, as mainly representing the software component integrators, was mainly depicted as a high-tech industry that lies at the intersection of several other industrial sectors and industries. As stated above, it is not an easy task, or in some cases even relevant, to distinguish between the different sectors under the ICT-cluster umbrella. That is also the case in the present study because the aim is to study the emerging software component business within the ICT cluster from a holistic network perspective. As there are different perspectives on the software component business – e.g., those of the component developers/sellers, distributors/intermediaries, and utilisers/buyers – and as the same companies can in fact have all of these basic roles at the same time, the area under research becomes somewhat blurred.

Therefore, in order to provide a clarification of the empirical context of this study, I will next illustrate what can be regarded as the *main* roles of the various sectors within the ICT cluster in the emerging software component business. This illustration needs to be kept at a rather rough level because, as mentioned above, the same company may be regarded as representing quite a few sectors within the ICT cluster and, furthermore, may act partly as a software component developer, partly as a component utiliser (i.e., an end customer), and in some cases even as a component distributor (see Niemelä *et al.* 2000). The illustration provided in Figure 13 divides the sectors into software component developers, distributors/SIs, and end customers. SI companies that acquire software components for integration into their own system product for sale further down the line should be regarded from the component developer's point of view as distributors and intermediaries rather than as end customers. However, even between the software component developer and the SI there may be intermediaries, in addition to those between the SI and the end customer.

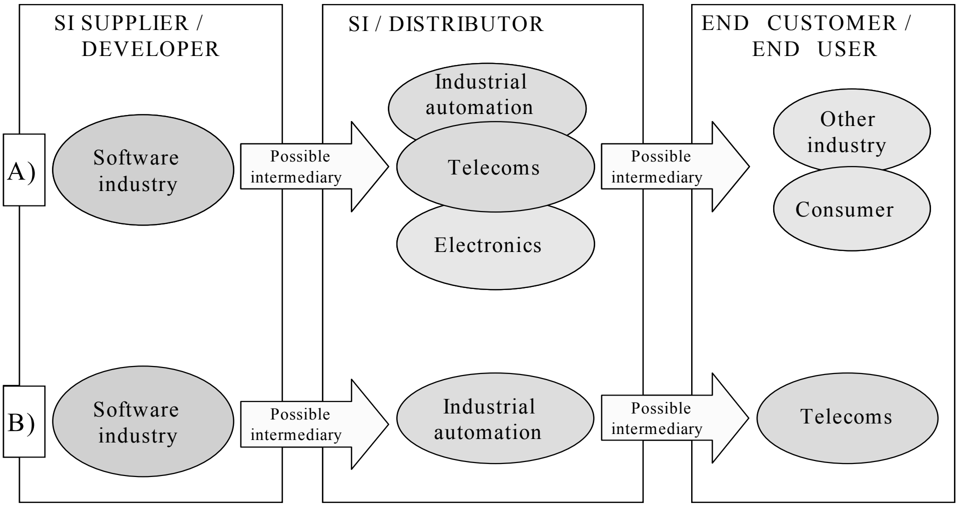

Fig. 13. Possible roles of ICT-cluster sectors in the software component business.

In Figure 13, two alternatives for the main roles of ICT sectors in the software component business are identified. The first alternative, A, refers to a situation where a software company develops software components that are sold to an SI representing the electronics, automation, or telecommunications sectors within the ICT cluster. Furthermore, these companies are as SIs acquiring the software components in order to integrate them as parts of an overall system product that is then sold to either some other industry (e.g., a process automation system to a paper mill) or to consumers (e.g., mobile phones). The second alternative, B, refers to a situation in which the software industry, again, plays the role of the component developer but both the distributor/SI and the end customer are found in sectors within the ICT cluster. An example of this is a software component that is part of an automated production line that is then sold to a company operating in the telecommunication sector.

In conclusion, the software industry is most likely to play the role of a software component developer/seller, whereas the other sectors of the ICT cluster can take the role of either the distributor/SI or the end customer, depending on the kind of product/solution into which the software component acquired is going to be integrated.

Part II: Elaboration on value-creating networks

3 Bringing together the concepts of value creation and business networks

This chapter starts the theoretical part of the study by, firstly, reviewing the concepts of value creation and business networks separately. The discussion about business networks is strongly built around the research tradition of the IMP Group concerning industrial networks, henceforth called the network approach. Use of a network approach as based on the work of the IMP Group provides a solid theoretical grounding for a macro-network-level discussion. However, also the North American research tradition concerning strategic alliances is taken into account, providing interesting insights on the micro network level.

Discussion of business networks is conducted in a network management section, which synthesises the different research streams addressing industrial networks and strategic alliances. Secondly, the two concepts of value creation and business networks are joined together in a discussion of value-creating networks. The discussion presents three recent pieces of research on the issue and acts as a basis for development of the empirically grounded model of value-creating networks.

3.1 Raison d’être: to create value

The concept of value itself is not always so clear and easy to understand, so the concept of *value creation* can be even more unclear. Generally speaking, value creation can be regarded as the raison d'être of collaborative customer/supplier relationships (Walter *et al.* 2001, Parolini 1999).

In fact, every company has its own value creation process, through which it creates value in its business operations. Such a process-oriented view of value creation has been given particular emphasis in studies concerning customer relationship management (CRM) (e.g., Storbacka *et al.* 1999b). The value creation approach to customer relationship management suggests that if the supplier is aiming at building a good and long-lasting relationship with the customer, it has to have a thorough understanding of its customer's mission, goals, vision, and strategy (Storbacka *et al.* 1999a). This is because the value creation process represents the actions that the customer takes in order to achieve its goals and to fulfil its mission. Thus, the customer always measures value in relation to its own goals.

An important consideration in applying the value creation approach to customer relationships is that by understanding the customer's value creation process the supplier can more thoroughly identify the problems that the customer has that affect its business activities. It has been argued that through understanding the customer's value creation process the supplier can notice problems and concerns of which the customer organisation itself is not aware (Storbacka *et al.* 1999a). By providing a solution to these unrecognised problems, the supplier can offer a more valuable relationship to the customer than competing suppliers can.

However, if we define value creation as a process that is part of a company's overall approach to business, it is rather broadly defined and thus rather hard to understand. A helpful tool for better understanding the value creation process is to look at the overall process in terms of different sub-processes.

For example, Hirvonen & Helander (2001) have studied joint value creation in the context of the professional services business, particularly learning and personnel development services. They argue that in learning and personnel development services the value creation process in which the service provider – i.e., the supplier – should be most interested is the personnel development process of the customer organisation. This process is a *sub-process* of the customer organisation's whole value creation process – i.e., of the general business process of the customer organisation. They describe in brief what kinds of sub-processes can be identified in the personnel development process.

Firstly, the customer company should be able to identify what kind of services it really needs. This is labelled the *need identification process*. Depending on the nature of the need, the customer company can either recruit new people with the needed competencies or can educate the existing personnel. If the company decides to educate the existing personnel, this is usually done through acquiring learning services from an external service provider. This *acquisition process* includes operations such as identifying and evaluating the potential suppliers, bidding rounds, and contract negotiations. After the buying decision is made in the final stage of this process, the courses are started for the personnel and the *education process* begins. After the course, the *utilisation process* for the learning services commences, referring to the process in which the course participants actually use or don't use the learned skills in their work. It can be argued that during this, the real results of the education are discerned. (Hirvonen & Helander 2001)

Hirvonen & Helander (2001) further argue that many suppliers concentrate more on the acquisition and education processes than on the need identification and utilisation processes, despite the latter being the most critical and difficult ones from the customer's point of view. Moreover, the value created for the customer lies mostly within the utilisation process, in the customer's view.

Although the work of Hirvonen & Helander (2001) is tied to its context of professional services, their argumentation is in some respects applicable to other contexts also. It is helpful to understand value creation through different sub-processes, in which the actual amount and nature of the value created differs. Moreover, customers have different kinds of difficulties with each of these sub-processes, and, by identifying these problems and difficulties and solving them, the supplier is better able to create value for the customer.

Nevertheless, it is important to point out that this problem-solving for the customer should be done in a profitable way, at least in the long run (e.g., Normann & Ramirez 1993). As Anderson & Narus (1999) have pointed out, besides recognising the actions through which the supplier can create value for the customer, it is also crucial that these actions be taken in an economically profitable manner. When the supplier bases its products and services on its own core competencies, it can solve its customers' problems profitably without excessive consumption of resources. This is also pointed out by Hammer & Stanton (1999) as they underscore that the purpose of any company is to deliver value to customers in such a way that it also creates value in the form of profits for shareholders.

3.2 Views of business networks

The large umbrella of business network studies can cover, for example, studies concerning industrial networks (e.g., Håkansson & Snehota 1995, Easton 1992, Håkansson & Johanson 1992), business ecosystems (e.g., Moore 1997), strategic enterprise networks (e.g., Hyötyläinen 2000, Achrol & Kotler 1999, Jarillo 1993, Jarillo 1988), strategic alliances (e.g., Hutt *et al.* 2000, Doz & Hamel 1998, Gilroy 1993, Heide & John 1990), and focal nets (e.g., Alajoutsijärvi *et al.* 1999b, Tikkanen 1998, Alajoutsijärvi 1996). Table 3 presents examples of studies of business networks, differentiated by the research focus, level of analysis (micro/macro), and whether the research is based on the IMP tradition or not.

Table 3. Business network studies with different research foci.

Research focus	Level of analysis: micro	Level of analysis: macro	Based on the IMP tradition
Industrial networks: e.g., - Ford 1997, Håkansson & Sharma 1996, Anderson *et al*. 1994, Easton 1992, Halinen & Salmi 1999		X	X
Business ecosystems: e.g., - Moore (1997)		X	
Strategic enterprise networks: - Achrol & Kotler 1999, Jarillo 1993, 1988	X		
Strategic alliances: e.g., - Parise & Henderson 2001, Hutt *et al*. 2000, Doz & Hamel 1998	X		
Focal nets: e.g.,: - Alajoutsijärvi *et al*. 1999b, Tikkanen 1998	X		X

These studies differ from each other in the unit of analysis; studies concerning industrial networks are studies of so-called macro networks and strategic alliances, while strategic enterprise network studies are studies of micro networks[19]. For example, certain studies that are concerned only with *supplier* networks (e.g., Gadde & Håkansson 2001, Harland & Knight 2001, McCutcheon & Stuart 2000) can be classified as among micro network studies. In the discussion that follows, the levels of macro networks and micro networks are first examined separately and then analysed together in the section 'Network management'. The network management issue is brought up because the different network levels differ in their manageability – macro networks are not manageable by a single actor in the same way as micro networks are.

For the study, the different network levels are important to discuss since they provide two interrelated and supplementary levels of analysis for the phenomenon being studied, value-creating networks.

3.2.1 Industrial networks

The following discussion of industrial networks aims to present the underlying assumptions and basic tools for a macro network level of analysis. These theoretical findings are used later in the study to solve the research problem – that is, to describe in the best way possible value-creating networks in the software component business and to analyse them.

3.2.1.1 Basic elements of the network approach

According to Easton (1992), the network approach aims at achieving understanding of industrial markets as complex networks that are formed from a bunch of inter-organisational relationships. Möller & Wilson (1995) say by way of summary that network theory aims at providing conceptual tools for analysing both structural and process characteristics of industries. The aim is to understand complex systems of relationships by studying an industry from a holistic perspective. They also point out that both the structural and process characteristics can be viewed at different levels, which are the industry level, the level of firm in industry, the level of the firm as a nexus of business exchange relationships, and the relationship level.

Håkansson & Snehota (1989) point out that the network approach takes into consideration the relations between different actors. All the actors, their activities, and resources are bonded, linked, and tied up together, and in this way they build up a wide network. In this network, also the external resources of a firm are usually very important, which is why it is meaningless to denote clear organisation boundaries; it could even be said that it is impossible to disconnect the organisation from its context.

The network approach also suggests that the effectiveness of the organisation is a result of how it 'relates' to the context, not of how it 'adapts' as the more traditional approaches suggest. So, while 'adapting' leads to a focus on the internal processes of the organisation, 'relating' induces a shift in focus to its context because the distinctive

[19] More detailed discussion concerning the different network levels is provided in Section 3.2.3.

capabilities of an organisation are acquired and developed through the organisation's relationships with the other actors in the surrounding network. Also because of this connection to the other actors, the management of organisational effectiveness is dealt with by framing the context rather than by designing and planning a future pattern of activities – e.g., internal issues – as traditional approaches suggest. (Håkansson & Snehota 1989)

Easton (1992) illustrates the basic elements of the network approach from four different viewpoints, or metaphors: networks as relationships, positions, structures, and processes. A basic assumption with the network approach involves the essential unit of relationships, from which proceeds understanding of the network as a sort of cluster of relationships. Thus, in order to understand the functionality of networks, it is important to understand also the individual relationships between organisations. Relationships are characterised by four basic elements: mutuality, interdependence, different power relations, and investments made in the relationship. (Easton 1992) Furthermore, the effects of the relationship can be both positive and negative. Additionally, in the relationships can be found both primary and secondary functions. Primary functions refer to the relationship's effects on the parties involved in the dyad, whereas secondary functions refer to the effects that the relationship has on the other actors in the network. (Anderson *et al.* 1994) The key role of relationships in the network approach is also visible in the above list of network model propositions as provided by Håkansson & Snehota (1989).

Networks as structures are concretised through the interdependencies between the organisations. If there are no interdependencies between the organisations, neither will there be any network structure. The greater the interdependence of the organisations, the clearer the structure of the network. Thus, there can be so-called 'tight' and 'loose' networks. Tight networks are characterised by a great number of bonds between the actors and well-defined roles and functions for actors. Loose networks, on the other hand, are illustrated by the opposite characteristics. The question of the boundaries of the network is also related to the 'networks as structures' perspective. Although in principle the whole world economy could be seen as one huge network, it is essential for the purposes and implementation of research to divide networks into smaller pieces and examine these smaller parts of networks. This division should always be done based on the purposes of the study. For example, it is possible to limit examination of the network in terms of the interdependencies between organisations. (Easton 1992)

Analysis of networks as positions mainly involves examination of the network from the viewpoint of a single company. However, micro and macro network positions can be differentiated. Micro positions are characterised by the role of the company in relation to another company, the company's significance to another company, and the nature (strength) of the relationship between two companies. Thus, micro positions focus on dyadic relationships. A broader perspective, on the other hand, is characteristic of macro positions – e.g., also the nature of so-called indirect relationships and the company's own role in the overall network. The nature of networks as processes mirrors the nature of the networks themselves: networks are stable but not static. Due to the interrelationships among actors in the network, evolutionary changes are more characteristic of networks than radical changes are. (Easton 1992)

3.2.1.2 The ARA model of industrial networks

The actors–resources–activities (ARA) model of industrial networks can be seen as the basic theoretical grounding for the discussion of industrial networks. The basic idea of this model is that every organisation is embedded in a network of relationships with other actors. The actors carry out a set of activities that are linked together. Furthermore, in order to carry out the activities, there is need for resources. (Håkansson & Johanson 1992) The ARA model is illustrated in Figure 14.

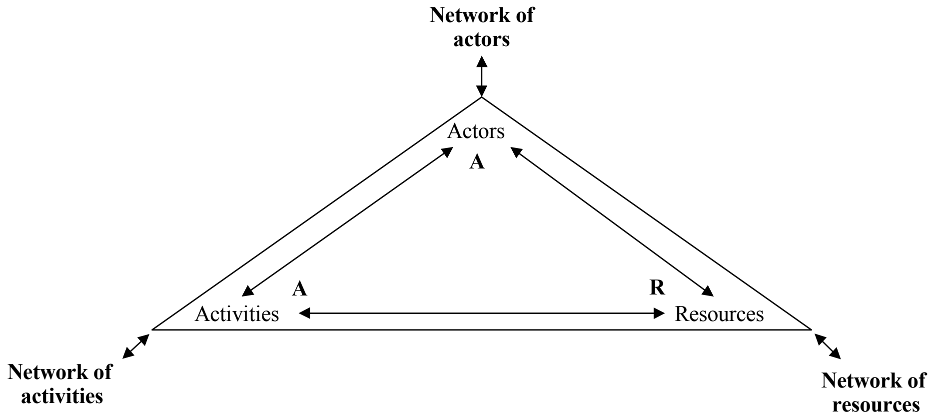

Fig. 14. The ARA model of industrial networks (Håkansson and Johanson 1992, 29).

In the industrial network model, actors are persons, organisations, or groups of organisations that control activities and/or resources. Relationships are developed between the actors through exchange processes. Furthermore, actors are attached to the overall network through these relationships. Attachment to the network gives to the actors the possibility to use resources of the others, too. Actors can control resources indirectly or directly. Indirect control is based on the relationships that the actor has with other actors within the network. Direct control of resources instead appears through ownership. What is also characteristic of the network actors is that they are target-oriented. A common target for all actors is to increase their own power and influence in the network. Actors believe that more powerful positions within the network render them able to achieve other objectives. Actors are also characterised by possession of varying views and opinions concerning activities, resources, and other actors in the network. This is natural because each actor knows its own local network better than the more distant parts of the overall network do. (Håkansson & Johanson 1992)

Activities can be divided into two types: transfer activities and transformation activities. Transfer activities involve movement of the control of resources from one actor to another, whilst transformation activities see resources themselves change their form. Variation with respect to other activities is also characteristic of activities; some activity circles are tightly bonded to other activity circles, while other circles have only loose links. It is important for the overall network that new activities and changes in the old ones can make the overall network more effective. Thus, network changes occur through activity changes. Both transformation activities and transfer activities demand resources. Typical features of resources are their heterogeneity and the control over them possessed by the actors. Due to the amount of heterogeneity, resources can be used in numerous different ways and in several different contexts. Thus, it is impossible to identify the possibilities of resources exhaustively. However, it is important to get as much experience concerning the network resources and information about them as possible if one wishes to increase the effectiveness of the network as a whole. (Håkansson & Johanson 1992)

A network is comprised of these three elements, which all have an interaction relationship to others. Actors develop and maintain relationships, and activities are related to others, just as resources are. These three elements form their own networks, which then together form the larger network. Important network forces are thus the functional dependency relations, power structure, information base, and inter-temporal dependencies. Inter-temporal dependence means that as the network is being formed by memories, investments in the relationships, information, and routines, all the changes happening in the network must be accepted by a relatively large portion of the network. Thus, all changes happen gradually from a network perspective. This means also that stability and development are intimately linked to each other in the network; in certain areas, development is based on stability, while in others stability rests on development. (Håkansson & Johanson 1992)

In sum, industrial networks are full of different types of interdependencies. Actors within the network need to be able to observe and to process these interdependencies in order to achieve success. The model for industrial networks offers tools for that; by combining the activities and resources of one's own company with those of the customers, suppliers, and other network actors, the company is able to succeed in operating within the interdependence network. This process does not, however, consist of mere co-operation; it does include co-operation with other companies, but it also acts against, through, and despite other companies. (Ford *et al.* 1998)

Håkansson & Snehota (1995) have developed the model presented above for industrial networks in a more practical and more dynamic direction. They have elaborated upon the model by describing network development as a dynamic entity that is built by actor bonds, activity links, and resource ties. With the help of these dimensions, the nature of a relationship developed between two actors can be characterised. Additionally, the dimensions can also be used to help illustrate those effects that the relationship has on the dyad itself; on both parties separately; and, lastly, on third parties. Thus, through utilisation of the dimensions, important and holistic information can be obtained concerning the effects of each relationship on the surrounding network. In the material that follows, the actor bonds, activity links, and resource ties are each discussed in more detail.

Actor bonds connect actors together. Actor bonds affect also the way the actors experience each other and various situations. Furthermore, actor bonds have an influence on what kinds of identities are formed for the various actors within the network. An identity that is formed affects every activity performed by the parties in the relationship, but also the activities performed change the identities of the parties in the relationship. However, identities are also affected by the images one party in the relationship has of the other. Some of these images are formed through joint, concrete activities, but some are only based on assumptions about the other party. This kind of identity forming can be used to examine the strength of the bonds between the actors. Similarly, the level of mutual commitment and trust between the parties can be used to this kind of examination of the strength of the bonds between the actors. This is because the bonds are created in a relationship where the parties show a certain amount of interest in each other and become mutually committed. (Håkansson & Snehota 1995)

Activities are linked to each other in various ways. There can be identified, e.g., technical, administrative, and commercial links between network activities. An essential element is that development of the activity links is affected by development of the overall relationship between the actors. Furthermore, activity links can be seen as forming broader entities of activity chains, in which the activities carried out by a single actor are based on the activities that have been carried out by another actor. (Håkansson & Snehota 1995) This idea is in fact in line with the identified shift from Porter's (1985) original intra-organisational value chain model toward an expanded idea of the value chain as an inter-organisational value constellation (Normann & Ramirez 1993), in which the interrelated activities of different organisational actors are looked as one entity. At the same time this kind of notion of value constellation emphasizes the notion of end customer, thus a downstream movement along the overall value chain can be identified (Wise & Baumgartner 1999).

Håkansson & Snehota (1995) illustrate the idea of activity links through an example of activity as a development of new technology: a company can develop a marvellous new technology, but if there aren't any users for that technology, there is no real value in it. Thus, the support of the surrounding network is essential. Rather often, it is impossible for a single company to develop new, functional technology by itself; usually, technologies are developed through co-operation between several actors, as their activities are linked.

Resources are possessed by the actors and also shared and distributed by the actors. Resources include different types of elements, such as various forms of technology, materials, and information. The role of the resource ties is to connect the resource elements possessed by two or more network actors. In addition to the activity links, also the resource ties are affected by the development of the relationship between the actors involved. Thus, the relationship itself can be seen as an important resource, too. (Håkansson & Snehota 1995)

The ARA model and its dynamic application involving actor bonds, resource ties, and activity links forms the core of the network approach. Through this model, it is possible to study inter-organisational exchange[20] from a holistic perspective. The ARA model is going to be applied in part later in this study in order to provide a holistic perspective on the research phenomenon, value-creating networks.

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[20] The network approach is not the only possible approach for studying inter-organisational exchange. Other potential major research approaches are the interaction approach (used by, e.g., Cunningham & Homse 1986, Campbell 1985, and Håkansson 1982), the transaction cost approach (TCA) (Williamson 1996, Williamson 1985), and the political economy (P-E) approach (Stern & Reve 1980). For more information about these different research approaches, see the metatheoretical analysis provided by Möller (1995).

3.2.2 Strategic alliances and focal nets

Whereas networks are the complex, multifaceted structures of organisation that result from multiple strategic alliances, alliances are the individual agreements and collaborations between a smaller number of partners (Weber 1992). Thus, networks can be seen as something wider than strategic alliances. However, strategic alliances and focal nets provide useful views concerning the manageability of networks, and that is why they should not be forgotten in a discussion concerning business networks.

Like networks, strategic alliances can be defined in a variety of ways. However, it is fairly typical to emphasise in the definitions of strategic alliances both collaboration and long-term perspective (e.g., Doz & Hamel 1998). Also, Håkansson & Sharma (1996) point out that continuity is one major characteristic of a strategic alliance, along with co-operation. However, they argue that continuity is more of a structural characteristic, along with instrumentality and rationality and the characteristics of complexity and informality. Co-operation, on the other hand, is more of a process characteristic that is closely tied with conflict and adaptation aspects of strategic alliances. What **is** typical of most definitions of strategic alliances is the basic assumption that alliances differ in some specific ways from normal buyer/seller relationships, but, on the other hand, they cannot be equated with mergers and acquisitions, which always involve arrangements concerning the ownership of the companies involved (see, e.g., Håkansson & Sharma 1996).

In several studies (e.g., Fedor *et al.* 1995, Lorange & Roos 1992, Harrigan 1988), it has been argued that technological complementarity, decreased time to market, and market access are the strongest benefits that are sought from alliances. Additionally, an alliance can act as a source of early-stage capital for small start-up firms (Carayannis *et al.* 2000). However, as Fedor *et al.* (1995) point out, usually the most important driver for alliances is the desire to leverage one's own core competencies through partners who possess unique skills, resources, or market positions. This is in line with the work of Doz & Hamel (1998), while according to them, there are three main purposes for alliances. These are co-opting, co-specialisation, and learning and internationalisation. Co-opting turns potential competitors into allies and complementary providers of goods and/or services in order to allow new businesses to develop. Co-specialisation means the synergistic value creation that results from the combining of previously separate resources, positions, skills, and knowledge sources. Learning is particularly important where those skills that are collective, embedded, and even tacit are concerned. All three of the main purposes listed can be seen as the *value* the alliance can produce for the participants.

However, it is not an easy task to build and maintain a successful alliance. First of all, alliances require a lot of time, commitment, and energy in order to succeed. Furthermore, alliances are often very complex and thus hard to structure: it is not easy to handle a bunch of relationships in such a way that everyone benefits from the alliance. Although strategic alliances and alliances in general have been rather popular, there is evidence based on empirical studies that more than half of strategic alliances fail (Ho Park & Ungson 2001, Ernst & Halevy 2000). Because the outcomes of such failures can be devastating, quite a few researchers have been interested in studying the reasons behind alliance failures (e.g., Ho Park & Ungson 2001, Eisenhardt & Schoonhoven 1996, Park & Russo 1996, Fedor *et al.* 1995, Hamel 1991).

Ho Park & Ungson (2001) state that, in general, the two main issues behind alliance failures are inter-firm rivalry and managerial complexity. Inter-firm rivalry is a consequence of opportunistic behaviour on the part of an alliance partner; it is not uncommon for each partner to try to maximise its own individual profit and interests instead of common ones. Furthermore, alliances often fail because it is hard to co-ordinate two or more companies in such a way that the long-term goals of the alliance can be achieved. It can also be argued that alliances fail because it is hard to take into account all the matters relevant to alliances, which include strategic, financial, legal, and cultural ones (Fedor *et al.* 1995).

As a term closely related to strategic alliances, the term '*focal net*' can be of use, although the latter refers to the research tradition of the IMP Group and strategic alliances are closer to the American research tradition. Nonetheless, it can be argued that the unit of analysis is rather similar in studies of strategic alliances and studies that are described as dealing with focal nets. What is similar is that usually in such studies the aim is not the study of the overall macro network – e.g., a macro network for a particular industry. To the contrary, the aim is to study narrower and more local networking phenomena. Usually, these studies are carried out from a certain company's point of view, or at least a central role of a certain, single company within the net is identified. These central companies have been called, for example, focal companies or hub companies.

Tikkanen (1996) emphasises that a focal net is always part of a broader network and thus could be viewed as a local network or micro network. However, the difference is that a focal net is studied from the viewpoint of a certain, single network actor, which usually is a company. The central aim in focal net analysis is to take into account all parts of the broader network that are relevant from the single actor's perspective. Consequently, it is necessary to determine which parts of the network are taken into account – i.e., what the bounds of the focal net under study are. It needs to be noticed that utilisation of a focal net study does not mean that only the direct relationships of the focal company are studied. Rather, all the relationships that have relevance to the focal company are included in the analysis. Overall, focal net studies offer a meaningful transitional form of research between network studies and studies that concentrate on either dyadic relationships or intra-firm issues.

How, then, can one determine what is a proper focal net for study? According to Tikkanen (1998), the focal net is defined through the focal company. In other words, the focal net is defined through one single actor within the broader network that has been selected for study. The focal net and its boundaries are defined from the viewpoint of the focal company — how the focal company perceives the net surrounding it. The downside of such a definition of the focal net is that it reflects the perceptions of only a single actor operating in a network. Consequently, there might be some important interdependencies or other key network features that are not recognised by the focal company and that thus may not be taken into account in the analysis of the focal net.

3.2.3 Network management

How much do industrial network studies and studies concerning strategic networks and alliances differ from each other, in the end? Referring to the works of Håkansson & Sharma (1996) and Möller *et al.* (2002), one can state that, in general, network studies and net studies differ from each other not only in their unit of analysis and value creation logic but also in their assumptions concerning manageability of networks.

The manageability of networks has been discussed in, for example, studies focusing on supply networks. A popular question has been whether a supply network is emergent rather than the result of purposeful design by a singular entity. Choi *et al.* (2001) argue in their study concerning supply networks that too much control – i.e., management in the strict sense of the word – may cause problems in terms of innovation capability and flexibility in the supply network. Conversely, allowing too much emergence, in the sense of relative lack of management and control, can undermine work routines in the supply network – and also predictability from the management angle.

The work of Choi *et al.* (2001) does not offer any straight answer to the question of whether networks can or even should be managed. However, the work of Möller *et al.* (2002) provides a more fruitful perspective from which to understand the problem of manageability in the framework they offer in terms of network management levels. According to Möller *et al.*, network management can be viewed from four different interrelated levels, namely 'Industries As Networks', 'Firms in Strategic Nets', 'Relationship Portfolios', and 'Exchange Relationships'. Different key issues and managerial challenges characterise each of these levels, as illustrated in Table 4.

Table 4. Network management framework (Möller et al. *2002).*

Level of Management Issues	Key Themes	Managerial Challenges
Level 1		
Industries As Networks: Envisioning and orchestrating the network	Networks, as configurations of actors and value activities, are not transparent.	How to develop valid views of relevant networks and their opportunities
	Ability to understand networks and their structures, processes, and evolution is crucial for network management.	How to analyse strategic nets and key actors to gain an understanding of network competition
	The capability of influencing other core actors is essential.	How to orchestrate whole networks
Level 2		
Firms in Strategic Nets: Net management	Firms' network behaviour is related to the: strategic nets they belong to; positions they have and roles they play in these nets; and major business relationships	How to develop and manage strategic nets
	The ability to identify, evaluate, construct, and maintain positions and relationships is essential in strategic nets.	How to mobilise and co-ordinate key actors How to enter new nets (market entry, new product field, new technology) How to manage net positions
Level 3		
Net & Relationship Portfolios: Portfolio management	A firm is a nexus of resources and activities. Which activities to carry out internally and which through different types of nets is a core strategic issue.	How to develop and manage an optional strategic net portfolio
	The capability of managing one's positions and roles in multiple nets is required.	How to manage the actor relationships in particular nets – from an organisational and analytical perspective
Level 4		
Exchange Relationships: Relationship management	Individual customer/supplier relationships form the base of strategic nets.	How to evaluate a strategic relationship's potential for future value How to manage relationships efficiently – from organisational and analytical perspectives
	The ability to create, manage, and conclude strategic relationships is a core resource for a firm.	How to manage major relational episodes efficiently

The 'exchange relationships' level refers to individual customer/supplier relationships as the basic unit of analysis; the 'relationship portfolios' level to a group of customer/supplier relationships from a single firm's perspective; the 'firms in strategic nets' level to the so-called focal net or strategic net, which can be understood as manageable and a smaller portion of the macro networks; and the last level, 'industries as networks', to networks as entities that cannot be managed in the strict sense of the word but still need to be understood for development of a valid view of the relevant networks and the opportunities they contain.

As can be seen from Table 4, each of the network management levels requires different kinds of capabilities from the participating companies. These capabilities are related to management at levels two to four, whereas at the first level, 'industries as networks', the term 'managing' is changed to 'influencing'. This refers to the assumption behind network management: the focal company can manage relationships and even a bunch of relationships, but the level of networks is not manageable by any single actor. Understanding the individual exchange relationships forms the prerequisite for management at all three of the other levels (Möller 1999). However, this does not indicate that the level of exchange relationships holds a position of superiority to the other three layers, due to their interrelated nature.

The framework combines the varying views of the strategic school, which emphasises the manageability of nets by a 'hub organisation', and the industrial network approach, whose proponents argue that a business net cannot be fully controlled by any single actor. Although Möller *et al.* (2002) do not fully open up the question of network management to dialogue, they have succeeded in combining the varying views of manageability by adopting a pragmatic view, which understands management of business nets as a relative matter. They argue that the nature of management – i.e., the opportunities for control and co-ordination – varies along different levels within a business network. (Möller *et al.* 2002)

Harland & Knight (2001) too have reflected on the issue of manageability of networks. They argue that there are different interpretations for the concept of network management. The expressions 'to *plan and control* networks' and 'to *influence* a network' have both been utilised in addressing network management. Harland & Knight argue that these *controlling* and *coping* aspects afford too simple a picture for proper discussion of network management. They suggest that controlling and coping should be seen as *extreme positions* along the spectrum of an actor's potential behaviour within a network. Therefore, they continue that, in conjunction with network management discussion, it should be considered what factors affect organisations' positions on this controlling/coping spectrum and how organisations might respond in terms of adjusting their roles in the network or changing their positions to enable taking on different roles.

Harland & Knight believe certain network management roles should be identified in order to enable better understanding of the position factors. In identifying these network management roles, they draw upon the work of Snow *et al.* (1992) and their own empirical study concerning the national health services sector. The network management roles identified are network structuring agent, co-ordinator, advisor, information broker, relationship broker, and innovation sponsor. Interestingly, Harland & Knight (2001) discuss these six different network management roles through key *competence* requirements, in a similar way to that in which Möller *et al.* (2002) discuss different network management levels through central capabilities that are needed in managing each of the levels. However, Harland & Knight (2001) specify the required competencies at a more detailed level – by identifying, e.g., change management, conflict resolution, consultation, group facilitation, lobbying, and agenda-setting elements – than Möller *et al.* (2002) do in identifying, for instance, capabilities for identifying and influencing other actors' roles and positions within the network.

The question of network management seems to be related to the level of analysis employed in network studies. For analytical purposes, it can be argued that a macro network – i.e., industries as networks – is the broadest and uppermost level in network studies. However, a macro network can be understood as gaining its structure from several smaller entities, micro networks – i.e., firms in strategic nets. Furthermore, the level of micro networks can be broken down further into smaller units of analysis, clusters of individual relationships. Lastly, a bunch of relationships – i.e., a relationship portfolio – can be examined as consisting of single dyadic relationships. The opportunity to control another actor's resources and activities is, naturally, different at each of these levels. Although examination of sub-parts is useful in understanding what a macro network consists of, it can be questioned whether such an entity as a network can be understood as a sum of its parts or is in fact something more. In this study, this kind of examination is undertaken for analytical purposes in order to better understand the different levels of the units of analysis, not as something that directly illustrates how networks are structured in real life.

Thus, network management levels are closely tied to the question of the unit of analysis used in the research. It is important for a researcher to have identified whether the study concerns the network level or net level. This choice is, of course, dependent on the objective of the study. In considering whether to carry out a network or a net level study, or both, certain guidelines should be kept in mind. Firstly, a network study in a strict sense of the term 'macro network' is usually quite hard to carry out, because too large a unit of analysis causes difficulties in, e.g., gathering relevant empirical data. By contrast, in carrying out a net level study, it is easier to gather relevant information because focal companies usually know their own relationships rather well. Secondly, it is impossible to study the whole macro network because, in the end, all economic activities in the world can be seen as linked in some way. Thus, in every macro network study the borders of the network must still be defined, even artificially. Thirdly, a study performed at the level of the macro network can easily remain too general and descriptive, whereas companies and managers would like to have more practical and detailed information to help them in everyday decision-making. On the other hand, an analysis that is carried out only at the net level may easily leave some important network features and characteristics unnoticed, due to the concentration on only one actor's perspective.

A summary of the above discussion of different network levels and elements of network studies can be made based on the framework that is provided by Gadde & Håkansson (2001). The basic idea in their framework is that the three basic elements of network studies as identified in the ARA model – *actors, resources*, and *activities* – are visible at all the different levels of composition of network studies models. In other words, it doesn't matter whether the study is about dyadic relationships, focal nets, or industrial networks; in any of these cases, actor bonds, resource ties, and activity links are usable tools. After all, as was pointed out earlier in the text, relationships form clusters of relationships and these bunches of embedded relationships form networks. Thus, the same elements in terms of actors, resources, and activities are present at each of these levels of analysis. Figure 15 below illustrates the ARA elements and the different levels of depth in network studies related to the management point of view, based on the work of Gadde & Håkansson (2001).

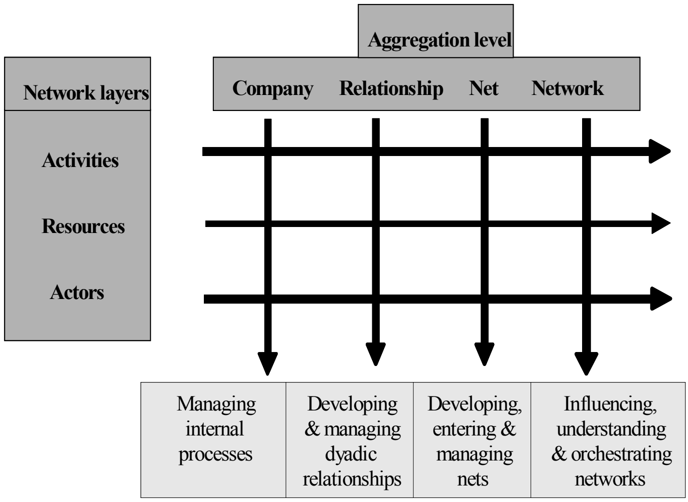

Fig. 15. Network layers and aggregation level (modified from Gadde & Håkansson 2001).

In this study, the research phenomenon of value-creating networks is described and analysed at both the net and network level. The network aggregation level is needed in order to provide a holistic understanding of the empirical context that acts as a basis for the deeper analysis of a particular focal net in the selected empirical context. Together these two interrelated levels of analysis form the arguments for the empirically grounded model of value-creating networks presented in this study.

Next, the concept of value creation within networks is discussed by presenting different frameworks and models related to value-creating networks. Alongside presentation of the different models and frameworks, there is discussion of the issue of the level of analysis used: the net or network level.

3.3 Value-creating networks

By reviewing earlier research on value and value creation, one can identify a shift from studying value creation at the level of relationships (e.g., Storbacka *et al.* 1999a, Donath 1998, Lapierre 1997, Storbacka & Lehtinen 1997, Donath 1996) toward studying value creation at the level of networks, nets, and alliances (e.g., Möller *et al.* 2002, Kothandaraman & Wilson 2001, Möller & Törrönen 2000, Parolini 1999, Doz & Hamel 1998). One possible reason for such a shift might be the notion of the important relationship between one's own core competencies and the reasonable ways, and number of ways, to try to create value for the customer. In other words, it is not usually reasonable to try to create value for the customer just through the firm itself and its limited competencies if there is the option of allying with other firms that can complement the existing competencies in order to together create superior customer value. Thus, in an alliance or a network, the value that is created for customers should be created in a web of actors (such as an alliance) in which each actor does the things related to its core competence. The web operates in order to create value for the end customer, but each actor gives something to the creation process and captures something from the web. If the supplier tries to create maximum value for the customer by itself, in the long run the supplier might well also do things for the customer that are not related to its core competence and serving the customer might not be profitable anymore. But when the web is constructed of complementary core competencies needed to create maximal value for the end customer, each supplier actor does not have to make major sacrifices. In the end, each can capture more value from the web then it originally gave away.

Also Hamel & Prahalad (1991) have studied value creation in alliances. According to them, value creation in an alliance depends first on whether the market and competitive logic of the venture is sound, and then on the efficacy with which the partners combine their complementary skills and resources – i.e., how well they perform joint tasks. Each partner then appropriates value in the form of monetary and other benefits. Moreover, according to Normann & Ramirez (1993), it is essential to look beyond the immediate boundaries of the social and business systems and to discover new ways to reconfigure these systems in order to reinvent value for the customers. Today's strategy has to focus on reinventing value in co-operation with other actors in the network, such as suppliers, partners, allies, and customers. This makes clear strategic thinking very important and also very difficult: strategy can no longer be seen as the art of positioning a company in the right place along the value chain; strategy has to be seen as systematic social innovation, in which the role of the customer is very important to take into account. Customers should not be regarded merely as the value receivers or as value consumers; they should be seen also as co-producers of value (Prahalad & Ramaswamy 2000, Parolini 1999). Shapiro & Varian (1999) have even created their own term for customers as co-producers of value; they call them *procumers*.

The basic idea is that when customers take on more and more of the role of a co-producer of value, also the customers' competencies are essential to understand and to take into account (Prahalad & Ramaswamy 2000). Thus, in a value network, the question is not only that of the company's own competencies, or even of its suppliers' and partners' competencies; the customers and their competencies play a substantial role.

However, in order to understand value creation in business networks, it is necessary to tie it to the different network levels as identified by Möller *et al.* (2002). For example, Ford & McDowell (1999) define value in a relationship from the angle of actions; i.e., some relationship actions have effects that are positively valued, whereas others are negatively valued. They discuss the value effects on four different, interrelated levels. These levels are effects in the relationship; effects on the relationship; effects on the relationship portfolio; and, lastly, effects within the network. At each of these levels, the nature of the value differs. At the first level, value is regarded as immediate effects. At the second level, value is understood in terms of change in the state of the relationship. At the third level, that of the relationship portfolio, value is viewed in terms of change in the total relationship portfolio, and at the level of networks it is regarded in terms of change in the network.

However, in mapping the existing research concerning value creation at the net or network level, several different terms referring to a net/network were found, although it has not always been so clearly articulated which network aggregation level was being addressed. The discussion below covers three rather recent pieces of research, the works of Kothandaraman & Wilson (2001), Parolini (1999) and Möller, and Rajala & Svahn (2002), each of which presents its own view of value creation networks. *Although they address the same issue, value creation in networks*, *the frameworks developed and the network aggregation level addressed are labelled differently*, as Kothandaraman & Wilson (2001) speak of value-creating networks, Parolini (1999) about a value creation system, and Möller *et al.* (2002) about value systems with different example nets. Additionally, these works in some respects point out the same aspects of value creation in networks, but in some respects their viewpoints differ. Each of these pieces of research and its central elements shall now be discussed in turn.

The value-creating networks of Kothandaraman & Wilson. Kothandaraman & Wilson (2001) start their article by pointing out that all companies belong to some value-creating networks, in which some companies play important roles and have an influence in shaping the networks while others play minor roles and are shaped by the networks. These different positions or roles in networks have been discussed by several other researchers, too (e.g., Doz & Hamel 1998, Jarillo 1988), who refer to the central actor as, for instance, the 'hub company' or 'nodal firm'.

Kothandaraman & Wilson emphasise that understanding a firm's role in the context of networks requires significant effort and is extremely important, as companies usually do not think about their network positions. Rather, they are more interested in thinking about how they can compete against other companies. However, the study argues that companies are now moving into an environment in which they will not compete against each other but will instead become members of a network of companies that will compete against another network of companies. As such *networks of companies have been assembled for the purpose of creating value for the customers*, these network systems could be called value-creating networks.

In order to better understand such value-creating networks, Kothandaraman & Wilson have created a model that emphasises superior customer value, core capabilities, and relationships as the building blocks. This model is presented in Figure 16.

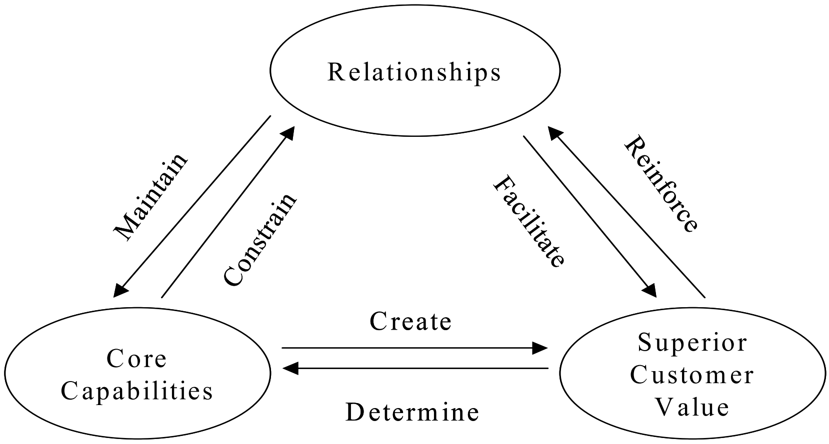

Fig. 16. Model of value-creating networks (Kothandaraman and Wilson 2001, 384).

According to the model, the objective of a value-creating network is to create *superior customer value*. However, the extent or degree of value creation is influenced by the *core capabilities* of the participating firms; i.e., the capabilities together create the value. According to the authors, the value that the customer of a network wants to consume determines the nature of the participating firms' core capabilities[21] and how the other members of the network value them. Furthermore, the way to create the value is influenced by the nature of the *relationships* that the firms have with each other. Therefore, types of relationships between network participants and relationship changes affect value creation. Thus, the three building blocks of the model – value creation, core capabilities, and relationships – are very interconnected in nature.

Kothandaraman & Wilson (2001) point out that, most importantly, companies must be able to create value. However, this value creation depends upon the core capabilities, which in turn are limited because of, e.g., the range of technologies needed to produce a product, the rate of specialisation, and the complexity of today's business environment. To add their value creation ability, companies need to find partners with whom to create superior value compared to that of other value creators and to deliver high performance in terms of the attributes that are important to the customer. Companies should also be able to manage these partnerships in a way that allows each partner to profit from being involved in the partnership. The core capabilities of the partners involved in value creation should be complementary, in order to be able to create superior value. Thus, the assembling of core capabilities in the larger unit should extend beyond the capabilities already contained within the company.

The actors in the network should realise that they bring value to the network only to the extent that they offer diverse core capabilities that are valued by the network. Other actors in the network want to develop relationships with those actors that have unique capabilities. Therefore, the core capabilities in turn constrain the quality of relationships between firms in the network. (Kothandaraman & Wilson 2001)

[21] For a more detailed discussion of capabilities and value creation, see Möller *et al.* (2002).

All in all, the final value that customers of the value-creating networks want determines the nature of the member actors' core capabilities that will be valued by the other network members. Kothandaraman & Wilson mention as an example that if a customer especially values faster delivery of goods, then the network will look for companies that have superior logistical capabilities. Additionally, when customers appreciate the value delivered by the network, this gives positive feedback to the network members and reinforces the quality of relationships between the members.

The value creation systems of Parolini. Parolini (1999) uses the term '*value creation system*' (VCS), which is comparable to the concept of value-creating networks proposed by Kothandaraman & Wilson (2001). According to Parolini, a value creation system can be defined *as a set of activities that creates value for its customers*. These activities are carried out by using sets of different resources: human, tangible, and intangible. Furthermore, activities are linked by flows of material, information, and financial resources, and by so-called influence relationships. In fact, Parolini emphasises the role of activities in value creation systems. Therefore, she also points out the question of control of activities by specifying that value-creating activities can be controlled by the market, a hierarchy of co-ordination, and/or intermediate forms of co-ordination.

According to Parolini, it is also important to understand that end customers do not simply receive and consume the value; they can also participate in creating it. Thus, the role of customers in networks is seen also as that of possible producers of the value. Parolini also points out that various economic players may participate in a given VCS and an economic player can participate in more than one VCS.

The concept of the value net is utilised by Parolini as a strategic tool for making sense of the various VCSs in which organisations are involved. The basic characteristics of the value net concept are:

- broad vision of the value-creating system as a whole
- adoption of the point of view of the end customer
- broadened view of the traditional value chain toward the overall value net perspective
- capability of describing multiple relationships among activities
- capability of describing systemic products and co-production phenomena
- capability of describing the variability in the configuration of companies and value-creating systems
- capability of illustrating strategic choices of inter-firm networks
- orientation toward innovation
- focus on core competencies
- the use of *activities* as key elements, regardless of how such activities and resources are divided among the economic players involved

Identification of activities plays an important role in Parolini's (1999) work; she has specified that emphasis in the analysis should be on those activities whose control ensures the greatest profitability (i.e., have positive impacts) and those activities that do not create enough value in relation to the resources required, or which even remove value from the system (i.e., have negative impacts). Additional guidelines for identifying the most critical activities in a VCS involve concentrating on the activities that are:

- most critical in relation to the final result

– those whose output has some unique elements distinguishing it from other products
– those whose contribution can be perceived by purchasers
– those whose performance requires skills and resources that cannot be easily imitated tied to system bottlenecks
– control points, in that control over them enables influencing the behaviour of the entire VCS

Based on her discussion concentrating on activities and relationships, Parolini (1999) has illustrated value net analysis via a picture presented here as Figure 17. In the figure, the central role involves both different relationships that tie various activities together – i.e., flows of goods, information, and money and relationships of influence or mutual influence – and activities divided into realisation, supporting, and consumption activities.

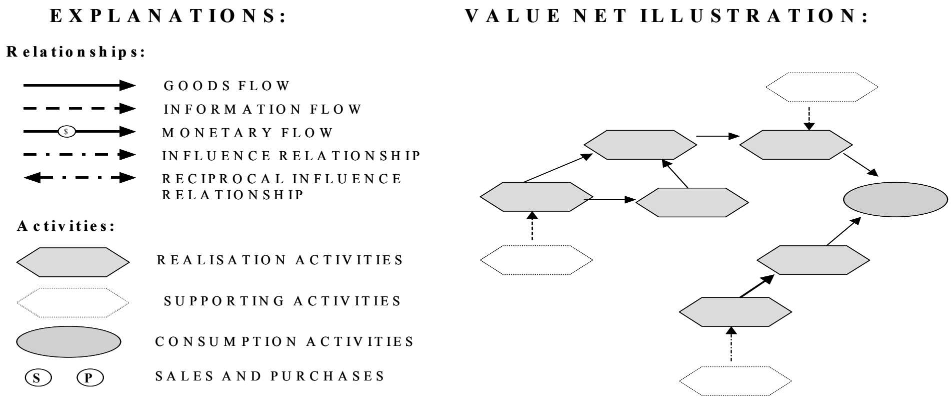

Fig. 17. Value net (modified from Parolini 1999).

Overall, Parolini (1999) focuses on discussing the meaning of value and on characterising the activities of value networks. The purpose of the value net as a strategic tool is to illustrate as clearly as possible the VCS as a whole, identify the make/buy/connect choices that the players in the system either have made or could make, and make explicit the *value proposition* and *value creation principles* of the network. Because the value net revolves around activities carried out by interacting network participants, a considerable number of *dynamics* are involved. Moreover, changes in value nets are caused by *drivers* that affect not only the reshaping of network activities but also the roles and relationships of network participants in particular.

It needs to be noted that it is not clear in the work of Parolini whether she applies the term 'value creation *system*' at the level of network and the term 'value *net*' at the net level. However, it seems that she refers by the term 'system' to the level of the macro network, yet 'value net' seems to be used in her work as a *tool* for a network-level analysis, not referring in specific terms to any smaller portion of the macro network.

The value systems of Möller, Rajala, & Svahn. Möller *et al.* (2002) focus on identifying different types of strategic business nets and their management in their work. However, as a first step toward identifying different kinds of strategic business nets, they propose a *value system continuum* (VSC) and, moreover, use capability-based analysis when discussing the value creation potential of different kinds of value systems and nets. In addition, they also address the question of network management levels, as already pointed out in this study – in, e.g., Section 3.2.3.

The work of Möller *et al.* is based on a rather broad review of other research about value creation and networks. However, they are able to add new, interesting insights to the discussion about value creation within networks, as they propose a value system continuum, identify different types of strategic nets, and illustrate the core managerial questions and capabilities required in net management. A discussion summarising these insights is provided in the following paragraphs.

Möller *et al.* propose a value system continuum based on a theoretical review and add a few example nets to accompany the continuum, apparently based on empirical findings. This value system continuum is presented in Figure 18.

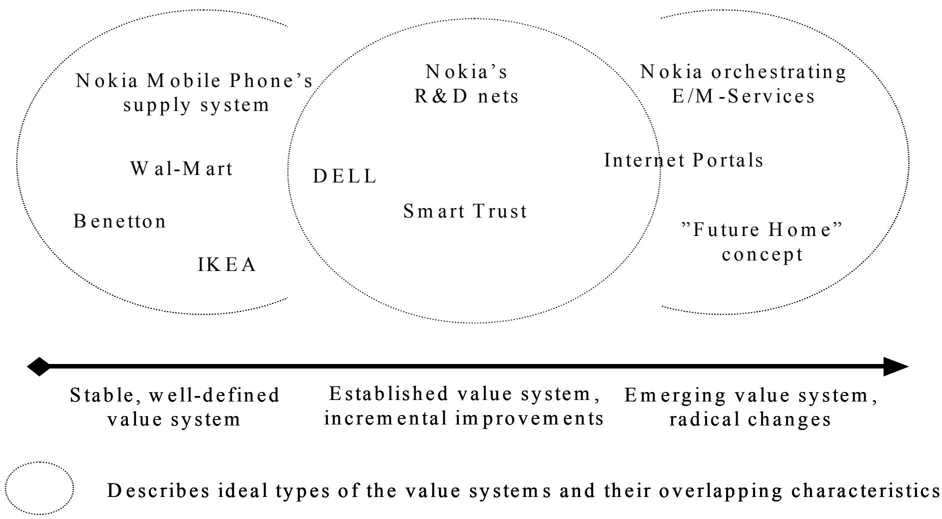

Fig. 18. Value system continuum with example nets (Möller *et al.* 2002).

Möller *et al.* argue that the value system and its level of determination have an important role in providing an understanding of strategic nets. They point out that the value system continuum, as presented in Figure 18, is a simplified illustration. The continuum is based on assumptions about how stable and well-defined versus emergent and still rather unstructured the value systems are. The left side of the figure describes those value systems that are clearly specified and relatively stable. The actors producing and delivering specific products, and also their value activities and capabilities, are to a fair extent known. As a rather opposite position, the right side of the figure illustrates those value systems that are emergent. They can be called future-oriented nets, and they require radical changes in the existing value systems and in the creation of new value activities. Moreover, they are characterised by uncertainties in value activities and the actors' capabilities. Value systems that are relatively well determined but still modified through incremental and local improvements are illustrated in the middle of the continuum figure.

Most multi-actor R&D processes can be situated at this point along the value system continuum. (Möller *et al.* 2002)

Möller *et al.* discuss network management in their research as well. As an important part of their network management discussion, a capability discussion is provided. Accordingly, capabilities and challenges involved in the management of strategic nets are related to the type of the strategic net. This aspect of the influence of the strategic net type is taken into account in the network-capability-base framework presented in Figure 19.

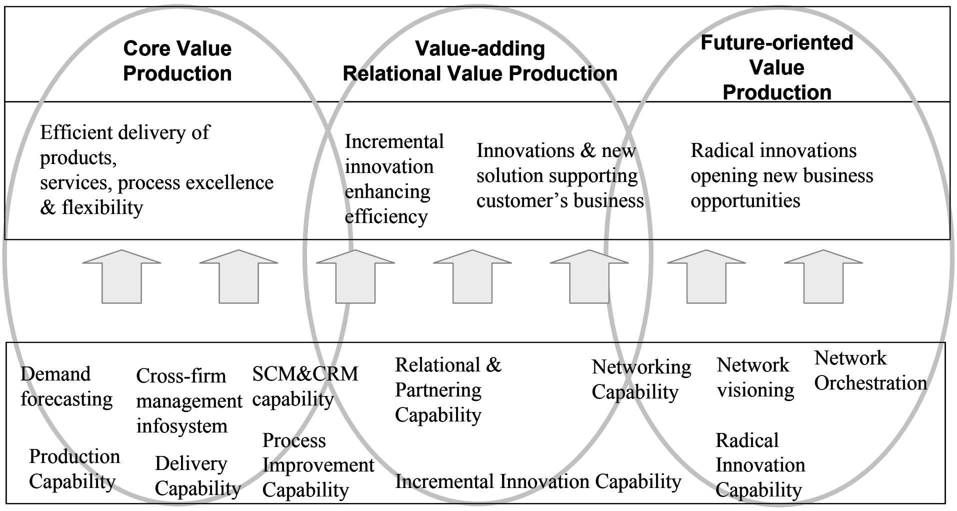

Fig. 19. Value production and network capability base (Möller *et al.* 2002).

The framework developed by Möller *et al.* shows in a simplified way how capabilities are seen to be linked to value creation in the network context. Accordingly, the capabilities needed in value creation are presented roughly in order of increasing complexity, but not in order of superiority or importance. In fact, all of the capabilities identified are important ones, as it is, for example, impossible to master the customer's business capability (see the right end of the continuum) without being able to first handle simpler value creation activities, such as production and attainment of process improvement capabilities (see the left end of the continuum). Thus, the capabilities shown nearer the left end of the continuum can be treated as essential learning steps to be taken in order to move toward the right end of the continuum.

In the diagram shown above, the capabilities are presented in two rows in the lowermost square. According to Möller *et al.*, the upper row refers to capabilities that are needed in managing strategic business relationships and business nets, whereas the lower row refers to those capabilities that can be regarded as more traditional business competencies. It is also noteworthy that although the capabilities are presented in the form of rows, a set of them is needed for creating any type of value. Moreover, the more complex the value system in question is, the broader the set of capabilities required.

In summary, Möller *et al.* focus on discussing strategic business nets that could also be called value nets, based on the value-system-continuum framework. Accordingly, the framework developed in this study is based on the work of Parolini (1999), which has already been discussed in this chapter. Also, Möller *et al.* (2002) utilised the value system approach in identifying different kinds of managerial capabilities and challenges related to various kinds of strategic nets. The work of Möller *et al.* articulates and takes into account the different network aggregation levels more than, e.g., Parolini's (1999) work does.

3.4 Concluding thoughts on the material in the chapter

In this chapter, the concepts of value creation and business networks were discussed, first separately, then jointly in the section 'Value-creating networks'.

Value creation was understood here as the raison d'être of any business relationship – companies engage in relationships with other companies in order to increase their value creation potential by combining their own competencies with the other parties' supplementing competencies. This leads to a networked way of doing business – to business networks.

The discussion on the existing research on value-creating networks was focused on presenting the research of Kothandaraman & Wilson (2001); Parolini (1999); and Möller, Rajala, & Svahn (2002). These pieces of research have a lot in common, although they also have their own particular foci and viewpoints on value creation within networks. The works of Kothandaraman & Wilson (2001) and Parolini (1999) differ from each other not only in their exhaustiveness, as Parolini's work is a book full of discussion of value creation systems and the work of Kothandaraman & Wilson is an article dealing with the issue of value-creating networks, but also in their emphasis. Parolini (1999) emphasises in her work the notion of activities as the key element in value creation system studies, whereas Kothandaraman & Wilson (2001) emphasise all elements of their model of value-creating networks equally.

In addition, the work of Möller *et al.* (2002) differs from the other two mentioned in its focus on studying value production as it relates to suppliers' capabilities. Additionally, Möller *et al.* bring to the discussion also the concept of network management levels.

However, what seems to be common and in the central role in all of the research discussed is the notion of value creation. Kothandaraman & Wilson (2001) concentrate on discussing value from the perspective of the end customer, as they understand a value-creating network as an entity aiming at producing superior value for end customers. Parolini (1999) too points out the relevance of the end customer in determining what kind of value should be created, and her work presents the broadest discussion on value and value creation. Möller *et al.* (2002) talk about value especially in terms of core value, relational value, and future-oriented value production. They discuss these different value production types from the standpoint of suppliers' capacity to produce them.

Besides value creation, relationships are highlighted as an important aspect of value networks. The notion of relationships is very clear in the work of Kothandaraman & Wilson (2001) and is pointed out as one key aspect of their value-creating network model. The concept of relationships is, however, essential in the other models as well. Parolini (1999) has a slightly different view on relationships than, e.g., Möller *et al.*; Parolini focuses on defining relationships between actors via monetary and information flows, while social interaction is given a more central role in the work of Möller *et al*.

The importance of understanding and identifying competencies and capabilities is pointed out clearly in all of these works. Core competencies have a central role, especially in the works of Möller *et al.* (2002) and Kothandaraman & Wilson (2001). In these works, the term 'capabilities' is used instead of 'competencies'. However, in the work of Möller *et al.* (2002), capabilities are understood in resource-based terms, as is done in this study, although the present study uses the term 'competence' instead of 'capability'[22].

[22] The terms 'capability' and 'competence' are often used in parallel (see Lewis & Gregory 1996).

4 Preliminary model of value-creating networks

This chapter presents the development of the preliminary model of value-creating networks as a step-by-step process, adding one element after another to the model. The elements are based on the studies of Kothandaraman & Wilson (2001), Parolini (1999), and Möller *et al.* (2002), which were discussed in the previous chapter.

In these pieces of research, the concepts of value, core competencies, and relationships were brought up as the rationale for establishment of value-creating networks. These three concepts, however, need to be looked at more closely before an empirical analysis is carried out, to enable a fuller understanding of the phenomenon under examination. Thus, a conceptual analysis of value, core competencies, and relationships is presented in the sections that follow. The concept of value is further honed and specified in the text as 'perceived end customer value', which better describes its contents and special role in the preliminary model.

Thus, the chapter is structured around the different elements forming the preliminary model for studying value-creating networks, and the end of the chapter summarises the steps by presenting the entire preliminary model. Also, the ARA elements that were discussed in Chapter 3 as the basic elements of any business network analysis are taken into account in the model. The end of the chapter also addresses how the elements making up the model are related to each other.

4.1 Element one: perceived end customer value

Based on the theoretical review concerning value-creating networks, the concept of value itself is one of the most important elements to understand. In the previously discussed pieces of research regarding value-creating networks, several definitions were examined and given varying levels of emphasis; in some of the works, the concept of value was not even defined in exact terms. In the sections that follow, the concept of value is looked at more closely through examination of it from the content, context, and process viewpoint. These angles have been used in order to gain at the same time a multifaceted view of value and one that provides as clear a picture as possible.

4.1.1 The content view: trade-off between benefits and sacrifices

Value is a concept that is commonly used by both academics and actors in the field, but it is often rather unclear what is actually meant by it in different contexts (Ford & McDowell 1999). From a rather broad perspective, the concept of value can be regarded as the trade-off between benefits and sacrifices (Walter *et al.* 2001, Lapierre 2000, Parolini 1999, Slater 1997, Berry & Yadav 1996, Ravald & Grönroos 1996).

These benefits and sacrifices can be understood in monetary terms, but they can also be seen as including non-monetary rewards, such as competence, market position, and social rewards (Walter *et al.* 2001). Non-monetary costs can include, e.g., time, effort, energy, and conflict invested by the customer to obtain the product or service.

In this study, value is understood in both monetary and non-monetary terms. Monetary value is, naturally, important to define when one speaks of *commercial* software components, and businesses are created in order to achieve profits. However, utilisation of commercial software components may very well include other benefits and sacrifices in addition to monetary ones. For example, competence questions play a considerable role in the process of deciding whether or not to use commercial software components.

Nevertheless, it can still be argued that defining value as the trade-off between benefits and sacrifices offers a content-based view of value as a concept – emphasis is placed on what the network actor understands and feels to be the benefits and sacrifices. In this way, the network actor itself defines the content of the value under consideration.

4.1.2 The context view: absolute and differential value

According to Parolini (1999), it is also useful to distinguish between absolute value and differential value. The difference between absolute value and differential value is based on the assumption that it is possible to regard value as something very real and absolute while at the same time the expectations and mental images of the value receivers are also important factors in the evaluation of value. The concept of absolute and differential value is closely linked to the view of perceived benefits and sacrifices by the network actor.

Absolute value refers to something very real, whereas differential value refers to value understood as something that not only is dependent on the end customer's own expectations and evaluations but also is evaluated *in relation to other possible solutions*. Thus, absolute value can be defined as the algebraic sum of the value attributed to the absolute benefits connected with the product and the costs incurred when using the product, whereas differential value is the difference between the absolute net value that can be received from a given value creation system and the absolute net value of a similar product / substitute product offered by a competing value creation system. (Parolini 1999)

Parolini (1999) offers a summary of how absolute value consists of several elements: *tangible* ones (e.g., quality, durability, functional characteristics), *intangible* ones (e.g., trademark- and designer-related issues), *services* (basic, complementary, and accessory services), and *economic elements* (price of the product and all other economic elements). These elements of absolute net value and their relative importance depend on both the type of product under consideration and the market segment at which the product is aimed. Additionally, absolute value can also be examined in terms of the following criteria for products: whether they improve the performance of the customer or reduce costs; whether they are 'hygienic' or 'motivating'; whether or not they are under the control of whomever is performing the analysis; and whether the costs are borne before, during, or after the purchase. In Figure 20, absolute value is illustrated by listing the possible benefits and the possible costs typical of absolute value consideration.

BENEFITS

- Quality of the product
- Range
- Durability/obsolescence
- Availability and quality of complementary products/services
- Availability and quality of accessory products/services
- Warranty
- Prestige, social acceptance, security
- Method of purchase
- Diffusion
- Compatibility with other goods

COSTS

- Purchase costs
- Information costs
- Search and installation costs
- Learning costs
- Switching costs
- Running costs
- Maintenance
- Updating
- Impossibility of using complementary goods already owned by customers
- Cost of complementary goods and accessories

Fig. 20. The main elements of absolute net value received by customers (Parolini 1999).

Differential value is even harder to define and measure than absolute value is, because the expectations of the customers are based on the alternatives available on the market; i.e., the impact of similar or substitute products is remarkable (Parolini 1999). Thus, measuring of differential value always requires also a mapping of other potential solutions and comparison of those with the one under consideration. However, usually it is not an easy task to identify which options are seen as potential and comparable solutions *in the eyes of the customer*. In general, a false perception of value is more likely when there is presence of:

– intangible elements and services
– systemic and complex goods
– benefits that are not immediate
– post-purchase costs and costs of consumables
– products and services that are new to the customer
– infrequently purchased goods

From the viewpoint of this study, which focuses on software components and larger system deliveries including such components, the list presented above is interesting. First of all, software itself is very intangible and thus the value it creates is not so easy to measure. Secondly, in the case of rather a lot of software components, the benefits are not immediate. Furthermore, the post-purchase costs of software components may be hard to determine in advance because there may occur sudden problems in the functionality of the component when it is integrated with a larger system. Naturally, upgrade and maintenance costs, as discussed in Chapter 2, are characteristic of software and may cause unpredictable post-purchase costs. Lastly, as software components are usually sold to end customers as part of larger system products and deliveries instead of being sold as they are, determination of the value received by the end customer provides fertile ground for misinterpretation. Due to these typical characteristics of software components, and of larger system products and deliveries including such components, the way the value is communicated to the customer is a crucial element. Thus, clear value propositions and value statements are required (see, e.g., MacStravic 1999, Feather 1998, Anderson & Narus 1995).

Absolute and differential value provide a context-based view of the definition of value, with the differential value understandable only if the context in which the value is created and captured is also understood. Although absolute value is a useful tool in a value-creating network analysis, the concept of differential value is the one that can provide a real explanation that answers, for example, the question 'Why did the customer choose product/service alternative B instead of product/service alternative A?' However, as Parolini (1999) points out, differential value is usually very hard to measure in exact terms – especially when value is understood not only in monetary terms but also in non-monetary terms.

4.1.3 The process view: value tied to the whole relationship

The third view of the concept of value is the process view, which is in this study applied to underscore the importance of understanding value creation as a process during which the customer and supplier interact. During the interaction, the product/service is exchanged between the parties and thus the benefits and sacrifices are realised. However, there is also a great amount of interaction between the parties in the relationship that is not directly related to the object of exchange. This interaction does, however, usually influence how the customer perceives the total value gained.

To be more precise, the benefits and sacrifices, whether understood in monetary or in non-monetary terms, are naturally related to the product/service that is exchanged between the buyer and the seller, as Reidenbach *et al.* (2002) suggest when they define value as 'the interaction between the benefits that customers want from a particular product/service and the price they are willing to pay to acquire the benefits provide by that product/service'. However, Thomas & Wilson (2003) suggest that consideration of benefits and sacrifices should not be limited only to something related to the *object of exchange*; instead, value should be regarded also in relation to the benefits and sacrifices that occur in/from the *relationship* between the buyer and the seller. In other words, customers do not perceive the value only through the object of exchange; they also take into account the whole relationship with the supplier as an influence on the amount of perceived net value.

Also Kothandaraman & Wilson (2001) bring up the issue of understanding value creation as related not only to the product but also to the overall process via which the product is developed, marketed, and delivered to the customer. This kind of problematisation was brought up in Chapter 3 in discussion of the process-oriented view of value creation and presentation of the work of Hirvonen & Helander (2001). In the process-oriented approach to value creation, *value related to the object of exchange* and *relationship-related value* are interlinked.

For example, if we modify the ideas of Hirvonen & Helander (2001) concerning the different sub-processes into a more appropriate form for consideration of the software component business, the sub-processes could be named as need identification, acquisition, integration, and utilisation processes. The actual object of exchange, the software component, is physically exchanged between the supplier and the customer somewhere between the acquisition and integration processes, but the interaction between supplier and customer starts long before the point at which the actual exchange of the physical object takes place. Furthermore, the interaction between the supplier and the customer will likely continue also after this. In a strict sense, these interactions are not *directly related to the object of exchange*, but they still have a rather strong influence on the total value perceived by the customer. Naturally, it is hard to make clear distinctions between the value perception related to the object of exchange and that related to the relationship, and usually this distinction is not even necessary. However, sometimes the role of relationship-related value is important to bring up in order to remind the actors in the field that the value perceived by the customer is a sum of multiple things. These elements are sometimes only indirectly related to the object of exchange, but nevertheless their weight in the customer's perception of value can be huge.

4.1.4 Summary: conceptualisation of perceived value to the end customer

The above discussion has dealt with the concept of value through highlighting three interrelated and supplementary views: the content, process, and context views. These three angles have been used to clarify the rather imprecise discussion surrounding value as a concept. Figure 21 illustrates the perceived value to the end customer and its main contents as the first element in the preliminary model of value-creating networks.

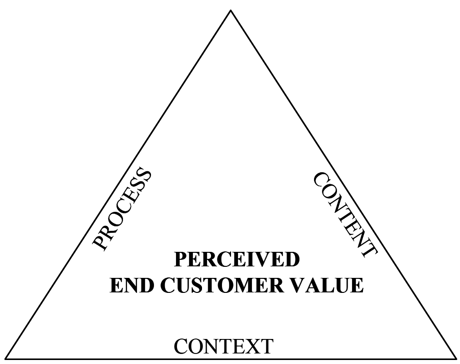

Fig. 21. Element one of the preliminary model of value-creating networks: perceived end customer value

This first element of the model of value-creating networks highlights *the role of the end customer* as the actor determining what kind of value the network should strive to create. Furthermore, the term '*perceived*' refers to the basic nature of value for the customer – the value created by the network is in the end measured in the mind of the end customer. This leads to the fact that the value created is in most cases very hard to measure. The content, process, and context views can be used as tools to better grasp the value created by the network. The content view emphasises that value should be measured as the *trade-off between benefits and sacrifices that are not only monetary but also non-monetary*. The process view emphasises that *value is not merely tied to the actual object of exchange*, such as a software component; instead *it is dependent on the successfulness of the whole relationship* between the customer and the supplier. The context view, for its part, puts forward the notion of *differential value*: the network should be able to create more value than the end customer could achieve by choosing some other solution created by another, competitive network.

4.2 Element two: core competencies

A good starting point for the discussion of core competencies is the work of Alajoutsijärvi & Tikkanen (2000), who bring up the *relation between competencies and value created for the customer*. In their work, they combine three theoretical discussions addressing organisational competencies, business processes, and industrial networks, and they define a core competence as something that 'refers in its most general sense to an organisationally embedded capability that can *create differential value* through a chain of activities that *a customer is willing to pay for*' (Alajoutsijärvi & Tikkanen 2000). Thus, the role of the customer is emphasised in this definition, while it is others' role to see that it is, ideally, delivered something that the customer values as useful and is at the same time difficult to get from other sources. In fact, the degree to which core competence is distinctive depends on how well endowed the company is relative to its competitors and how difficult it is for competitors to imitate its competencies (Teece *et al*. 1997).

In the next sub-sections, core competencies are discussed through consideration of organisationally embedded resources, strategic activities, and knowledge and skills, which have been key themes in theoretical discussion about competencies and capabilities (e.g., Alajoutsijärvi & Tikkanen 2000, Seppänen 2000, Sanchez & Heene 1997, Prahalad & Hamel 1990).

4.2.1 Organisationally embedded resources

Prahalad & Hamel's (1990) article 'The Core Competence of the Corporation' can be argued to be the true beginning of researchers' increasing interest in the issue of core competence, although its roots, as based on the so-called resource-based theory of the firm (cf. Wernefelt 1984, Pfeffer & Salanick 1978), go back a long way. The resource-based view of the firm considers firms as bundles of resources. The firm's resources can be defined as tangible and intangible assets that are tied semi-permanently to the firm. These assets can be physical, organisational, and human. Thus, resources can be almost anything, including the local competencies that are fundamental to a company's competitive advantage. Specifically, resources are assets that can be used to implement value creation strategies. (Wernerfelt 1984)

However, it does not necessarily follow that a company owning valuable resources can also create competitive advantage. Besides owning valuable resources, companies should also have unique competencies. Thus, resources are important, but their value creation potential is eventually determined via distinctive competencies that are involved in the value creation processes by deploying and co-ordinating different resources. This highlights the relationship between resources and competencies.

This study's actual discussion of core competence begins by presenting the work of Prahalad & Hamel (1990), which provides a starting point. According to them, a diversified corporation is like a large tree. The trunk and major limbs are core products; the smaller branches are business units; and the leaves, flowers, and fruit are end products. As the root system provides nourishment and stability for the tree and in that way keeps it alive, the root system of a corporation has the greatest power. In a corporation, the root system is the core competence.

So, core competencies are the most essential part of every company. But how can we define them more precisely? Firstly, core competencies are the collective learning in the organisation. Secondly, core competencies can be seen as communication, involvement, and deep commitment to working across organisational boundaries. A core competence involves many levels of the organisation and all functions. Thirdly, core competencies do not diminish with use, but they do still need to be nurtured and protected; knowledge fades if it is not used. Finally, core competencies can be seen as the glue that binds existing businesses together, and they can also act as an engine for new business development. Everyone should keep in mind that cultivating core competence does not mean outspending rivals on research and development, nor does it mean shared costs when two or more strategic business units (SBUs) use a common facility or share a component. Building core competencies has to be seen as different from just integrating vertically, and as more ambitious than that. (Prahalad & Hamel 1990)

How then can core competencies be identified in a company? First, it should be stated that core competencies provide potential access to a wide variety of markets; in other words, they allow many kinds of business implementations. It is also necessary to know that core competencies should make a significant contribution to the perceived benefits of the end product for the customer – i.e., create superior end customer value. And lastly, a core competence should be difficult for competitors to imitate. It is also essential to make a distinction among core competencies, core products, and end products because global competition is played out according to different rules and for different stakes at each of these levels.

Prahalad & Hamel (1990) feel it important to point out also the dangers of being blind to the core competencies and just concentrating on the SBUs. This blinkered approach leads to a situation where only a few areas of the global competitive battle are visible to the top management. Furthermore, this distortion leads to a situation where core competencies and core products are not developed and invested in enough, and where resources are tied up because not all of the activities possible are taken into consideration by the top management.

Furthermore, Prahalad & Hamel state that core competencies are rare within most firms. A single firm is fortunate if it has three or four major core competencies. They also argue that to be a core competence the skill must add significant value to the market offering, must help the firm act across multiple markets, and must be something at a superior level that very few firms can emulate.

The work of Prahalad & Hamel on core competencies is fairly exhaustive. However, there has been criticism to the effect that the view of Prahalad & Hamel cannot take into account a human content well enough (see, e.g., Kothandaraman & Wilson 2001) or the dynamics related to core competencies.

4.2.2 Strategic activities

The work of Sanchez & Heene (1997) as presented in the article 'Reinventing Strategic Management: New Theory and Practice for Competence-Based Competition' provides a more dynamic view of core competencies than the work of Prahalad & Hamel (1990) does. Sanchez & Heene look at core competencies from the standpoint of strategic management. They argue that strategic management tries to understand, in theory and in practice, how firms may improve their performance in competitive interactions with others. In keeping with this view, there have been many changes in the business environment and in firms since the early 1980s. The framework of strategic management should follow these changes and become more dynamic, systematic, cognitive, and holistic. Competence-based strategic management is just such a new way of thinking, bringing new approaches for modern management after the long period of polarised and fragmented traditional strategic theory.

Important issues in competence theory and practice are distinctive sets of strategic goals, strategic logic for actions needed to achieve the goals, resources available and used in pursuing the goals, and also the different ways that firms co-ordinate their resources. The aim of competence theory is to build a conceptual framework for linking the dynamics of a firm's internal processes and their external competitive interactions. The dimensions of this framework are competence dynamics; a systematic and cognition-based approach to competence; and a holistic approach to managing competencies. (Sanchez & Heene 1997)

According to Sanchez & Heene, in their contributions to process theory, researchers are making efforts toward developing a general theory suited to various competitive contexts, as managers are more interested in developing a theory whose application leads to success in a specific context. Through joining these two efforts in a so-called double loop, learning a new theory and practice of competence-based strategic management can be developed. In addition, Sanchez & Heene suggest some objectives for developing this competence theory and its implementation.

In sum, the idea of competence-based strategic management is to develop a new way to manage organisations in a rapidly changing environment. The most important issue in competence-based strategic management could be considered to be the observation about the link between internal resources and external interactions; managers should pay attention to both of these.

On the other hand, there has also been criticism of reliance upon the concept of core competence as a strategic tool. For example, Gadde & Håkansson (2001) argue that relying on core competencies can be risky, especially because core competencies are rather hard to identify; in particular, it is hard to identify what could be the core competence in the long run. Additionally, they argue that there is a complex relationship between flexibility and control. The more flexibility pursued, the less control remains. Thus, when companies concentrate on their core competencies and purchase other activities needed for the value creation from other actors, they have more flexibility in their operations due to the increased outsourcing, yet the level of controllability is decreased at the same time.

Nevertheless, core competencies are understood in this study as activities having strategic importance, because they are repeated patterns of action involving certain assets used to create, produce, and deliver differential value for which a customer is willing to pay.

4.2.3 Knowledge and skills

Alajoutsijärvi & Tikkanen (2000) define competence as knowledge and skills needed to be able to choose what task to perform, why to perform it, and how to perform it. This definition is based on the work of Sanchez (1995) via Alajoutsijärvi & Tikkanen (2000), wherein he talks about three different content areas of competence. These content areas are know-what, know-how, and know-why. Alajoutsijärvi & Tikkanen define know-what as the ability to choose an important task to be carried out from among alternative, less important tasks. Thus, know-what involves strategic understanding of the purposes for which both know-why and know-how can be applied. Accordingly, know-why concerns the understanding of the principles that govern the functioning of processes related to the specific task, and know-how refers to the ability to change the course of the current system to a desirable direction.

However, Alajoutsijärvi & Tikkanen provide even more angles from which to consider the competence discussion. Besides the content side of competencies, Alajoutsijärvi & Tikkanen talk about competencies in terms of three distinguishing dimensions. The first dimension covers relationship-specific, portfolio-specific, and general competencies. Portfolio-specific competence can also be referred to as substantial competence, accordingly. The second dimension consists of individual, team-based, organisational, and inter-organisational competencies, whereas the third dimension distinguishes between tacit and codified competence. (Alajoutsijärvi & Tikkanen 2000)

As Alajoutsijärvi & Tikkanen speak of competencies at individual, team-based, organisational, and inter-organisational levels, also Lowendahl & Haanes (1997) touched on the issue when arguing that companies' value creation depends on both intra-firm and extra-firm resources and competencies. Based on this, they argue that there should be a shift from an emphasis on the competencies and resources that the company *has* to the resources and competencies that the company *utilises*. Thus, from this viewpoint the relevance of defining organisational boundaries is questioned. On the other hand, Lowendahl & Haanes (1997) also point out that companies do not own, in the strict sense of the word, their competencies, because they are to a large extent situated in individuals' heads. Based on similar argumentation, Boisot *et al.* (1997) argue further that as competencies are often in rather tacit form and inside an individual's head, the competence is lost if the employee leaves the company. However, if the knowledge and competence of the employee is made explicit by some kind of codification, at least some of the knowledge and competence can be retained by the company.

4.2.4 Summary: conceptualisation of core competencies

Competencies can be viewed from several angles. Seppänen (2000) has studied competencies and especially competence change in the context of contractual R&D nets. He has extensively summarised and discussed different views of competence. Based on a review of the relevant theory, he has defined competence as activities conducted to create and make use of resources by individuals and organisations in relationships. Moreover, the notion of 'core' as related to competencies refers to such competencies as the management perceives as of central importance to the company's goals and strategy (Seppänen 2000). Seppänen's definition of competencies takes into account not only their resources aspect but also activities and actors.

Building upon the foregoing discussion concerning core competencies, a corresponding definition of 'core competence' can be provided as understood in this study: core competencies are *organisationally embedded resources that can create differential value for the customer when they are created and used through a chain of activities that are carried out by the network actors*. The notion of core competence defined in this way is included in the preliminary model for studying value-creating networks as the second element of the model.

Figure 22 illustrates core competencies as the second element of the preliminary model of value-creating networks.

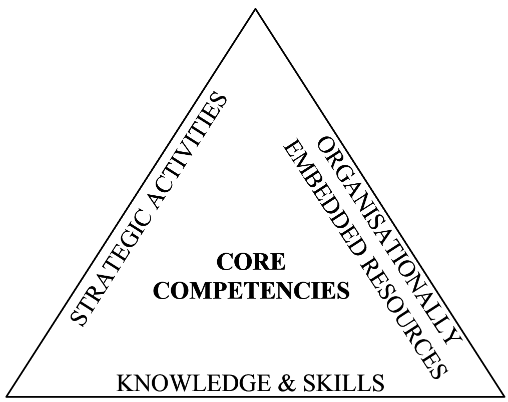

Fig. 22. Element two of the preliminary model of value-creating networks: core competencies.

In Figure 22, core competencies are understood as strategic activities, organisationally embedded resources, and knowledge and skills. Core competencies are those resources that can enable significant value creation for the customer. Although they are organisationally embedded, from a value-creating network perspective they should be viewed as free from clear organisational boundaries. The strategic nature of the core competencies is realised also from the knowledge angle: they are needed to enable choosing what task to perform, why to perform it, and how to perform it in order to create differential value for the customer.

4.3 Element three: relationships

In discussing both the concept of value and that of core competencies, the concept of relationships was mentioned. This was inevitable. Relationships form the third of the interrelated elements of the preliminary model of value-creating networks. Relationships are an element of the foundation of any network analysis, as networks consist of several direct and indirect relationships, but their role as an interlinking element in a study of value-creating networks is even more important: the way in which the value is created is influenced by the nature of the *relationships* that the network actors have with each other. Therefore, the types of relationships that exist between network actors and changes in these relationships affect the value creation in the business network. In the sub-sections that follow, relationships are discussed in terms of what is characteristic of business relationships and what varying actor perspectives exist where business relationships are concerned. Additionally, the material in the section on the nature of relationships includes discussion of what angles can be explored in mapping different kinds of business relationships.

4.3.1 Essence of business relationships: exchange and interaction

The concept of business relationship is not always as clear or understood as uniformly as it might at first seem to be. However, this study applies the concept of business relationship to an exchange of different attributes between two *organisational parties* (see, e.g., Möller & Wilson 1995). Typical of a business relationship is that it can be viewed as a sequence of acts and counter-acts (i.e., interaction). Through these acts, exchanges of different attributes between the parties are carried out. Thus, the key terms in the definition of business relationship, as followed in this study, are *exchange* and *interaction*.

4.3.1.1 Different attributes of exchange

The concept of exchange is often used in attempts to define business relationships, and sometimes without specification of what the concept really stands for. Blois (2002) posits that 'an exchange occurs between two organisations when resources are transferred from one party to the other in return for resources controlled by the other party'. Furthermore, Blois argues that exchanges should be seen in terms of disaggregation, with exchange made up of different kinds of attributes – e.g., the physical product, price, payment procedure, and personal contacts – and these attributes are valued differentially by the organisational parties. In other words, the organisational parties have their own 'want lists' concerning exchanges, and these wants may or may not be fulfilled. Moreover, the want lists of the organisational parties usually vary from each other.

Ford (1997) talks about different types of exchange: product/service exchange, information exchange, financial exchange, and social exchange. Product or service exchange usually forms the core of the exchange. The characteristics of the product or service in most cases have a significant effect on the relationship. The exchange process as a whole will be quite different depending on whether or not the product or service is able to fulfil the needs of the buyer.

Product exchange. Thus, the element of exchange between the parties in the relationship includes different attributes and types of exchange. However, the attribute comprising the physical product is so important in the examination of a relationship between an SI and supplier that it needs more attention. Especially from the viewpoint of the empirical target of the present study, the software component business, consideration of standardisation versus customisation proves very interesting.

Customised products are to some extent designed or adjusted to satisfy the needs of specific market segments or even individual customers. Therefore, one of the biggest differences between customised and standard products is the need for communication between the product developer and the customers (cf. Heikkilä *et al.* 1991). Customised products require specific skills from the suppliers (Chisnall 1995); the requirements of the customers have to be considered much more carefully than is the case with standard products. This also means that the relationship between the product developer and the customer is much closer and more interactive. The need for close interaction builds customer loyalty, and usually a high degree of mutual dependency arises (Chisnall 1995).

There is often a need for some kind of customisation in the SI business, and the role of the relationship between the supplier and the SI is therefore an important matter to take into account. For example, if some end users are demanding customised products, the SI must identify these needs and determine, in co-operation with its suppliers, what kinds of product modifications are needed. The SI usually cannot, however, expect its suppliers to make the necessary part modifications alone, because of their distance from the end users. In other words, the SI and the suppliers should have a close enough relationship to design and implement the modifications together. However, in considering component markets, there is usually a need for both standard and tailored components. If there is a greater need for customised components than for standard ones, a need for closer co-operation between the engineering departments of the SI and the suppliers arises. If standard components play a major role, close interaction between the buying department of the SI and the selling departments of the suppliers is emphasised (Chisnall 1995).

Whether the components are standard or tailored to the customer, it would be useful for the SI to categorise the necessary components for purposes of parts sharing. Two useful categories are components with a strong influence on product quality and components with only a weak influence (Fisher *et al.* 1999). This categorisation helps the

SI to control its production and the quality of the final product more carefully than is allowed by a system considering the difference between standard and custom components alone. From the SI's point of view, there is also a difference between whether the component is acquired as part of a product platform or as an independent sub-assembly – i.e., a product. The difference is due to the fact that a product platform is not a product but rather the core of a product family. In fact, the product platform supports the design of product architectures that spawn one or more product families. For the SI to be effective, a product platform should be implemented before any customised products are developed (see, e.g., Sääksjärvi 1998).

Information exchange. The content of information is the most important aspect of information exchange. This can be characterised by the degree to which technical, economic, or organisational questions dominate the exchange. Also, the depth and breadth of the information should be an important consideration. The way the information is exchanged depends on the value of the information. Usually, soft data such as information about the practical use of the product or service are transferred through a personal channel – e.g., in face-to-face contacts or by phone. Technical and commercial data are mostly transferred through an impersonal channel – i.e., through media such as magazines or the Internet. (Ford 1997)

Financial and social exchange. Financial exchange is another basic type of exchange within a business relationship. The quantity of money exchanged is an indicator of the economic importance of the relationship. Social exchange is very important to take into account, too, especially given that all business relationships have some uncertainties. Instances of social exchange have an important role in reducing these. In cases where geographical or cultural differences exist between the parties and where the experience of the parties is limited, social exchange has an important role. Many relationships are based on mutual trust between the parties. Building of trust is a social process, which takes time and must be based on personal experience. This process requires also successful carrying out of the three other aspects of exchange. (Ford 1997)

4.3.1.2 Interaction between parties in the relationship

Interaction refers to active contact between the parties in the relationship (Gummesson 1996), and business relationships evolve as a result of interaction between the parties doing business (see, e.g., Turnbull & Valla 1986, Håkansson 1982). A business relationship, in turn, is a framework within which subsequent interactions take place. A great many studies have examined business relationships from the viewpoint of interaction (e.g., Brennan & Turnbull 1999, Kotsalo-Mustonen 1995, Ford *et al.* 1986, Turnbull & Valla 1986, Campbell 1985, Håkansson 1982). These include studies interested in examining aspects of interaction and relationships between companies and, furthermore, in increasing understanding of the behaviour of buying and selling companies in industrial and/or international markets.

The evolution of interaction can be described as a social exchange process between two firms conceptualised as collective actors. One of the firms, usually the supplier but often the buyer, takes the initiative in conducting business with another. If the other party responds, the interaction evolves, and gradually commitments are made by both of the firms (Holm & Eriksson 1996). Thus, interaction in business relationships is a matter of co-ordinating activities and resources between two firms (Håkansson & Snehota 1995).

Ford *et al.* (1986) identify four different aspects of interaction, which are capability, mutuality, particularity, and inconsistency. According to them, capability can be described as answering the question 'What can you do for me?' In other words, it describes the relationship between the two parties of the dyad in terms of what they can do for each other and what functions they can fulfil. Thus, the aspect of capability is very closely related to the resources of the interacting parties, and in order to fulfil certain functions, different kinds of resources are needed. The second aspect, mutuality, is based on the assumption that the parties have shared goals and interests, at least to some extent. Mutuality can be also described through answering the question 'How do you see me?' and is closely related to the dominance and balance aspects of the relationship.

'What are you ready to do for me, compared to what you do for others?' describes the third aspect of interaction, particularity. It relates to the interaction between the parties in the relationship in terms of uniqueness and direction – e.g., in terms of how much special treatment the parties in the relationship are ready to give each other compared to the way they generally treat others. The fourth aspect, inconsistency, refers to the lack of clarity in interaction; i.e., it refers to ambiguity. It is highly likely that there exists some variation in the interaction between the parties in the relationship from time to time. For example, the context of the relationship may vary and cause changes – e.g., in the capabilities of the parties to invest in the relationship. Thus, inconsistency in a way describes the dynamics of the interaction and also highlights the possibility of the coexistence of conflict and co-operation within the interaction. It is important to notice that all four of these aspects of interaction are closely interconnected, although the capability and mutuality aspects refer more to the effects of interaction, whereas particularity and inconsistency are more concerned with the implementation of interaction. (Ford *et al.* 1986)

In the interaction approach to business relationships, the viewpoints of both parties have been taken into account. As Ford *et al.* have stated, all relationships must be examined from both the company's own perspective and the perspective of the other party. This can be termed the dyadic approach to business relationships (Ellram & Hendrick 1995). In the discussion that follows, the SI relationship is viewed from both the SI's point of view and that of its supplier. Then, the discussion is supplemented by the viewpoint of a potential intermediary, and, lastly, the SI relationship is discussed in terms of the different stages of the relationship, different relationship types, and nature of the relationship in general terms.

4.3.2 Perspectives of the parties in the relationship

In this section, the different parties in the relationship are discussed. This refers in particular to the SI and its supplier. Additionally, a potential intermediary's point of view has been taken into account. The end customer's perspective is not discussed in this section, as it was dealt with in Section 4.1 in the discussion of the first element, 'perceived end customer value', of the preliminary model of value-creating networks. It needs to be noted that, naturally, there exist relationships between the end customer and the other actors in the network, but these relationships are not addressed in this section.

4.3.2.1 System integrator's perspective

Buying process. As the SI represents the customer's and the buyer's role in the relationship, the buying process as part of the overall supply strategy has a big influence on the relationship. Thus, identifying the actors participating in the buying process and the activities that are carried out during the buying process helps to determine the structure of the relationship. Both the actors that act as the buying unit and the activities making up the buying process have been studied in the industrial marketing and management literature (e.g., Gadde & Håkansson 2001, Lorge 1998, Gadde & Håkansson 1993, Cunningham & Homse 1990, McQuiston 1989, Jackson *et al.* 1984, Doyle *et al.* 1979, Webster & Wind 1972).

On the SI's side of things, there are different individuals who participate in the buying process and thus have a major influence on the way the relationship is formed with the supplier. These individuals usually represent different professions, including purchasing, production, engineering, R&D, finance, and marketing. It is noteworthy that these people are not only the ones who do the actual purchasing but are also the ones with some level of influence on the overall buying behaviour of the SI. Thus, they are the individuals affecting the buying decision. Often, they are also referred to as the buying decision group. Usually the group is an informal unit whose aim is to gather and analyse the information needed for the buying decision. There are usually different roles in the group that the supplier should be aware of. These include, for example, users, gatekeepers, influencers, deciders, and buyers. (Chisnall 1995)

Whether the purchase is a so-called new task buy, modified re-buy, or straight re-buy also has an influence on the buying and selling behaviour of the parties in the relationship. For example, a straight re-buy is quite simple, but a new task buy requires a great deal of information exchange and negotiation since the case is considerably different from past experiences (Chisnall 1995). Naturally, in the case of a re-buy, the supplier is already familiar to the SI and its buying decision group, so that has an influence on the way the buying process proceeds and is organised. Thus, the buying process is influenced by the nature of the mutual relationship – i.e., how familiar, close, and dependent on each other the parties in the relationship are.

The interdependence between suppliers and buyers is, furthermore, influenced by the market structure, which determines the available choices and sources of power of any prospective partners in the market. Figure 23 illustrates the influence of the market structure – in other words, the number of existing suppliers and buyers. For example, in concentrated markets, where few suppliers and buyers exist, there are likely to be more instances of partnering than are found in the other three market situations. One party exerting power over the other characterises a less equally balanced supplier/buyer relationship, where there is buyer dominance or supplier dominance. In the final situation, where there are many alternative suppliers and buyers, mutual commitment between suppliers and buyers is usually low and there is greater freedom for both parties to change partners (Cunningham & Homse 1990). It should be noted, however, that the number of potential buyers increases if the suppliers operate in more than one industry. In other words, the suppliers can decrease the dominance of the few big buyers by leveraging their markets also to other industries – i.e., by operating in horizontal markets.

		NUMBER OF SUPPLIERS	
		Few	Many
NUMBER OF BUYERS	Few	Mutual interdependence	Buyer dominated
	Many	Supplier dominated	Relative independence

Fig. 23. Market structure vs. relationships (Cunningham & Homse 1990).

The automotive parts industry representing a well-known SI business is a good example of the model shown in Figure 23**.** As is widely known, there are few big automotive SIs at the global level. These companies, such as General Motors and Toyota, play a major role in the whole industry. Because there are only a few of them, the car manufacturing industry is dominated by the buyers, from the parts suppliers' point of view. However, the situation is different in cases where a supplier has a presence not only in the automotive industry yet also operates in other industries. In the latter case, it has many more potential customers and is not so highly dependent on the car manufacturing companies. For example, the biggest firms in the US car parts industry usually have a major presence in other markets as well, but in Japan the major parts manufacturing firms are often highly dependent on the automotive sector. (Lamming 1993)

The interdependence issue affects the process of interaction between the SI and its suppliers. In the SI market, there is usually the question of adaptation regarding the quality and functionality of various components. The SI usually wants the supplier to modify, develop, and improve its components in various ways. On the other hand, to some extent it is desirable from the supplier's perspective that the SI accept standard components, which the supplier could then make available to its other customers, too (Axelsson & Håkansson 1990). In most cases, the SIs are much bigger and more global than their suppliers. The party that adapts is therefore usually the supplier, not the SI. This question of adaptation is comparable with that of one of the aspects of interaction presented by Ford *et al.* (1986), mutuality.

Vertical co-ordination has been seen as one way to improve industrial purchasing relationships by balancing the power dependencies between the SI and its suppliers.

Vertical integration can be defined as purposeful co-ordination of activates and information flows between two independent companies. The underlying idea is to avoid strict legal agreements between the parties and to achieve a more informal and flexible relationship. Naturally, the profits that emerge from changing the patterns of behaviour are split between the parties in the relationship (Buvik & John 2000). By definition, vertical co-ordination refers to partnering and partnership types of relationships (see, e.g., Spina *et al.* 2000, Weber 2000).

Different sourcing strategies. One possible move toward closer relationships with suppliers has been presented: the so-called partnership sourcing approach. Partnership sourcing represents a collaborative approach in which the SI and a fairly small number of suppliers work closely together (Ellram & Edis 1996) in order to achieve the superior performance that arises from long-term collaboration between the SI and the supplier (Macbeth & Ferguson 1994, Lamming 1993). Characteristic of a partnership sourcing relationship are also sharing of both risks and rewards as well as a focus on continuous improvement (McIvor & McHugh 2000, Ellram & Edis 1996).

Although many SIs speak of partnering with their suppliers, whether this is the actual procedure in practice is debatable. For example, van Weele (1994) found in his study of Western SIs that quite a few of them retain considerable economic power in comparison to their suppliers, although they speak in terms of partnerships with their suppliers. Furthermore, it is not always clear that the fundamental characteristic of a partnership, sharing of risks and rewards, can be implemented in practice, because usually the small supplier companies do not possess such resources that they could share the risks with the SI, in practice. Swink & Mabert (1999) argue that an SI desires from its suppliers not only minimised risk but also support for global product strategies, including market knowledge, local presence, and/or access to new global markets. Furthermore, an SI usually wants from its supplier provisioning of scarce resources and capabilities. Thus, it may, for example, want its supplier to provide turnkey solutions and contributions to new product development.

A concept closely related to partnership sourcing as a supply strategy is the just-in-time (JIT) philosophy. In the JIT philosophy, the aim is also to increase close co-operation between the SI and its suppliers. However, the JIT philosophy emphasises achieving better cost control through reducing inventories (Spear & Bowen 1999, Frazier *et al.* 1988, Gelinas *et al.* 1996), whereas in partnership sourcing the inventory question has not received as much special attention. The fundamental objective behind the JIT philosophy is to eliminate waste of all kinds from the production and delivery systems of both the SI and its suppliers (Heberling 1993, Frazier *et al.* 1988). This requires exact timing of materials deliveries, exact quantities, and perfect quality. It should be noted that the JIT philosophy has received a lot of attention in studies concentrating on SI relationships worldwide, although the concept was originally developed and applied only in Japanese companies. The approach's Japanese background and links to the structure of Japanese society should be kept in mind when the philosophy is applied in other contexts.

Another sourcing strategy, network sourcing, also originated in Japan. According to Hines (1995), network sourcing represents a hybrid approach to purchasing strategies, as it involves the use of two or more sources per product type, with *only one used* for a single product or code number. Network sourcing as a purchasing strategy relies on establishing a close and stable sourcing network that is *hierarchical*. Thus, it results in a multi-tiered network of suppliers and subcontractors. As a purchasing strategy, network sourcing combines certain elements of single sourcing – e.g., close, personal relationships – and multiple sourcing[23] – e.g., alternative suppliers for the component to be sourced.

The relationship between sourcing strategies and the buying process. The chosen sourcing strategies influence the way the overall buying process is carried out. The buying process involves a series of actions taken by both the SI and its supplier. The process consists of different stages or steps, which are usually seen as starting with problem recognition and ending with performance review. The number of steps is dependent on whether the SI is carrying out a new task buy, modified re-buy, or straight re-buy. For example, a new task buy may include at least the following steps: problem recognition, general description of needs, product specification, supplier search, invitation for tenders, supplier selection, specification of order processes, and performance review. In comparison, in a straight re-buy, most of these steps may be unnecessary because a relationship already exists with the supplier. (Kotler 2000)

There are also various factors influencing the buying process. Four main influences can usually be identified: environmental, organisational, interpersonal, and individual. Environmental factors include, e.g., economic outlook, interest rate, competitive developments, and political and regulatory developments. Organisational factors involve such issues as the objectives of the company, systems, policies, and structures (e.g., different supply strategies). Interpersonal factors refer to group dynamics that are evident during the buying process, whereas individual factors consist of personal motivations, perceptions, and preferences that each individual in the buying decision unit may have. (Kotler 2000)

4.3.2.2 Supplier's perspective

From the supplier's perspective, the SI as a party in the relationship can be viewed both as one possible marketing channel and as a direct customer. In the discussion that follows, both of these viewpoints are discussed.

The marketing channel view. From the viewpoint of the component supplier, the SI business is often considered a marketing channel. There are several studies that have focused on channel research (e.g., Kuivalainen *et al.* 2000, Jensen 1993, Achrol & Stern 1988, Dwyer & Oh 1988, Anderson & Narus 1986, Anderson & Narus 1984, Achrol & Stern 1983). Marketing channels can be defined as interdependent organisations involved in the process of making an assortment of products and services available for use or consumption (see, e.g., Jensen 1993, Achrol & Stern 1988). There exist different types of marketing channels from which the companies offering products or services can choose. Usually, a distinction between channel types is made in terms of the inherent degree of directness that each channel structure provides. Directness refers to lack of intermediate stages in the sales or product flow from the point of origin to the consumption point (Bowersox & Cooper 1992). In other words, the more intermediaries exist in the marketing channel, the more indirect the channel is.

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[23] For more information about single and multiple sourcing strategies, see Baily and Farmer (1982).

The SI business may be considered a channel in a situation where the company's product is sold as an integrated and inseparable component of another company's offering. One benefit of such a channel is easy access to specific market segments (Kuivalainen *et al.* 2000). This logic makes the SI channel attractive, particularly for small and medium-sized enterprises (SMEs) seeking to serve customers with whom they are not so close yet. However, it is difficult for SMEs to win the attention of big SIs (Moore 1991).

Another negative side to this channel alternative is that only the SI's brand may be visible. Thus, the SI channel is not the best option if the supplier is dedicated to building its own brand and visibility (Kuivalainen et al. 2000). Also, the question of a possible channel conflict should be considered. If the SI business is seen as a distribution channel from the supplier's point of view, there may occur some conflicts between the channel and the other channels used by the same supplier.

The question of choosing the right distribution channel is important, and the evaluation of channels should be conducted properly. The company should pay attention to at least two questions: 'Has the channel already built a relationship with the end customers?' and 'How does the channel fit into the overall product mix and marketing strategy of the focal company?' (Moore 1991) Even if the supplier may not favour an SI as its sales and marketing channel, in light of the goal of serving end users directly someday, there are also success stories involving SI partnerships. The Japanese consumer electronics industry is one of them. As the first step toward globalisation, several Japanese electronics companies gained economy of scale through extensive use of SI agreements with partner firms in Europe and the USA. Their aim was not so much to achieve a large market share *per se* as to gain global manufacturing volume and scale. After these had been established, the companies moved into the market, pushing their own brands on the basis of their abilities to offer high-quality products at low costs – taking advantage of economy of scale in pursuit of the desired scope. (Lorange & Roos 1992)

However, it is debatable whether such development from SI supplier toward serving end users is possible where 'small' product parts, such as individual components, are concerned. It can be assumed that this would be more likely for 'bigger' parts of the SI product – i.e., when the parts can be regarded as somewhat independent products in the eyes of end users. Another problematic issue is the question of vertical markets. Usually the SI has control over the whole vertical market, and it may be very hard for the supplier to gain a considerable share of these markets.

One possible way, from the SI supplier's point of view, to handle such a problem is to apply a horizontal approach to vertical markets. With this approach, the supplier builds strategic alliances with other component suppliers, not just with SIs. With the help of these alliances, the supplier may focus on a single kind of customer and product set, while simultaneously leveraging other SI suppliers' vertical market experience and business relationships. Together the suppliers may offer a better solution for end users than the original SI.

The customer relationship management view. In addition to looking at the SI as one possible marketing channel, one can, of course, view the SI in terms of its role as a customer of the supplier. Thus, it is relevant to consider a customer relationship management point of view, too. In fact, the growing importance of CRM is one of the emerging trends in industrial marketing and management (see Storbacka *et al.* 1999a). Customer information has traditionally been stored in multiple systems throughout a company, due to the fact that the various enterprise systems were designed to support specific business processes rather more than specific customer relationships. Also, the fact that customers are served through multiple channels leads to a situation where customer information is dispersed throughout the company. By contrast, the basic idea of CRM is to collect, manage, and store customer data centrally and in this way to help the company serve its customers better. By codifying their CRM processes and implementing a CRM system, companies can ensure that their customers are served seamlessly across all channels. (Storbacka *et al.* 1999a)

Successful CRM does not simply mean a more appropriate way to gather, analyse, and utilise customer information; it should be understood more like a business philosophy in which the role of customers and management of customer relationships is recognised and valued. The CRM approach is based on the assumption that every customer has its own processes by which it creates value. The customer's value creation[24] processes are established to achieve its business goals and mission. Ultimately, this means that customers always measure value in relation to their own goals. If a supplier wants to build a good relationship with the customer, it has to have a thorough understanding of the customer's mission, goals, and business drivers (Storbacka *et al.* 1999a). In other words, to build a long-lasting and successful customer relationship, the supplier needs to achieve a deep enough understanding of the activities by which the customer creates value for itself.

However, this problem-solving for the customer should be done in a profitable way, at least in the long run. As Anderson & Narus (1998) have pointed out, besides recognising actions by which the supplier can create value for the customer, it is also crucial that the supplier can perform these actions in an economically profitable way. Solving of the customer's problems should therefore be based on the supplier's own core competencies, so that the supplier can solve the customer's problems without any big sacrifices. This is because core competencies do not deteriorate as they are applied and shared; rather, they can even grow when they are applied (Prahalad & Hamel 1990).

Therefore, the basic idea of CRM is to first identify the customer's value creation process and then to learn to support it in a profitable way so that both the supplier and the customer can benefit from the relationship. In the SI context, the supplier should familiarise itself with the SI's value creation process first, as the SI is its direct customer. However, because of derived demand, also the process of creation of value for the end customer plays an important role. If either the SI or the supplier does not understand the needs of the end customers, the joint business may not be successful.

The purpose of the examination and determination of the customer's value creation process is to better understand the concerns related to the customer's business activities. Another advantage of understanding the customer's value creation process is that the supplier can more easily communicate with the customer concerning the value that it can create for the customer (Anderson & Narus 1998). As MacStravic (1999) has pointed out, it is important to communicate with the customer in the 'right' way so that the customer can recognise the value that the supplier is able to create. When the supplier understands

[24] The concept of value creation was discussed more thoroughly in Chapter 3.

that different customers have different kinds of value concerns, it can classify its customers as different types on the basis of their respective value propositions and processes. Thus, different customers gain different kinds of support in their value creation processes. Another important point is that the supplier should evaluate which customer relationships are the most valuable ones and those most worthy of protection and nurturing. Storbacka *et al.* (1999a) suggest that this evaluation should be based on the so-called learning value, reference value, and strategic value of the customer, as well as the economic return of the customer relationship. After the evaluation, customer relationships can be divided into those that should be protected, changed, or developed.

Although CRM emphasises the customer's side of things, its focus is in fact on the relationship, and it therefore encompasses both the supplier company's interests and the customer company's interests. In other words, CRM aims at linking together the business processes of the supplier and its customer in a profitable way.

4.3.2.3 A possible intermediary's perspective

The question of the existence of intermediaries in business relationships is closely connected to marketing channel decisions, which were discussed in the previous section. As stated earlier, the more intermediaries there are between the seller and the end customer, the more indirect the marketing channel is (Kotler 2000). Besides the number of intermediaries[25] existing in the channel, the types of intermediaries necessary and their roles within the channel must be considered.

In the context of SI-type relationships, intermediaries can create value for both component producers and buyers through a variety of services. These include, for example, market-based services, requirement-based services, and negotiation-based services. In market-based services, the intermediary can create value by providing customers with specialised knowledge of the market. This knowledge could include information on the qualities and quantities of available components and buyers. Through requirement-based services, the broker can create value by providing clients with feedback on the interactions of their requirements and how the market might meet the associated requirements. Lastly, by providing negotiation-based services, the intermediary can create value by interacting with customers to create mutually acceptable deals. In some cases, the intermediary can, for example, create a package deal that connects a number of customers and component producers. (Robinson 1997)

In the SI context, the relationship between the component supplier and the SI is usually so close that the first two services are not necessarily relevant. The third one, 'joint deals', could be important at least in terms of virtual supply chains consisting of a great number of partners. Even the first two types of services can be valuable at the

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[25] Exclusive distribution, selective distribution, and intensive distribution are examples of possible strategies when companies are deciding on the number of intermediaries to use. Exclusive distribution means severely limiting the number of intermediaries, whereas intensive distribution consists of the manufacturer making its goods and services available at as many outlets and through as many intermediaries as possible. Selective distribution is the middle ground between these two strategies, as it involves the use of more than a few yet not all possible and available intermediaries. (Kotler 2000)

beginning of an SI partnership – i.e., when the supplier or SI is searching for potential partners. For example, there is a strong desire in the electronics industry to increase the use of services that help companies in the component acquisition process – e.g., in finding appropriate component suppliers (Laine *et al.* 2000).

4.3.3 The nature of business relationships

In order to gain a more holistic view of business relationships, the discussion below delves into different levels and stages of relationships, relationship connectors, and types of relationships. Although these angles can also be considered separately, they are interrelated in nature. For this reason, they are all discussed as matters related to the nature of business relationships.

Relationship levels and stages. First of all, business relationships can be analysed at different levels. Storbacka *et al.* (1999a) have identified three different levels that together constitute the structure of customer relationships: a contact level, relationship level, and overall interaction level. The contact level refers to the purchasing situation. At the relationship level, the customer evaluates how well the chosen product or service supports its own value creation process. At the overall level, the customer is interested in understanding how well the whole relationship with the supplier supports the accomplishment of its goals and mission. Unfortunately, it is commonplace for suppliers to think only about their success at the contact level, when in fact they should concentrate more on the relationship level and the overall level. This has been pointed out by many relationship marketing researchers, including Grönroos (1997), Gummesson (1997), and Morgan & Hunt (1994).

Another important angle from which to analyse business relationships is to identify different stages in their development. Just like any relationship, business relationships change over time. They are started and ended. Evolution of business relationships has in fact been a rather popular research topic, and different models of relationship stages have been presented by authors such as Ford (1997), Halinen (1994), Dwyer *et al.* (1987), and Ford (1980). Also some of these studies place particular emphasis on certain phases of the relationship; see, e.g., the work published by Tähtinen (2001).

Ford (1997) distinguishes five stages in the evolution of a business relationship. The stages help to better understand relationship development and evolution, although not every relationship develops by careful adherence to the stages. The stages are the pre-relationship stage, the early stage, the development stage, and the long-term (or final) stage. The pre-relationship stage is the first stage, in which the relationship is started. It might refer to a situation in which a company is seeking new customer relationships. Also, in a situation where the performance and potential of existing customers are evaluated, a company might notice the need for new connections and relationships. There are some factors, including social, cultural, technological, and geographical distance, that can make relationships hard to establish. If there is a large gap of this sort between the actions of the parties, the relationship is more complicated as a consequence. The second stage, the so-called early stage, is when the company has an established connection with the potential customer, supplier, or other relevant actor. Some action can already be involved at this stage – such as the delivery of a product or service. No procedures have been established yet. At this stage, it is possible to reduce the distances mentioned above. The commitment of the parties is rather low in this stage, as the parties do not have much evidence on which to judge each other's commitment to the relationship. (Ford 1997)

The third stage, the development stage of the relationship, occurs as deliveries of continuously purchased products or services increase. This stage occurs after contract signing for major capital purchases. Both parties will be dealing with such matters as integration of the product or service purchased. The long-term stage, the final stage of the four, is characterised by the companies' importance to each other. Stage four is reached after large-scale deliveries of continuously purchased products or services have occurred or after purchasing of major unit products. The long-term relationship leads to the establishment of standard operating procedures, trust, and norms of conduct. The final stage is reached in stable markets over long periods of time. It is marked by an extension of the institutionalisation process to a point where the conduct of business is based on industry codes of practice. (Ford 1997)

Rather similar stages in the relationship development process have been identified by Dwyer *et al.* (1987), who describe relationships as evolving through five phases: awareness, exploration, expansion, commitment, and dissolution. Thus, the phases of development identified by Dwyer *et al.* (1987) are rather similar to those presented by Ford (1997), except for the addition of the fifth phase, the dissolution phase of the relationship.

The different stages of the relationship involve different kinds and amounts of exchange between the parties. As regards the different kinds of exchange that occur between the parties concerned, supplier/customer relationships usually include at least three types of exchange: knowledge, emotional, and financial exchange (Cross & Smith 1997). This means that the supplier can gain a 'share of the customer's thoughts' by giving him enough information, a 'share of his heart' through shared values and branding, and a 'share of his wallet' through the right actions. The exchange of emotions can be viewed in terms of relational exchange. Trust, along with commitment, is one of the key features associated with relationships characterised by relational exchange.

Different relationship types. The level of closeness and co-operation can be used as a basis for defining different types of relationships. Webster (1992) has presented a classic model of the relationship continuum, illustrating different kinds of interactions in which organisations may be involved. Under this model, not all business relationships are depicted as close and oriented to the longer term; instead, relationships vary along a continuum from pure market transactions, at one end, to fully integrated hierarchical firms, at the other. In the middle are so-called partner relationships, characterised by close co-operation but in terms of two separate actors. This study concentrates on transactional relationships and partnerships, not addressing the other extreme of the relationship continuum – situations such as acquisitions and mergers. Acquisitions and mergers are omitted from the scope of this study because they make software component utilisation an internal issue of the newly merged companies. For example, if a small software component supplier is acquired by a larger SI, these two companies become one legal entity and therefore one can no longer speak of exchange of *commercial* components between the two companies.

Partnerships have been a popular theme of research (e.g., that of Link & Scott 2001, McIvor & McHugh 2000, Dent 1999, Swink & Mabert 1999, Virolainen 1998, Ellram 1990). Their goal is helping companies to get what they want with the help of other organisations. A need for partnering can occur because, for example, a company wants to expand its resources, satisfy customer needs better, reduce its expenses, increase productivity, increase job security, or improve its relationships in general. Thus, the list of reasons behind partnering is long. One important part of forming partnerships is therefore that companies understand what they want from their partners. Once this is understood, they can better evaluate the potential partners and their abilities to offer the help the company needs. However, successful partnerships require also committing to the relationship in the long run. This is required of both parties in the partnership. In summary it can be stated that commitment is an important stage of partnership development, parallel to the assessment, exploration, and initiation stages. (Dent 1999)

In addition, long-term business agreements, single or dual sourcing, integrated research and development, the JIT delivery approach, open sharing of technical and commercial information, joint problem-solving, and continuous quality improvement have been pointed out as some of the main elements of partnerships (Lehtinen 1996). Typical variables that have been used to characterise a partnership type of relationship have been listed by Virolainen (1998) as co-operation, interdependence, commitment, trust, communication, conflict resolution, shared values, and relationship outcomes. What is, surprisingly, left off the list is sharing of both risks and rewards. Sharing of costs and risks is listed by McIvor & McHugh (2000) in their argument that collaborative relations typical of partnerships can be viewed from four angles: joint cost reduction, supplier involvement in new product development, delivery and logistics management, and focus on the core business strategy.

Möller (1994) has studied both transactional and partner relationships. He uses the term '*relational exchange*' to refer to partnership relationships that are characterised by different kinds of economic, social, legal, technical, informal, and procedural bonds. Discrete transactions, on the other hand, are described as predominately governed by market forces. In these so-called *transactional relationships*, buyers and sellers are seen as interacting only on the basis of rather selfish considerations, aiming at merely finalising the single transaction to hand. Future co-operation is not actively considered in the transaction, and the seller is usually accorded a value related to its current products and prices.

Several other researchers have come to a similar conclusion regarding the differences between transactional and partner relationships in their research on business relationships (e.g., Heide & John 1990, Spekman 1988, Dwyer *et al.* 1987, Hanan 1986). According to these researchers' studies, partner relationships require open information sharing based on both person-to-person and electronic communication. The relationship involves a high level of trust and commitment over time, joint conflict resolution, and the sharing of risks and rewards. Such collaboration affords many of the benefits of vertical integration without the attendant loss of strategic flexibility. In contrast, sourcing from multiple suppliers and the use of competitive bidding, fully developed bidding specifications, and short-term contracts to achieve low purchase prices characterise transactional buyer/supplier relationships.

Evidently, the parties may also have differing views as to the kind of relationship in which they wish to engage with the other party. In the industrial marketing and purchasing research, the portfolio view has been used to illustrate both the buyer's purchasing strategy and the seller's marketing strategies, as well as what results from the different strategies from the relationship point of view.

Campbell (1997) has presented a classification system for buyer/seller relationships illustrating the interplay between buyers' strategies and sellers' strategies. According to this classification scheme, both buyers and sellers have three alternative strategies to use in relating to the other party and thus the business relationship can be understood by considering the interplay between these strategies. The competitive strategy refers to a company's aim to engage in a more transactional relationship, whereas the co-operative strategy can be described as a more partnership-style relationship. The command strategy illustrates a situation where one party has dominance over the other, for some reason, and aims to use this one-sided dependence. Furthermore, different kinds of interdependencies result from these strategies, and some interplay situations are even evaluated as 'mismatch'. Figure 24 illustrates these classes of interdependencies.

Marketing strategies

Purchasing strategies	Competitive	Cooperative	Command
Competitive	Independent Perfect Market	Mismatch	Independent Seller's Market
Cooperative	Mismatch	Interdependent Domesticated Market	Dependent Captive Market
Command	Independent Buyer's Market	Dependent Subcontract Market	Mismatch

Fig. 24. Campbell's classification of buyer/seller relationships (Campbell 1997).

Campbell's (1997) classification system, based on competitive, co-operative, and command strategies as applied by both buyer and seller, and the above discussion of the relationship continuum, can be summarised by way of a two-dimensional model that takes into account the dominance/balance aspect of the relationship and the competition and collaboration aspect. This model is based on the work of Alajoutsijärvi (1996), in which a model is developed for the study of industrial buyer/seller relationships. The model is presented in Figure 25.

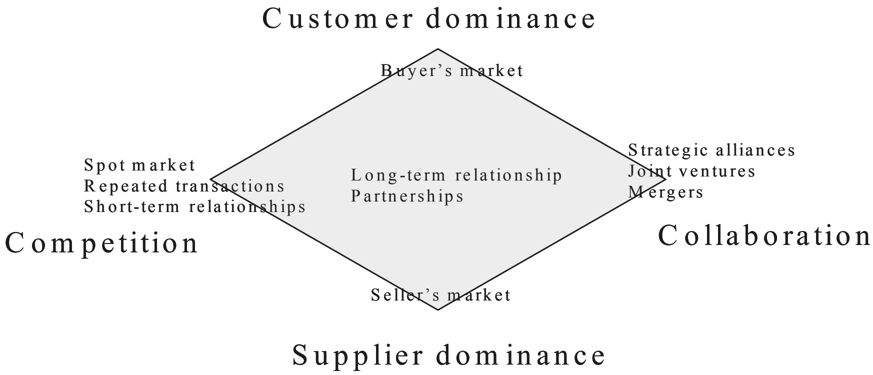

Fig. 25. Buyer-seller relationship continuum (modified from Alajoutsijärvi 1996 and Webster 1992).

Referring to Figure 25, one can see that the key idea in the model developed by Alajoutsijärvi (1996) is that the diamond-shaped area represents a space in which business relationships can be positioned with respect to both the dominance/balance dimension and the co-operation/competition dimension. It is possible for a business relationship to be very balanced and highly co-operative, with the supplier and the SI as the customer equally powerful in the relationship. In such a case, the relationship can be positioned in the middle of the space. However, a business relationship can also be situated somewhere at the very extreme of both dimensions – e.g., as highly competitive and characterised either by supplier dominance or by customer dominance.

Relationship connectors. The above discussion of different angles from which to analyse business relationships can be summarised for the most part by referring to the work of Cannon *et al.* (1999), in which six different kinds of connectors culled from theories of business relationships and interdisciplinary empirical research are specified. Thus, the identified connectors take into account quite a few important aspects of relationships and draw on several earlier relationship studies. The six connectors are information exchange, operational linkages, legal bonds, co-operation, relationship-specific adaptations made by the buyer, and relationship-specific adaptations made by the seller.

Information exchange is defined as expectations of open sharing of information that may be useful to both parties in the relationship. More open sharing of information means also that both parties are ready to share important, even proprietary information. For example, this may include involving the other party in the early stages of product design or openly discussing future product development plans (Cannon *et al.* 1999). This relationship connector is highly dependent on the level of trust in the relationship; the more trustworthy one party is, usually the more willingness the other party has to share information openly.

According to Cannon *et al.* (1999), operational linkages show the degree to which the systems, procedures, and routines of the parties in the relationship have been linked in order to facilitate operations. Cannon *et al.* (1999) point out that operational linkages vary from the arm's length extreme to fairly close inter-firm routines and systems, a view reminiscent of the relationship continuum presented by Webster (1992).

Legal bonds are detailed and binding contractual agreements made by the parties. These agreements specify the roles and obligations of both parties in the relationship (Cannon *et al.* 1999). Tying this to the above discussion of transaction-based relationships and partnership relationships, strong legal bonds characterise well transaction-based relationships, whereas partnership-style relationships place a focus on minimising the number of legal bonds.

Co-operative norms as one of the relationship connectors reflect the expectations that the parties have about working together to achieve mutual and individual goals jointly (Cannon *et al.* 1999). Co-operation and competition are in a central role also in the model developed by Alajoutsijärvi (1996), presented in Figure 25.

The final two connectors described by Cannon *et al.* (1999) are relationship-specific adaptations made by the seller and those made by the buyer. Whereas the other four connectors deal with joint behaviours and shared expectations, adaptive behaviour focuses on the individual behaviour specific to one party in the relationship. Again, it can be pointed out that extensive adaptations is more typical of a partnership type of relationships than of a transaction-based relationship. Adaptation is closely related to the question of how balanced the relationship is. Mutual adaptation is characteristic of a balanced relationship, whereas adaptation by only the seller or only the buyer is characteristic of relationships in which one party has a greater degree of dominance.

These six connectors can be utilised in characterising different business relationship types – i.e., in forming a sort of relationship taxonomy. At this point in the study, it is worth pointing out that although the work of Cannon *et al.* (1999) is fairly comprehensive and based on a broad selection of previous business relationship studies and research, it does not take into account all possible angles from which one can analyse business relationships. For example, the important role of the object of exchange itself – i.e., the product or service exchanged between the parties in the relationship – has not been taken into account, although Ford (1997), among others, has identified it as comprising a special type of exchange between the parties in the relationship, along with social, information, and financial exchange. Information, by contrast, was taken into account also by Cannon *et al.* (1999), and indirectly the element of social exchange was included in the six relationship connectors as part of adaptation and co-operation.

4.3.4 Summary: conceptualisation of relationships

As can be seen from the above discussion concerning business relationships, there are several different but interconnected angles for considering business relationship as a concept. These have been dealt with in the discussion of interaction and exchange in business relationships; the perspectives of the parties in the relationship; and, lastly, the nature of the relationship. Supplier, SI, and possible intermediary perspectives were taken into account in the discussion. The perspectives of the SI and its supplier were given particular attention and reviewed through discussion of the buying process, sourcing strategy, marketing channel, and customer relationship management. The perspective of a possible intermediary was discussed first in general terms, then in relation to the software component business in particular. The framework for discussion of the relationship was further divided into relationship stages, relationship types, and relationship connectors. The discussion provided was not exhaustive, but it was an attempt to offer a multifaceted view of the concept of business relationship. Figure 26 serves as a summary of the above discussion of business relationships.

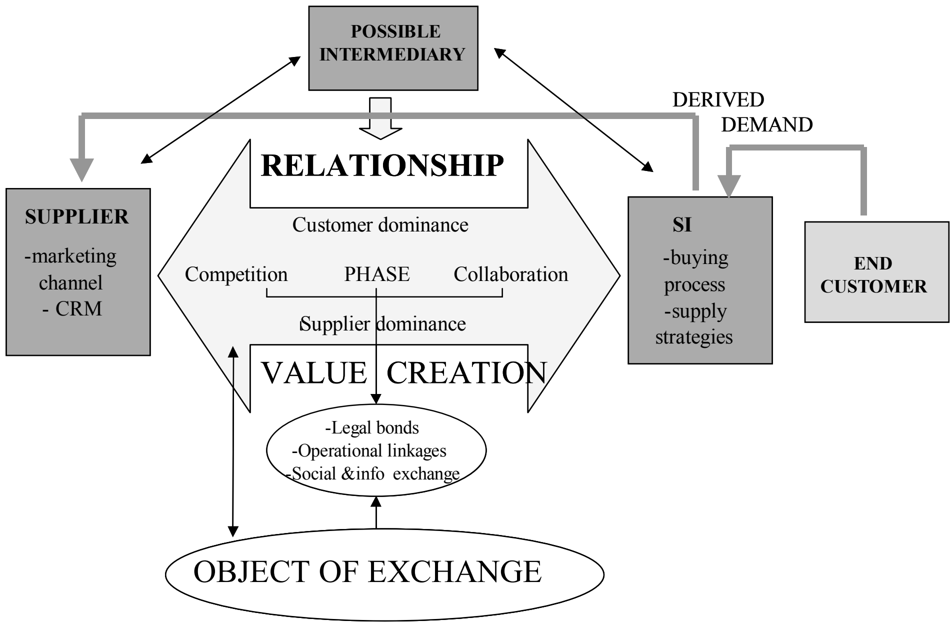

Fig. 26. Different angles from which to view a business relationship.

Figure 26 represents the different angles from which one can view a business relationship. The relationship connectors presented by Cannon *et al.* (1999) and the co-operation and balance aspects of business relationships presented by Alajoutsijärvi (1996) take a central role in the figure. Legal bonds, operational linkages, and social and information exchange are mentioned separately as directly based on the work of Cannon *et al.* (1999), which discussed six relationship connectors. However, these relationship connectors include also co-operation and adaptation aspects, which take a central role in the work of Alajoutsijärvi (1996), too. These are illustrated inside the arrow in Figure 26, added with the concept of the various relationship phases. Additionally, the object of exchange is also present in the figure. It has been identified as one of the most important influencers of business relationships by, e.g., Ford (1997), and value creation is taken into account in the figure as it appears in the relationship between the SI and its supplier.

Based on the above discussion, the third element of the preliminary model under construction, *relationships*, can be defined as *chains of interactions through which different attributes are exchanged between two organisations*. Business relationships can be viewed via different relationship connectors, especially the co-operation and balance connectors. Other relationship connectors consist of legal bonds, operational linkages, and social and information exchange. In Figure 27, a relationship and the detailed contents of the concept are illustrated as forming the third element of the preliminary model of value-creating networks.

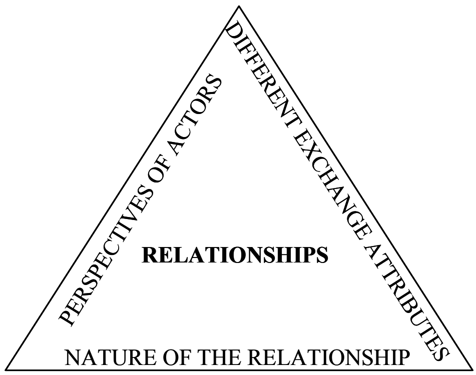

Fig. 27. Element three of the preliminary model of value-creating networks: relationships.

For purposes of analysis of value-creating networks, the three angles related to business relationships that are given more careful consideration are *different exchange attributes*, *perspectives of the actors*, and *the nature of the relationship*. The different exchange attributes that will be part of the analysis of relationships in a value-creating network are product (and service), information, social exchanges, and financial exchanges. These attributes are closely related to the issue of the nature of the relationship, as the amount and weight of different exchanges vary with the type of relationship. For example, the amount and import of social exchange is more evident in partnerships than in more transactional relationships. The nature of relationships refers to the different types of relationships as regards their closeness, the degree of balance of the relationship, and legal bonds. The phase in the relationship's development can serve as another potential classification criterion. However, the stage of development is not taken into account in this study – the software component business as the empirical target of the present study is still in its early development. On the other hand, the different actor perspectives are included in the analysis in order to provide a more multifaceted and holistic view for value-creating network analysis.

4.4 The preliminary model of value-creating networks

The preliminary model of value-creating networks rests on the three elements – namely, the perceived end customer value, core competencies, and relationships. In previous sections, each of these elements was examined and summarised. It is noteworthy that these three elements are highly interconnected in nature and that thus it is sometimes hard to distinguish between them in a value-creating network context. However, for analytical purposes, distinction between them is of use nonetheless.

All three elements are equally important for understanding of value creation in a business network. However, in mapping the relationships among the elements, the perceived value to the end customer is the starting point for everything – without the customer, there is no point in forming relationships in which competencies are joined in order to create value. What the end customer perceives as valuable *defines* what kinds of core competencies are needed in creating the value. Furthermore, the relationships between the network actors are *formed* based on who is able to utilise the competencies required. In the end, the value is created through the relationships between network actors, and thus the nature of the relationships affects the value outcome. Figure 28 illustrates these three interrelated elements, which together form the model of value-creating networks.

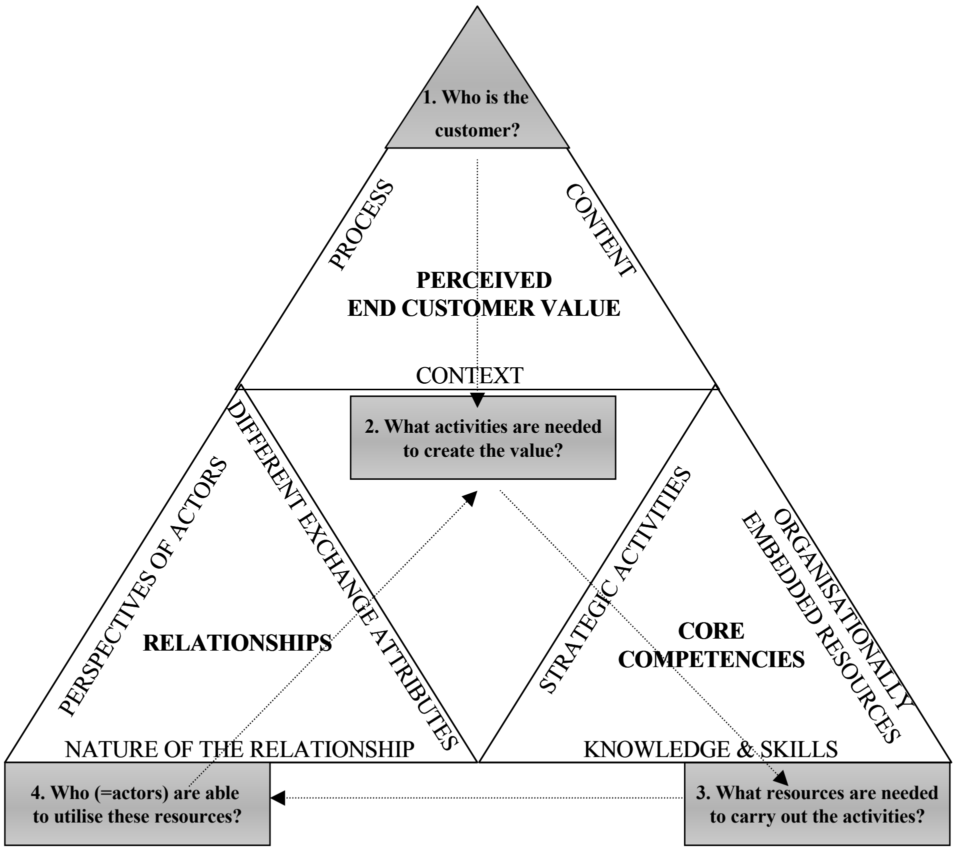

Fig. 28. Apreliminary model of value-creating networks.

The elements of perceived value to the end customer, core competencies, and relationships are interconnected in nature also when changes occur: a change in one element usually causes changes to the other two elements. For example, if there occur changes in the end customer's appreciation of the value created, a different kind of value must be created, and this may require different kinds of competence. Moreover, if the network and the relationships constraining it are built upon and structured by the logic of joining the core competencies of different actors together, changes will occur in the relationships, too. To summarise the model, each of the elements is again described, in brief.

Value is understood in this study as *the trade-off between benefits and sacrifices both in monetary terms and in non-monetary terms*. Furthermore, value is understood as something that needs to be created but also must be captured not only by the end customer but also by the value creation network and its individual actors. Additionally, value is in this study seen as *differential* and examined from *a process-oriented point of view*.

Core competencies are understood in the model both as *resources* that are organisationally embedded and as *activities* that are strategic in nature. They are *knowledge and skills* that enable creation of differential and superior value for the customer. Although core competencies are organisationally embedded, they should be regarded as free from exact organisational boundaries in a value-creating network context. In other words, the emphasis is on competencies that the focal network actor is able to *utilise*, not on competencies that the actor *possesses*.

The concept of *business relationship* refers to a chain of interaction between two *organisational parties*. During the interaction, *different attributes are exchanged for each other*. Relationships in a value-creating network context can be viewed from different actor perspectives – e.g., those of the end customer, SI, supplier, and intermediary. Different types of relationships can occur between the network actors, depending on the nature of the relationship. One can apply classification criteria such as the closeness of the parties; dominance or balance between the members of the network; and the role and weight of different relationship connectors, including information, social ties, and legal bonds between the parties involved. Additionally, the nature of the product/service under exchange influences the nature of the relationship and its stages of development.

It needs to be pointed out that through these three elements – value, competencies, and relationships – the elements of actors, resources, and activities are present in the model. The latter three elements are familiar from the ARA model and are in fact already included among the elements forming the foundation for the preliminary model of value-creating networks. For example, it is impossible to talk about relationships if there are no *actors* – i.e., parties participating in the relationship. Moreover, as relationships are identified through interaction events, the notion of activities is already there. Additionally, relationships usually exist for exchange of resources between the parties in the relationship. The existence of actors, resources, and activities is also inherent in and linked to the elements of value and core competencies, as core competencies were defined as organisationally embedded and strategic *resources* that can create differential *value* for the customer when they are created and used through a chain of *activities* that are carried out by the network *actors*. Thus, also the concepts of core competence and value tie actors, resources, and activities to the preliminary model developed for value-creating networks.

In fact, it would be virtually impossible to carry out a value-creating network analysis without utilising the concepts of actors, resources, and activities, because as the starting point for a value-creating network analysis is to identify the value created for the end customer, and as the value is something that is *perceived* by the end customer, the end customer as an important *network actor* needs to be identified at the outset. Afterwards, the identification of the *activities* that are needed for the specific value creation in question need to be identified, leading to identification of the *resources* that are needed for carrying out the value-creating activities. These ‘steps’ are also included in the preliminary model for value-creating networks.

Part III: Empirical research on the software component business in the industrial automation sector

5 Empirical research design

In this chapter, the empirical research design of the study is discussed. The chapter starts with a presentation of the methodological choices made in the study by discussing qualitative research methods and case study strategy and by providing argumentation for the use of these approaches in this study. Additionally, the selection of the empirical case, the data gathering process, and the data analysis process are discussed.

5.1 Qualitative methods and the case study strategy

This study has been carried out by using qualitative research methods. The choice of qualitative methods is derived from the study's purpose of *building an empirically grounded model for understanding value-creating networks related to the software component business*. Thus, the choice of qualitative methods is natural, as these are the most suitable research methods when the objectives of the study demand in-depth insights and the aim is to understand the target phenomenon. Additionally, as the present study deals with network analysis, for which a holistic perspective is characteristic, the choice of qualitative methods is all the more appropriate.

Utilisation of qualitative methods does not necessarily make a piece of research a case study, as Yin (1994) points out when arguing that a case study can be conducted by both quantitative and qualitative means. However, in this research, the empirical study is carried out as a case study by qualitative means. A case study has been chosen because this research strategy is well suited to new research areas, as Eisenhardt (1989a) has pointed out. Also, Patton (1987) points out that a case study is a good method when new perspectives are sought or when there is little knowledge available about the phenomenon under study. A case study is also a very suitable research strategy when the focus is on understanding the dynamic nature of the phenomena studied, as it is here with emerging software component markets. Moreover, it is a preferred method when the emphasis is on answering 'how' and 'why' questions, when the researcher has little control over events, and when the focus is on a phenomenon in its real-life context (Yin 1994). The research problem of the present study is indeed a 'how' question, as the problem was formulated as *'How can one best describe and analyse value-creating networks related to the software component business?'*.

Besides the option of carrying out a case study by quantitative or qualitative means, there are also different alternatives for the case study design. Yin (1994) talks about four possible alternatives, as one can conduct either a single-case study or a multiple-case study and both of these can employ a single unit/level of analysis (i.e., a holistic case study design) or multiple units/levels of analysis (i.e., an embedded case study design). This study represents a single-case study with multiple levels of analysis.

There are advantages of single-case studies over multiple-case studies, especially when the aim is not on finding law-like generalisations but rather on gaining an understanding of some particular phenomenon. The value-creating networks related to the software component business represent such a complex phenomenon that it is sensible to choose the single-case study as a research design, as it allows a thorough and holistic analysis of the phenomenon. A single-case study enables greater concentration on making sense of the various aspects of the case in depth than a multiple-case study does. Additionally, in the empirical part of my research, the aim is to use the single-case study to evaluate and develop further the theoretical model developed in the earlier phases of the research. As Yin (1994, 38) has stated, 'one rationale for a single case is when it represents the critical case in testing well-formulated theory'.

However, there are also some shortcomings related to a single-case study that cannot be overlooked. First of all, there is the possibility that the selected single-case study may turn out to involve a misunderstanding of the research phenomenon (Yin 1994). Near the end of this thesis, in Section 9.1, the findings from the single-case study covering the industrial automation sector are evaluated in contrast to the telecommunications sector, which would have been another potential empirical context to study. Secondly, in carrying out a single-case study instead of a multiple-case study there is the danger that research on the one case selected does not work out well (Stake 1995). If this happens, the case should be dropped and another selected. In this study, the selected case did seem to work well during the research process, as there were no problems involving access to the needed information and the findings from the secondary and primary data supported each other.

In addition to selecting between a single-case study and multiple-case study design, it is also important to determine the level of analysis used within the case (Yin 1994). In this study, the embedded case study approach is followed because there is more than just one level of analysis through which the case is analysed. As was pointed out in the first chapter, the case study consists of two interrelated levels of analysis, the network and net levels. Based on these two levels of analysis, the empirical study is divided into two parts, which are discussed in chapters 6 and 7. The first part of the empirical study is carried out as a macro-network-level study that addresses the whole industrial automation sector, whereas the second part of the empirical study is carried out as a focal net study in order to allow deeper analysis of the phenomenon. The focal net under examination is part of the wider network of the industrial automation sector, as illustrated in Figure 29.

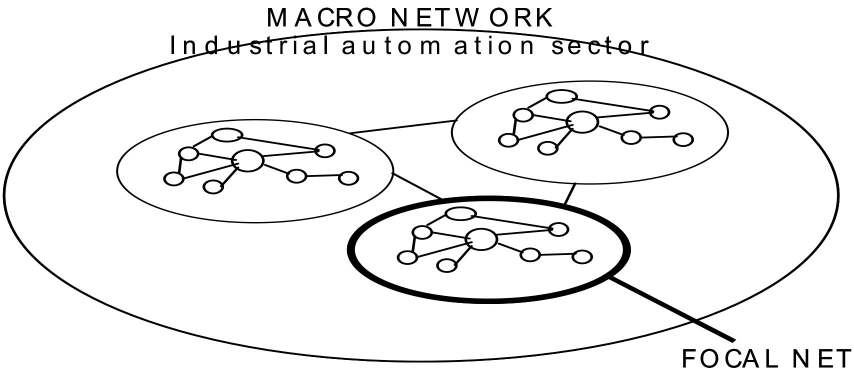

Fig. 29. The focal net as a part of the wider network of the industrial automation sector.

An embedded case study design with two levels of analysis, *the network and net levels*, was chosen in this study, as opposed to a holistic case study design, in order to understand the complex phenomenon as more multifaceted than would have been possible with only one level of analysis. If the level of analysis had been the focal net alone, the smaller unit of analysis could very well have led to some loss of the connectedness that is the very essence of a network (see, e.g., Easton 1995). The first part of the empirical study, dealing with the level of the macro network, acts to alleviate these shortcomings of the focal-net-level study to some extent. If, on the other hand, the level of analysis had been only that of the macro network, the risk of obtaining excessively abstract results would have been greater than it is with two mutually supplementary levels of analysis. Thus, the focal net level of analysis provides a deeper and more detailed understanding of the phenomenon under study, while the macro network level of analysis is necessary since a focal net is not easy to understand without its broader context (see, e.g., Möller *et al.* 2002). These levels of analysis are presented in Table 5.

Table 5. Levels of analysis used.

Analysis level	Unit examined	Example of the empirical material to be sought and used
Macro network	Industrial automation sector as a whole	Industry literature Interviews of the selected experts and representatives of SIs and suppliers acting in the sector
Focal net	A narrower part of the whole network, a net around an industrial automation system integrator company	Company documents (of the selected SI) Interviews of personnel representing the selected SI and its suppliers, customers, and possible intermediaries

5.2 Case selection

The case in this study is a value-creating network that is related to the software component business. In selection of the value-creating network to be studied, there were two main stages of specification. In the steps taken for making the selection, the following criteria were applied: the ability to maximise what can be learned through the case, accessibility, and acceptable practical limits on carrying out the case study – e.g., time limits (Stake 1995). The steps that were taken are presented in Table 6.

Table 6. Steps taken in selection of the case.

Specification step	What was chosen?	Why it was chosen?
Aim: to roughly specify the boundaries of the macro network to be studied; in other words, to narrow the scope of the empirical study from the whole ICT cluster to one specific sector in order to increase research manageability	Industrial automation sector as macro network to be studied	A good representative of the whole ICT cluster as it stands at the intersection of the other sectors in the ICT cluster. According to previous studies, it is one of the ICT cluster's leading sectors in the utilisation of software components
Aim: to select one specific focal net from the macro network to be studied in more detail	A focal net that is formed around an industrial automation system integrator company	The specific SI was chosen as the defining actor of the focal net for the following reasons: Utilisation of software components was a very critical issue in the company The company's customers were especially concentrated in the other sectors of the ICT cluster – e.g., in the telecommunications sector There was a high level of accessibility to the company, its suppliers, and its customers

As explained in Chapter 1, the empirical study related to the software component business is conducted from the perspective of one specific sector of the ICT cluster, the industrial automation sector. There were three reasons for limiting the empirical study to only one sector of the ICT cluster. First of all, it was a matter of limiting the scope of the study for purposes of research manageability. Narrowing the research area was necessary because it seemed that a rather detailed network-level analysis would be too difficult to carry out at the cluster level, especially in such a dynamic cluster with such an unclear structure. Thus, focusing on only one sector was an attempt to specify a clearer and closer level of network analysis than has been used in previous studies concerning the ICT cluster in general (e.g., Meristö *et al.* 2002, Paija 2001). Secondly, the industrial automation sector was chosen for the empirical study due to its high potential for taking the lead over the other sectors in the ICT cluster in utilising commercial software components (see Niemelä *et al.* 2000). Thirdly, as the industrial automation sector stands at the intersection of several other segments of industry within the ICT cluster, it provides a multifaceted view of the whole cluster.

The case study is carried out in two interrelated parts[26], the first representing the macro-network level of analysis in the form of a general industrial automation study and the second representing analysis at the focal net level, in the form of a more detailed analysis of the focal net surrounding an industrial automation integrator company that utilises software components in the system solution it provides for end customers. The specific focal net within the broader macro network was chosen for three reasons: the chosen SI had both *experience* and further *interest* in utilising software components in its business; the SI had customers in other sectors of the ICT cluster, affording customer interviews that shed light on the software component as it related to the whole ICT cluster; and, lastly, the SI, its suppliers, and customers were accessible to the researcher.

The accessibility to the focal net was provided through a research project called Vertigo, in which I participated as a project researcher for a period of one year. Vertigo is a Tekes-funded research project that was carried out in co-operation by the University of Oulu and the Helsinki School of Economics and Business Administration in 2001 and 2003. The aim of the project was to study the Finnish software business, with particular emphasis on the changing product strategies, service concepts, and value creation networks of Finnish software companies. One of the companies that served as cases in the research project fulfilled the criteria of an industrial automation company that has both experience and further interest in utilising software components in their business. Additionally, the company provided a wider view of the ICT cluster, as its main customer base was in the telecommunications sector. Based on the fit of this company to the selection criteria I had for the focal company, that specific company was assigned as my case company during the Vertigo project, and that guaranteed accessibility to the focal net surrounding the selected company.

In further specification of the focal net to be studied, the starting point was to carry out discussions with the focal company representatives in order to together form an understanding of the main actors of the focal net from the standpoint of software and software components. In co-operation with the focal company representatives, the main software suppliers and the main customers were identified as forming the focal net to be studied.

In summary, the utilisation of two different but mutually supportive levels of analysis was chosen to ensure in-depth and thorough analysis of the research phenomenon by approaching it from different angles, that of the macro network and focal net.

5.3 Data collection

In-depth and thorough analysis is enabled not only by approaching the research phenomenon from different angles and using different levels of analysis but also by taking advantage of multiple sources of evidence (Patton 1987). In the present study, the most important source of evidence is interviews, but other sources of evidence come into play as well. These include the project meetings and workshops, focal company

[26] The findings from these two levels of analysis are presented in this thesis in two chapters: the macro network level of analysis is addressed in Chapter 6 and the focal net level of analysis in Chapter 7. A synthesis of these two levels of analysis is provided in Chapter 8.

documents, and all the secondary data collected during the background work phase of the research. Figure 30 presents an overview of the empirical material.

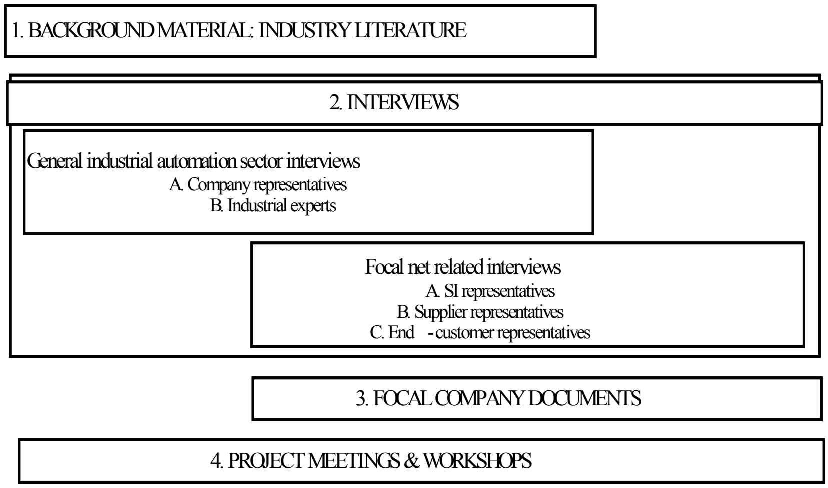

Fig. 30. Illustration of the empirical material gathered and used in the study.

The background material consists of a broad review of industry-related literature that was mainly gathered via the Internet. The goal was to find A) general information about the sector of industry as a whole; B) data about the key business principles, including business networks in particular and C) information about specific companies, products, and technologies; and D) automation software platforms, products, and components. Additionally, the background material includes an earlier study of the ICT cluster carried out in a research project, the results of which have been published by Seppänen *et al.* (2001) and in which I participated as a project researcher. The purpose of the background material was to familiarise the researcher with the industrial setting and to help formulate the themes and questions for the interviews. A list of the sources used as background material is provided in Appendix 1.

Interviews form the bulk of the empirical material for the present study. As Ghauri *et al.* (1995) have stated, a process-based approach and the researcher's own interpretations and closeness to the data can be tied to qualitative methods. Thus, it is typical of qualitative methods that data are gathered through a series of semi-structured interviews, which are usually very discussion-oriented. Such an approach has been utilised in carrying out the interviews for the present study. Thus, instead of structured questions, I have utilised broader themes with which the phenomenon under investigation has been covered from different perspectives. Informants' own opinions and subjective views have been emphasised, with an attempt to keep the interviews as conversational as possible. Lists of the interviews carried out are provided in Appendix 2, and the interview themes/questions are provided in Appendix 4. The interviews in this study consist of macro network interviews that tackle the industrial automation sector as an entity and focal net interviews that tackle one specific part of the macro network. Interviews as the main body of empirical data are discussed later in this section more thoroughly.

Documents that are related to the focal net level of analysis were also used as empirical material. These documents include not only the annual reports of the focal company and its suppliers and customers but also various kinds of commercial and technical material related to the system product created in the focal net.

Besides the background material, interviews, and focal-company-related documents, the data include several *meetings and workshops* related to the Vertigo research project. During the regular project meetings, and especially in the workshops, there were fruitful discussions among the researchers and company representatives involved in the project. Thus, these meetings acted as an important information source for me, as well as a forum where the preliminary model under construction and the preliminary findings from the empirical data were discussed and evaluated. A list of the project meetings and workshops is provided in Appendix 3.

The collection of empirical data was a very time-consuming phase of this study, due to the sheer amount of empirical data, in the form of not only the interviews but also meetings, workshops, etc. In Figure 31, the phases of conducting the interviews that serve as the main empirical data for the study are illustrated in order to better shed light on the temporal aspect of the interviews and how they were carried out.

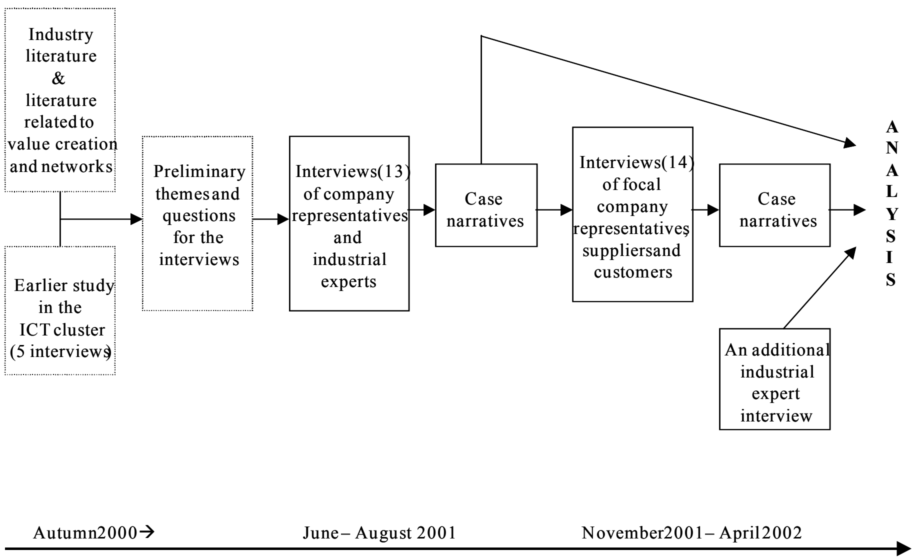

Fig. 31. Phases of conducting the interviews.

An important part of the process of conducting the interviews was the *development of the research themes*. This was done by becoming familiar with the literature addressing value creation but also by reviewing the literature related to the relevant sector of industry. Additionally, the initial understanding of the industrial automation sector as a part of the

ICT cluster was gained through the empirical study that was carried out in autumn 2000 (for more information, see Seppänen *et al.* 2001). Instead of set interview questions, broad themes were used during the interviews. Thus, the interviews were very unstructured in nature. It needs to be pointed out that in forming the interview themes I didn't directly use the preliminary model developed for value-creating networks; i.e., the interview themes didn't directly follow the various elements on which the model is built. However, indirectly the theoretical work that was done before gathering of the empirical data did influence the themes of the interviews, as I wanted to address issues – e.g., suppliers, customers, product development, past experience with suppliers/customers – that would lead the interviewee to talk about relationships, competencies, and value creation / obtaining value.

The themes that were utilised during the interviews varied somewhat between the macro network interviews and the focal net interviews. During the macro network interviews, themes that dealt with the industrial automation sector in general were emphasised instead of the company-specific themes that, by contrast, were emphasised in the focal net interviews. As indicated above, the interview themes I utilised are provided in Appendix 4.

Before conducting the actual interviews, I had to *choose the interviewees*. For the macro network interviews, I aimed to choose interviewees who could give as holistic and multifaceted a view of the industrial automation sector as possible, within practical limits (i.e., time, travel costs, accessibility). Interviewees were chosen representing the three main sub-sectors of the industrial automation sector: process, production, and machine automation. The companies that were selected for interviews varied not only in their roots in different sub-sectors of the industrial automation sector but also in their role as either SI or component supplier, as well as in their size, independence, and internationality. It is noteworthy that in all of the companies participating in the interviews software played an important role in production operations; for example, the companies had their own software development departments. Among the process automation companies, the role of software could even be described as remarkable; on the other hand, among the machine and production automation companies, the role of software was not that central yet. For the machine and production automation companies, software could be described as an area of expertise where rapid growth is expected in the near future.

Some of the companies are multinational corporations that operate in a broad range of automation sub-sectors, but usually their operations in Finland are concentrated in some specific sub-sector, like process automation for the forestry industry. Four of the interviews represented this multinational perspective. The rest were interviews of representatives of more domestically-focused companies, although most of them also operated at a global level despite being 'Finnish' companies. The profiles of the companies interviewed varied also with regard to their independence, as some were R&D or engineering units of a mother company and others were independent firms. Furthermore, five of the companies represented SIs, whereas four were suppliers. The interviewees were selected on the basis of their role in the company – how valuable they could be as informants.

In order to achieve non-company-dependent insights, a few industrial experts were selected. Four of the interviews involved automation R&D experts. Those interviewed possess extensive experience in the industrial automation sector and especially in software R&D. One of the R&D experts' interviews acted as a pilot interview; the interviewee was asked to give his opinion on the contents of the interview and to give any advice he might have for further development of the interview structure.

In summary, the selection of the interviewees for the macro network interviews was primarily based on the main distinction between industry R&D experts and company representatives. Furthermore, the company representatives were chosen so as to cover both SI and supplier companies representing all three main sub-sectors of industrial automation: process, production, and machine automation.

The focal net interviews were carried out from November 2001 to April 2002. During the previously mentioned Vertigo project, I was able to gain access allowing study of a focal net around an SI operating in the industrial automation sector. In order to gain a more holistic view of the focal net surrounding the SI and also to see the different actor perspectives on it, interviews were done not only inside the focal company but also of the SI's main software suppliers and the main system solution customers. The interviewees from these main software suppliers and main system solution customers were suggested by the focal company representatives. From the focal company, the interviewees were selected to represent both salespersons and more technically oriented software development personnel.

The interviews were conducted in the form of face-to-face interviews[27] in order to achieve a discussion atmosphere. Typically, the interviews lasted from one to two hours and were carried out in the office of the interviewee. The macro network interviews were temporally prior to the focal net interviews, and thus the experiences from these interviews aided in the focal net interviews to some extent. As the more holistic view on the industrial automation sector from a macro network perspective had already been gained, it was possible to concentrate more on tackling and understanding the focal net during the interviews involving the focal company and its suppliers and customers instead of devoting so much attention to tackling the industrial automation sector itself. Based on the interview transcripts and field memos, narratives of the interviews were written. From each of the interviews a separate narrative was written. Also, two broader narratives, one concerning the macro network interviews and one the focal net interviews, were written as summaries of the findings of both levels of analysis.

Besides these macro network and focal net interviews, one additional interview – of an additional industrial expert – was carried out. This interview is presented and used later in this study in Chapter 9's evaluation of the generalisability of the results of the industrial automation sector study to the whole ICT cluster.

5.4 Methods of analysis

In the use of qualitative methods, data collection and analysis are often done simultaneously (Ghauri *et al.* 1995), yet two main phases of qualitative research can be

[27] Except for one interview, which was carried out by e-mail.

identified: 'unriddling' and production of observations[28] (Alasuutari 1995). These phases need not occur in a definite temporal order, but still it is important to understand that they should be present in all qualitative research because otherwise the researcher may forget that observations as such are not the results of the study; the observations need to be analysed. Based on the analysis, the researcher becomes ready to present the results of the study.

Unriddling and production of observations provide some guidelines for analysing qualitative data, although it is characteristic of qualitative research that no set procedures for analysing the data exist. This is partly due to the element of subjective interpretation by the researcher and the analysis of the data. However, some guidelines are beneficial for researchers to use in evaluating and proving to others the quality of the study[29]. Eskola & Suoranta discuss different ways to analyse qualitative data, which can be used either singly or in combination. In this study, thematisation and grouping (see Eskola & Suoranta 1998) have been utilised to analyse the data.

Coding in its strict sense has not been utilised, mainly because it can result in excessively fragmented results when the aim is to study a phenomenon as holistic as a network is. Because the analysis of the data has been carried out 'manually', it is even harder to distinguish between the data gathering and analysis phases. In fact, the analysis of the data in this study started during the data-gathering phase, especially during the interviews. I started to build subjective interpretations from the data, although I hadn't yet started the analysis of the data in any strict sense. In the later stages of data analysis, I ended up thematising and grouping the data because they corresponded to the qualitative research methods.

The analysis of the data was done by using keywords and theme building. Separate analysis was conducted for the macro network data and the focal net data. Thus, the analysis process described below was applied first to the macro network data and then separately to the focal net data. The findings from the macro network data guided the analysis of the focal net data, as they helped the researcher to better understand the focal net.

The analysis started after reading of the data. In a second and third reading, I picked up a large number of keywords from the text. It should be pointed out that each of the interview narratives and also each discussion from the project workshops and meetings was first analysed on its own, as a separate text (as contrasted against, e.g., examination of all the interviews in the form of just one textual data entity). The keywords chosen from each of the texts were those that were actually mentioned in the text and were the words that in some way moved the text forwards. Usually these words were mentioned quite a few times, and they seemed to be important ones for the person using them. By picking up the keywords in this way, I tried to allow the empirical material to offer its own view of the research phenomenon. However, I cannot claim that the theoretical review of value-creating networks didn't affect the keywords that were found, as the interview themes I utilised did direct all of the interviews in certain directions.

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[28] Unriddling in qualitative research refers to interpretative explanation through references to other research and theoretical frameworks, whereas production of observations means distillation of observations by concentrating on essentials and by combining the raw observations (Alasuutari 1995).

[29] The evaluation of the present study is provided in Chapter 9.

After the selection of the keywords from each of the separate text entities, the bundling of the keywords was begun, by handling the selected keywords as one entity. Thus, at this point in the analysis the separate text entities were being dealt with as one entity. The keywords were classified under a few themes that were familiar from the preliminary model. In other words, at this point, the preliminary model did have a fundamental influence on the data analysis and acted as the eyeglasses through which the data were analysed. The analysis was based on utilising the central themes of core competence, relationships, and perceived end customer value and situating the selected keywords under each of the themes.

Most of the selected keywords were easy to position under specific themes, as they clearly explained just one of the themes. Thus, the preliminary model turned out to provide rather broad categories for analysis of the data. However, there were also keywords that seemed to be used by the interviewees in connection with several of the themes familiar from the preliminary model; obviously, it was hard to place these directly under one specific category. Based on these keywords that were 'left over' from the themes that directly came from the preliminary model, another category, that of system architecture, was added. Based on these themes/categories, the main findings of the empirical study (macro network level in Chapter 6 and focal net level in Chapter 7) and the outcome from the two supplementing levels of analysis (in Chapter 8) are presented.

6 Getting the big picture: a network-level analysis of the industrial automation sector

In this chapter, the main findings of the first part of the case study – i.e., the general study of the industrial automation sector – are discussed. The level of analysis is the network, as the aim is to provide an overview of the value-creating networks related to the software component business in the industrial automation sector. The discussion of the main findings is in some part supplemented by quotes from the interviews, in order to illustrate the logic behind the interpretations but also in order to bring the reader closer to the interview data. When direct quotations have been used, the quoted interviewee's role as SI, supplier, or R&D expert representative is stated. The quoted interviewees are also indicated by letters from A to M, following the marking logic for the list of the interviews provided in Appendix 2.

Moreover, the main findings are discussed first from the general viewpoint of the industrial automation sector – e.g., by presenting the overall characteristics of the sector. Then, the discussion continues with a rough-level network analysis that sheds some light on the structure of the value-creating networks related to the sector in general.

6.1 Characteristics of the industrial automation sector

The basic features of the industrial automation sector were discussed in most of the interviews in terms of how the sector differs from other industries – for example, consumer-related businesses or the ICT cluster in general. The opinions of the interviewees were quite consistent. The demands for real-time, deterministic data processing and for safety and reliability are much greater in the automation sector than in many other industries. Due to these requirements, some of the specific matters involved in automation systems are regulated by law, and some contexts have special requirements, one example being nuclear power plants. The biggest differences between the automation sector and the Finnish ICT cluster in general were seen in the opportunities for growth and the speed with which new technologies are adopted. The rate of growth is related, on one hand, to the rather limited number of customers and to the rather long life cycle of automated products and processes, on the other. For example, some automation systems are required to provide up to several years of non-continuous operation. This is particularly true in the process automation sub-sector.

SI, interviewee D: "High requirements for usage certainty are typical for the sector. Additionally, the adoption of new technologies is at a more moderate level than in the ICT cluster in general."

R&D expert, interviewee J: "The sector is closely related to more traditional industries; as a consequence, the sector has developed in smaller and more thoroughly thought out steps than, e.g., the telecoms sector has."

The automation industry can also be seen to be at a quite mature level; such products as power plants and forest harvesters have been built for a rather long time with no revolutions in their basic functionality. In addition, the automation industry has been widely considered to adopt new technologies quite slowly. According to those interviewed, the main reasons for this are the above-mentioned requirements for reliability and safety, but the rather conservative nature of the customer industries has had its effects as well; for instance, the steel and pulp industries often apply set investment periods. However, most of the interviewees pointed out that the adoption of new technologies has proceeded rather rapidly in the last two to three years, mostly due to the development of general ICT technologies.

Based on the rate of adoption of new technologies, the persons interviewed also pointed out a difference between domestic and foreign automation firms and customer firms. Finnish companies are usually more ready to make use of automated solutions, and automation solution providers are eager to try something new. In such fields as wood processing and paper manufacturing, Finnish companies are world leaders in technological terms. On the other hand, some of the interviewees claimed that, for example, American companies are more advanced in the use of ready-made components and in producing 'tools'. Almost every person interviewed pointed out that the Finnish markets are small and that this has led automation companies to concentrate on rather specific areas. For this reason, there are no ultra-large global automation corporations in Finland.

R&D expert, interviewee J: "Finnish companies can be automated easily, so this is a good place for automation companies to learn."

SI, interviewee D: "In Finland, there aren't any large actors because the markets are so limited. However, the quality of product development is quite good in Finland, at least in some cases."

At the industry level, one can make a distinction between process automation and discrete parts manufacturing automation, the latter consisting of machine and production automation. This distinction was visible also in the interviewees' comments. In general, it can be said that process automation is more advanced in technological solutions than in the machine or even the production automation part of the industry. For example, product development costs are equally high in both the process and machine automation fields, but machine automation companies usually have fewer potential customers and therefore also less money to spend than those in process automation do. However, based on the empirical data, it can be argued also that the distinction between process automation and discrete parts manufacturing automation is decreasing as a parallel phenomenon to the overall blurring between the industrial automation sector and the other sectors of the Finnish ICT cluster.

Also the question of standards is worthy of note in the industrial automation sector context as representing a rather typical high-tech industry. There are many standards in the industrial automation sector, and it is typical that industrial automation companies appreciate standards and standardisation work. For example, all the larger companies participating in the interviews were taking part in standardisation in the areas they considered most important. Furthermore, it is not an unusual policy that large SIs require that their suppliers comply with certain standards. Additionally, as was pointed out earlier, in some fields of automation, standards are a must and are therefore regulated by government or other official organisations. A general opinion among the interviewees was that standards make business run more smoothly by, for example, allowing integration of products provided by different suppliers. However, it is commonplace for some actors not to want to favour a particular set of standards, as they are afraid of losing their market position.

R&D expert, interviewee K: "There are several standards in the industry, and also should be at least when considering the safety requirements. There can be seen two kinds of standards in the industry: those that take the development further and those related to safety questions."

R&D expert, interviewee L: "There are many kinds of standards in a diversified field. Due to the requirements of cost-effectiveness, common de facto standards are used in less critical areas (e.g., TCP/IP, HTTP), but in the case of more critical areas, the segment's own needs go beyond standardisation, an example being different field buses in different usage areas."

In some cases, large actors push for different standards and development of, and agreement on, one shared standard does not occur. There are some examples of such situations in the industrial automation sector, where large actors have been pulling in different directions and have prevented standardisation in areas where it would have been of great benefit for the development of the entire industrial automation sector. One such case relates to the standardisation of so-called field buses[30]. An unresolved situation as regards field bus standardisation continued for several years, and in the end an unsatisfactory solution in the form of a standard that includes several different sub-standards was achieved. The solution was rather superficial because it resulted in no clear improvements to the interoperability and integration potential of the field buses in practice. Quite a few of the interviewees seemed to believe that an appropriate solution for this problematic situation cannot be found within the industrial automation sector. Instead, a solution could perhaps be found in more general ICT technologies.

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[30] Field buses support the transfer of information required for both distributed control and centralised supervision. Leviäkangas (2000) subdivides field buses further into three types or layers: sensor buses, device buses, and field buses and local area networks (LANs). Different types of buses are used to address different types of control problems.

SI, interviewee C: "When it comes to the situation of field buses, there is a 'not so good' solution, which includes eight different sub-standards. In fact, the only possible solution to the standardisation problem would be some solution that comes from the general ICT cluster."

When it came to issues of IPRs and contracting in general, those interviewed thought that the automation sector does not differ much from other information-intensive industries. However, the interviewees were not enthusiastic about talking about IPRs, especially not in a detailed manner. In some interviews, the informants were ready to talk about licensing, though at a rather general level. A shared opinion was that questions concerning licensing of software components are at present too complex and that simpler solutions are needed. It is usually the case that software component buyers do not obtain the source code, and it is the supplier who remains the owner of the component's IPRs. The opinions of those interviewed varied in whether they as the component buyers would like the source code or not. The arguments for obtaining source code were risk management and the opportunity to make modifications; the arguments against getting the source code were the resultant higher price of the component and the basic idea behind software components as encapsulated and to some extent 'black box' entities.

SI, interviewee E: "If we have done the requirement definitions on our own, then we are also going to have the IPRs and we want to have the source code. In the case of COTS we don't need the IPRs."

Still, what are known as escrow clauses are commonly used in the industrial automation sector in order to ensure the buyer's safe position in the event of sudden problems on the supplier's side. Escrow clauses state that it is agreed that the component buyer gets access to the source code in certain specific situations, such as if the component supplier faces sudden bankruptcy. However, the interviewees mentioned that there have not yet been any situations in which these clauses would have been needed. Therefore, they did not have any experience concerning how these agreements would work in practice.

6.2 The structure of industrial automation value-creating networks

The structure of the industrial automation sector as a network is discussed in the sub-sections that follow. First, in Section 6.2.1, the factors that have a considerable influence on value-creating network structure are identified based on the empirical material. One of the most important influencing factors emerging from the empirical material is the system architecture and its different layers. This factor is further discussed in Section 6.2.2 in terms of its influence on each of the elements of the value-creating network model presented in Chapter 4.

6.2.1 Influencing factors

One of the ultimate purposes of any value network is to create value for the end customer. Thus, the role of the end customer is an essential consideration in studying value networks, as the influence of the end customer on the way the network is structured is usually rather strong. As is typical for rather a lot of industrial markets, the industrial automation sector has a somewhat limited number of potential customers. Because of the limited number of customers, the markets are both mature and of limited size, and therefore one clear way to achieve viable growth is to buy other companies.

In addition, the alignment needs of customers and the use of similar ICT technologies will also drive convergence and networking in the industrial automation sector. As automation systems become larger and more complex, customers have difficulties following all the developments that take place in the area well enough to be competent to integrate their solutions by themselves. They are therefore forced to rely on the suppliers' professional experience and knowledge, and to order integrated, ready-to-use solutions. SIs play a central role in value-creating activities in the industrial automation sector, mainly because they carry out the integration work that requires co-operating suppliers, but also because they still usually own the end-customer interface due to their company brand names.

> *R&D expert, interviewee K:* "*Traditionally, the large automation users had their own units, their own competencies related to automation questions in their own business area (e.g., Fortum Engineering). However, there is a shift toward either making these units into separate companies or in some other way outsourcing these functions. This results in a clearer industry structure but also narrows the input of the customers (the automation users) in automation systems development.*"

The rather small number of customers and the continuously high product development costs also have an impact on the overall structure of the industrial automation sector. High product development costs favour bigger companies, which have more resources than smaller ones do. Thus, it should not come as a great surprise that there are now only five or six really big actors in the industrial automation sector, on the global level. The large companies include Siemens, ABB, and Honeywell. Because there appears to be no end in sight to the rising product development costs, it may be possible for the future to have room for even fewer large actors, as was pointed out earlier. Of course, there already exist, and will continue to exist, many smaller companies in the industry, too, but they are quite small indeed on the global level and usually maintain a narrow focus.

In general, the industrial automation sector does not have any clear boundaries; it is closely related to many other sectors of industry. Moreover, it is difficult to find official statistics specific to the automation industry. Despite this, the interviewees shared surprisingly consistent opinions on the structure of the industrial automation sector. These opinions were also in line with the findings from the secondary data.

The most frequently presented opinion was that the automation industry is at the intersection of many sciences and many other industries, though it nearly always involves hydraulic, electronic, mechanical, and software technologies. For this reason, automation companies have close ties to industries that develop and sell these technologies. The interviewees also shared the view that the ties are going to become even closer in the future as generic ICT technologies take a more and more central position in the automation sector.

R&D expert, interviewee J: "There is a shift from the industry-specific toward the more general, because general IT trends are reaching the automation sector."

SI, interviewee B: "Telecommunications technologies and automation systems are going to be more and more closely linked."

Based on both the primary and the secondary data, Figure 32 illustrates the sectors of industry closely related to automation systems currently. These involve the electronics, automation, and software sectors and the ICT industries at a general level, as well as a rather versatile service sector.

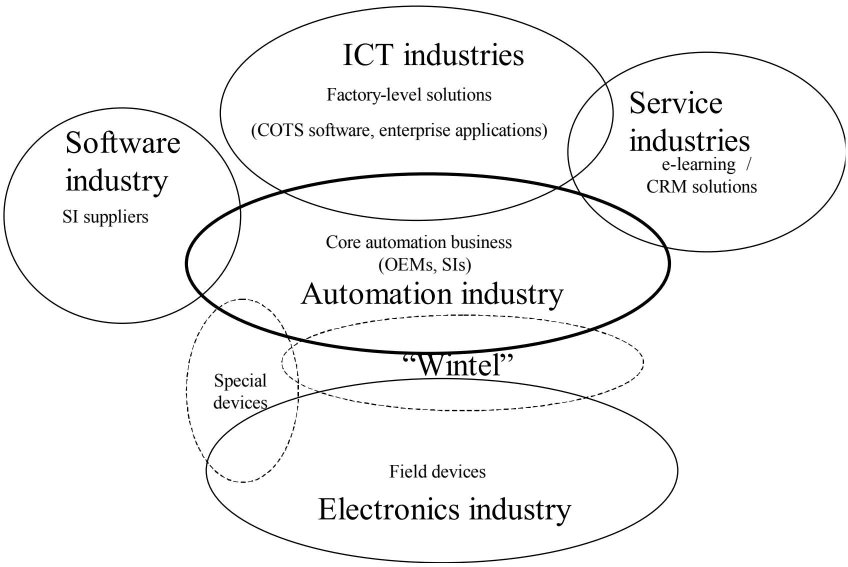

Fig. 32. Relationship of the industrial automation sector to other ICT sectors.

The basic idea in Figure 32 is that the industrial automation sector is very closely tied not only to the electronics sector but also to the software industry, telecommunications sector, and service industry. These ties are partly based on the roles of the electronics, software, and telecommunications sectors as suppliers to the automation sector but also on the possible role of the electronics and telecommunications sectors as customers of the industrial automation sector. As was stated in Chapter 2, an industrial automation company can deliver system solutions to other sectors in the ICT cluster, too, especially the electronics and telecommunications sectors. However, in most cases, the customer industries are more traditional industries like the pulp and paper industry or metal industry. This is the case for the most part in at least the process automation area.

In addition to this blurring of industry boundaries through the customer networks, the industrial automation sector has strong ties to other ICT sectors through the supplier networks. In particular, the tie between the industrial automation sector and the software industry is going to become stronger. The line between the two is already becoming more and more blurred with the increasing role of software in automation system deliveries. This shift was clearly identifiable from the empirical material.

SI, interviewee D: "The trend in the sector has been toward increased significance of software. For example, ten years ago hardware had a 90% share in system deliveries and software 10%, but in a few years, the percentages are going to be the other way round."

In addition, both the electronics and telecommunications sector play major roles in the supplier networks of industrial automation companies as regards comprehensive automation system solutions that include not only robotics but also software controlling the whole system. In fact, it became evident from the empirical data that a typical automation system consists of three layers or structures, namely *field devices* (sensors and actuators), process-controlling devices or the *automation system core*, and control room or *factory-level solutions*[31]. When compared to more general IT architectures, these levels can rather straightforwardly be likened to technological, business logic, and usage layers. These layers are illustrated in Figure 33.

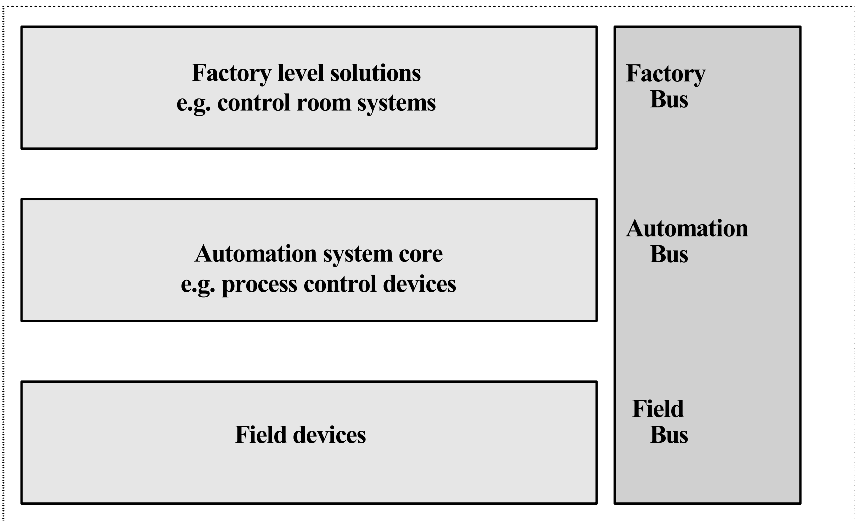

Fig. 33. Three-tier architecture of automation systems.

In Figure 33, also the channels of communication between the different system levels are illustrated: an automation system typically includes field buses; automation buses; and factory-level buses that interconnect field devices, process stations, and factory management stations. With such an architecture for automation systems, the lowest level,

[31] This can also be referred to as the usage layer or the information systems layer.

field devices, is an area in which the role of electronics companies as suppliers has grown remarkably in recent years. The middle layer, process control devices, is the core competence of most industrial automation companies. The uppermost level, control room systems, is an area where the software and telecommunications sectors have a growing role as representatives of the supplier network. This is due to the growing importance of general ICT technologies in automation systems and the fact that generalisation of the technology base began at the uppermost level.

From the viewpoint of value-creating network analysis, the tiered architecture of the automation systems plays a remarkable role. This architecture has a strong influence on the structure of the overall value-creating network at the sector-wide level for several reasons. First, all the SIs in the sector apply the same basic tiered architecture. Furthermore, the SIs have different kinds of supplier networks for each of the different layers of the systems architecture. During the interviews, the SI representatives clearly pointed out that in the case of automation systems one cannot talk about one single kind of component supplier network, because the SIs have very differentially structured supplier networks and supply strategies for each of the architectural layers. Additionally, the component suppliers are aware of their own position in the system architecture of the SIs. Also, the end customer's influence on each of the architectural layers varies. The end customer's influence is greatest at the uppermost level of the architecture, which is the closest and most visible level of the overall automation system for the customer. For example, a Microsoft product can be required as the operating system, and, naturally, such a requirement has an influence on the solutions that are utilised in lower layers of the system architecture, too.

SI, interviewee A: "Usually, the components aren't visible to the customer, and in most cases the customers don't need them to be. However, when it comes to certain issues that are close to the customer, customers can be quite demanding. Examples include demands concerning databases or Microsoft issues."

SI, interviewee C: "Due to customer requirements concerning Microsoft operating systems, our software solutions are built upon Windows."

Supplier, interviewee F: "Our suppliers are not visible to the customer, although sometimes customers technically make contracts directly with our suppliers, too, if a fairly big part of our solution comes from a single supplier."

In the sections that follow, the different architectural layers are briefly talked about from a more technical perspective. Then, in Section 6.2.2, the discussion is moved toward a more detailed value-creating network point of view. The brief technically oriented discussion is provided in order to provide a better understanding of how the layers are tied to each other and what main competencies are needed at each of the layers.

Field devices. Generally speaking, modern field devices are 'smart'; i.e., they include computerised elements that can be used in processing measurement and controlling signals either as part of sensors and actuators or 'closer' to them than in process stations. The intelligence of field devices has been increasing, but not necessarily in terms of autonomous intelligent operation. Many field devices are embedded real-time systems that realise special controlling or measurement algorithms used to acquire and make use of lowest-level system data. A typical sensor includes a measurement part and a signalling part that prepares the measurement data for sending to a process station. A typical actuator includes, correspondingly, a part that can actually effect the process – such as a valve – and another part that activates the effecting part. (Leviäkangas 2000)

Referring to the above, one could say that many field devices are classical embedded systems. Because of the emergence of smart sensors and actuators based on large-scale integration, automation firms may entirely trust special suppliers, or at least outsource the technical design and manufacturing of sensors and actuators. On the other hand, an automation company may have core competence also at the level of field devices, such as in the measurement of some special process parameter. There are examples of daughter companies – electronics firms – of larger automation companies that have been made responsible for such special competence.

The question of buying or building field devices is, from the viewpoint of an automation company, usually related to the volume and price – i.e., the complexity – of the sensors and actuators the system requires. On one hand, it would pay to focus on the process station and factory levels, where 'bigger' systems and opportunities exist and where perhaps less time-critical, integrated, and technically complicated solutions need to be developed. On the other hand, if, for example, sensors do not produce good enough data, it is difficult or impossible to provide a winning control solutions for customers.

Automation system control. One of the basic features of modern automation systems (cf. Leviäkangas 2000) is that implementation technologies do not dictate the basic functionality of the control or the core automation system. Unlike the technological basis of the implementation, the controlling level is most often viewed in terms of its distribution or centralisation. In other words, controlling functions differ with respect to their distribution.

However, the Wintel platform and field buses have largely led to standardisation of the interfaces between field devices and the core control system. As regards the latter, this has affected input/output (I/O) schemes. While I/O devices have become smarter in the sense that they can pre-process the data received from the field (such as for fault diagnosis), their basic functionality involves receiving and sending signals to and from field devices. One of the emerging trends in I/O devices is for controlling functions, such as motor control, to be integrated into the devices. In other words, elementary parts of control algorithms move closer to the controlled devices. Moreover, virtual devices and other such concepts will change the traditional I/O view in that there may no longer be physical devices behind I/O but electronic or even merely software-based 'devices' instead. However, no standard solutions exist yet that can solve the application integration problem in the sense of freeing automation designers to focus on their domain expertise – be it, for example, control of continuous processes or moving machines – rather than on designing the underlying control system architecture and individual technical solutions.

Information systems. It is obvious that the focus on specific electronic technologies, timing requirements, etc. decreases in moving from the field device level to the core control system and further 'up' to the layer of information systems. Most modern factory or control-room-level systems are rather generic IT systems. In other words, one could claim that the levels of the three-tier system architecture are dictated by the electronics (field), automation (distributed control), and information technology (centralised management, usage support) industries. The convergence of information technology and communication technologies and industries is clearly visible at the upper levels. It means that, e.g., general-purpose control room systems are emerging at the expense of manufacturer-specific systems – i.e., control room systems that used to be offered as part of industrial control systems.

The continuing evolution of generic IT solutions in the industrial automation sector results from increasing digitalisation and amounts of information to be processed, and it may ultimately affect all system levels. For example, an actuator could be visible directly in the control room via a browser, through an embedded Internet link. Such solutions gain additional support from the fact that the industry has become heavily dependent on information processing power at the lower systems levels, too. Open PC hardware and software technologies have provided the power. However, integration of complex systems has become harder because of the fluctuation of the traditionally hierarchically organised functionality between all levels of automation systems.

6.2.2 Architectural layers and the network structure

Based on the empirical findings, one can conclude that the industrial automation sector is clearly structured around three system layers, the uppermost being the factory-level information system layer, the middle one the control system core, and the lowermost layer that of field devices. Some of the larger companies – i.e., the SIs – offer comprehensive solutions covering all of these layers to their customers, but many smaller companies – i.e., the suppliers – operate at only one of these layers. The uppermost level is already very close to generic IT solutions, whereas the lowermost, real-time and reliability-critical, layer can be considered as related to the part of the electronic industry that deals with instruments and devices. Due to differences in the three layers, value-creating networks are often formed around these layers. As is a key from the commercial software component angle, the role and use of these networks differ greatly at different layers.

Core competence perspective. Core competencies were brought up by the interviewees as part of the discussion of co-operation and competition occurring between the actors in the industrial automation sector. According to the empirical data, development from 'vertical' relationships toward 'horizontal' relationships has occurred at the uppermost level of the three-tier automation systems architecture in particular, in which generic information and communication technologies have been quite heavily used for some time now. In comparing vertical and horizontal relationships, it must be stressed that vertical relationships are often built on mutual interest in interacting, whereas horizontal relationships often involve competitors being forced to interact with each other, giving rise to rivalry between them and mutual dependence. It is common for horizontal relationships to simultaneously involve both co-operation and competition. This has been called 'co-opetition'[32].

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[32] 'Co-opetition' as a term describing simultaneous co-operation and competition is utilised by, e.g., Bengtsson & Kock (2000).

Co-opetition among industrial automation companies was most visible in the arena of standardisation. In order to arrive at the best possible standard option for their own business, the companies were ready to co-operate with their competitors. In these cases, however, co-operation usually occurs only as long as the standardisation work lasts; when the standard has been agreed upon, co-operation will end. However, standardisation is not complete and has not always been successful in the industrial automation sector; e.g., the current field bus 'standard' actually includes eight manufacturer-specific sub-standards. The reasons behind this are that there are many strong actors in the industrial automation sector wanting to slow down the creation of single standards and that the customers lack the power to dictate how things should be done. It can be assumed that it would be beneficial to customers if standardised solutions were used.

SI, interviewee E: "A very interesting situation we have with company X: we have a supply relationship with them in one field, but in another business field they (through one of their subsidiaries) are a major competitor for us."

In relationships consisting of simultaneous co-operation and competition, the closeness of activities to the end customers seems to matter a great deal; the firms tend to co-operate more frequently in activities carried out at a greater distance from the end-customer interface. In other words, companies are usually more ready to co-operate with potential competitors in the upstream activities of the value chain and less ready to work together on the downstream activities, which include management of the customer interfaces. The influence of the end customer can be identified in this.

This is visible also in the industrial automation sector. Competing companies have, for example, participated in the same research project in order to access new technological innovations. Thus, enabling technologies – even if not fully commercialised yet and still under investigation – are more 'open' than the customer interfaces. Many of the experts interviewed indeed said that the core competence of an automation company is to know what customers want and to manage these relationships successfully. The experts were ready to buy software and other components also from their competitors, or at least from suppliers selling the same solutions to competing companies as well. It was argued that what is crucial is not the components themselves but what the company builds based on them. However, this mostly involves the upper and lower layer of the three-tier architecture. The middle layer of the architecture, that of the core competence of most of the industrial automation SIs, was usually kept more closely guarded from suppliers than the other two layers.

Core competencies were thus seen as something tied to the different layers of the system architecture. Similarly to how the SIs wanted to protect and keep secret their core competence area, also the suppliers pursued this end by providing their offering in as black-box a form as possible, providing a delivery in which only the interfaces are visible to the customer. This desire supports the increase of componentisation.

R&D expert, interviewee M: "Suppliers try to package their core competence into a box, of which only the interfaces are visible to the customer."

The SIs were ready to buy black-box deliveries, but in certain cases the need to obtain the source code, too, was evident. The need for the source code was raised particularly when the component either was a critical one in terms of the capability of the system solution to operate as intended or closely approached the SI's area of core competence.

R&D expert, interviewee J: "Companies want to buy whatever they can get as 'ready-to-assemble' solutions."

Supplier, interviewee I: "However, in the future, we are going to acquire software both with and without source code, depending on the situation. The source code is needed if the software in question is near our own area of competence, although the software costs more if the source code is acquired, too."

The competence angle was visible also in discussion of the relationship between the SI and end customers. Interviewees pointed out that automation systems are so complex nowadays that the end customers are in a way forced to rely on their SI's competence and professionalism. The customers simply cannot maintain automation-system-related competence at such a high level that they can independently choose the solutions to their problems. However, it was also argued that end customers trust in the competence of Finnish SIs and are in fact ready to place decision-making responsibilities in the hands of the SIs.

R&D expert, interviewee J: "Device and automation providers usually present top-quality high-technology competencies in their specific area of expertise. Therefore, customers trust in the suppliers' competence and buy bigger entities, and thus let the providers choose what kinds of devices etc. they are going to use. The situation was different five years ago: customers were the ones dictating what kinds of devices were to be used."

Relationship perspective. When it comes to the nature of the relationship between the SI and the end customer, relying on the SIs' competencies supports the development of closer, partnership-type relationships between the SI and the end customers. As end customers trust the SIs rather a lot when it comes to creating value for them in the form of better-functioning product lines and so on, close relationships are needed. Close relationships will ensure that enough important information related to the end customer's problems in production is shared between the parties in the relationship. Additionally, close relationships are preferred due to the maintenance agreements and guarantees that are common in the process, production, and heavy machine automation segments of the sector.

Thus, the relationships between the end customers and SIs in the industrial automation sector can be also evaluated by examining the closeness of the relationships and the dominance/balance of the parties, referring to the findings described in Chapter 4. For example, from the SI standpoint, the data gathered indicate that SIs usually have quite close relationships with their end customers. This is mostly due to three things. Firstly, as already pointed out, today's automation systems are so complex that the end customers are in a way forced to rely on their supplier's competence and professionalism. There is no way for the customers to maintain the necessary level of competence in this area.

The second issue is the major role of services in customer relationships; SIs are offering quite a broad range of services to their customers, and these services tie the customers to specific SIs not only during purchasing but also as part of the customers' other value creation processes. Thirdly, automation systems are as product investments so expensive and accompanied by such big risks that the customers often want to buy full system from an integrator with whom they have had a successful, long-term, and trustworthy relationship. The costs of switching SI might be quite high due to the system and service infrastructures already built and brought in use. However, close end-customer relationships in the industrial automation sector are caused also by the limited number of big customers and the long history of this sector of industry.

SI, interviewee A: "The number of potential customers is very limited. To our customers we offer ready-to-use projects; the customer's role is only to check that everything works smoothly."

On a related note, the role of service in the automation business is quite interesting. In some of the interviews, the significant role that system maintenance and end-customer support services play in the companies' overall business portfolio was pointed out specifically. Of course, there are pure service companies in the industrial automation sector, too, but there aren't so many pure product companies left nowadays. This is due to two needs: balancing of revenues and closeness of customer relationships. The automation business is very much concerned with project sales. The projects are usually quite large and from the customer's point of view risky and expensive.

As a consequence, project sales over any given period are usually not high, or at least sales don't usually occur at regular intervals. Thus, automation companies have in a way been forced to devise some kind of business that can smooth out the revenue flow and fill the gaps between projects. For addressing this problem, the service business is a smart move. Some of those interviewed said that they realised about five to ten years ago that customers need maintenance, repairs, and rebuilds after installation of the new automation system is complete and utilisation has begun. They had noticed that several smaller companies were near their customer, offering such after-sales services and doing well. At that point, the companies started to ask 'Why couldn't we do that kind of business, too?'

SI, interviewee B: "At the beginning of the 90s, we noticed that the systems delivered to our customers needed maintenance and upkeep, which many small companies, located near the customer, were taking care of. That notion was the beginning of our customer service units."

The idea of offering product-related services may seem self-evident, but from the product sales standpoint it is not obvious. Consider the changing relative importance of sales of new lifts vs. maintaining existing lifts for Kone Elevators and Escalators. For Kone, the 1970s and '80s were heavily focused on new product development; only by the '90s had the strategic importance of maintenance become obvious.

Another benefit of involvement in the service business alongside the traditional product business is the opportunity to gain a much better knowledge of the customer's business than can be achieved only by selling products. Although it must be noted that project sales also demand quite close co-operation with customers, the latter is still a more transaction-based business than the service business is. The service business does not offer merely a chance to co-operate closely in the purchasing phase; it also offers a chance to continue collaboration after the actual purchase of the automation system. In other words, services are a way for the automation supplier to participate in supporting the whole life cycle of the product sold, and especially the product use process – in which the most value for the customer is created. Thus, the service business provides a way to better understand what kind of value the end customer regards as superior.

As close relationships were taking root between the SI and end customers, close relationships were visible also between the SI and its suppliers. One important reason for this is, again, the complexity of the automation system solutions. The more complex the system produced is, the greater the risks of bugs and functionality problems. Moreover, it is hard to track what part of the system solution is causing the problem, and whose responsibility it is to fix the problem. In cases of software components, the problem may not be with a single component; it could instead be related to unsuccessful integration work. For solving these kinds of problems, the importance of close relationships with suppliers is emphasised, according to the interviewees.

SI, interviewee D: "Partnerships are preferred in Finland, due to the growing complexity of automation systems. When a system is very complex, it is hard to trace where the bug actually is if the system doesn't work as it should. In such situations, close relationships are helpful."

Thus, the increasing use of sub-parts and components in the automation industry does not cause any remarkable change to close supplier and contractor relationships, according to the persons interviewed. Although they all pointed out that using components offers a possibility for more competition between the various possible suppliers and that in the case of highly standardised components it would be quite easy to switch between suppliers, this is not going to be the case for all supplier relationships.

R&D expert, interviewee M: "Close customer/supplier relationships are going to stay."

Even if there were many alternative component suppliers, rather a large number of those interviewed did not see a strong shift occurring from close supplier relationships toward competitive arm's-length relationships. They saw that this would be counter to their chosen strategy of close suppliership relationships and that the trust built over the years with suppliers is more important than the momentary savings that could be achieved.

SI, interviewee E: "Even standards and the like are becoming more important; the significance of partnerships is going to remain, due to the strong need for integration."

The SIs' supplier relationships, not just their customer relationships, can be evaluated by using the relationship closeness and balance dimensions, discussed more thoroughly in Chapter 4. There are different kinds of supplier relationships, depending not only on the closeness of the relationship but also on the dominance/balance question. For example, an SI could have supplier relationships in which the SI itself is dominant but also relationships in which the supplier has a dominant role – e.g., when a Finnish SI is purchasing components from a rather large, global supplier. Relationships that are quite balanced are usually also quite close. These typically involve the first-tier suppliers of the SIs. However, it became apparent in the interviews that the SIs are going to have slightly more close, key supplier relationships than more transaction-based, arm's-length supplier relationships.

Although the relationships between the suppliers and SIs are for the most part rather close, the importance of legal bonds, particularly those related to what are termed 'IPRs' in the software component business, was still visible in the empirical material. Usually, the great weight of legal bonds is taken to refer more to transactional relationships than to partnerships, but these ownership and contractual issues seem to be important also in software partnerships, as software production can be considered part of the copyright industry, where the digital information that is being developed involves high sunk costs but almost no re-production and delivery costs. For this reason, the owner of the IPRs can bear the initial development costs and later enjoy extraordinary profits. This can lead to a new and problematic division of profits in the relationship between the SI and the supplier.

In addition to the issue of division of profits, the question of division of the responsibilities and risks is an important IPR-related obstacle to the software component business's development. If an SI integrates into its system product a software component produced by a relatively small supplier, is the supplier able to solve possible problems occurring because of a bug in the component or in the integration of the component with other components of the system product? Who should bear such risks: the supplier or the SI?

> *Supplier, interviewee G: "There is a lot that could be reused; however, we are tied to legal contracts with our project customers that say what parts we may and may not reuse."*

These kinds of questions can be labelled juridical or technical matters, but in the end they are indeed very much relationship questions. The way these questions are answered and the problems overcome is dependent on the overall nature of the relationship between the SI and its component supplier.

However, contemplation of the secondary data revealed that the more technically oriented question of component evaluation has received far more research interest than more relationship-oriented questions have. On the other hand, the interview data indicated that the evaluation of 'small' components was not seen as much of a problem compared to the problem of finding partners to provide 'big' components, sub-products, and platforms for long-term use. This viewpoint goes against many of the papers on software component evaluation, which often emphasise the needs of an occasional buyer to select a piece of software in an open marketplace, without close relationships with the potential suppliers. Thus, it can be argued that there is a need for discussion of the possible relationship types and their pros and cons within the software component business.

> *SI, interviewee C: "Component evaluation is not the problem. The problem involves information on suitable component suppliers with whom to co-operate."*

As already stated, the empirical findings indicate that the relationship between the component supplier and the SI can be close in a fairly large number of cases, due to needs for component customisation, the challenging nature of the integration phase, and the shared product development process. This is particularly true for suppliers that produce critical components or operate near the area of the SI's core competence. The closeness of the relationship can bring many advantages, including, for example, new product innovations and reduction of redundant functions. However, the close relationship also requires a lot from the parties involved. Building a successful relationship requires many investments in the relationship; various kinds of adaptations; and, most of all, commitment. Such commitment can be a risk for both parties because committing to a certain supplier or customer can result in elimination of other potential partnerships.

In more general terms, close partnerships require open and effective information sharing based on personal and electronic sharing of information. The relationship involves a high level of trust; commitment over time; long-term contracts; joint conflict resolution; and the sharing of information, risks, and rewards. Such collaboration affords many of the benefits of vertical integration without the attendant loss of strategic flexibility. However, open sharing of information was not always seen as an option, due to the fear of losing too much of one's competencies and knowledge to the other party.

Supplier, interviewee H: "In a partnership, there is the fear that we have to give away too much information about our core expertise."

SI, interviewee E: "A long shared history and strong trust are needed for successful co-operation."

The question of information exchange seems to play the critical role in software component markets and buyer/seller relationships. This is due to the special nature of components; the demanding requirements for documentation, testing, and quality; etc.

In fact, information sharing was seen as the most difficult aspect of building more co-operative relationships, especially from the viewpoint of the SIs. It was pointed out that open information sharing is needed in co-operation yet involves many risks. Co-operation is visible also in the strength of operational linkages between an SI and its supplier. Operational linkages can be strengthened through, e.g., shared product development activities or shared supply chain activities.

The closeness and co-operative spirit of the relationship may be harmed if one party is more dominant than the other. Based on the empirical data, it is more common for the SI to be in a dominant position, with the supplier doing more of the adaptation. This is especially true if the supplier and the SI are both domestic actors. However, there were also data concerning the reverse situation, in which the SI is a smaller actor and has to buy components from a larger, usually global-level supplier.

SI, interviewee A: "We are such a small buyer from their perspective that there are no possibilities for getting them to provide modifications."

Supplier, interviewee H: "With the big customers, we are closer and we negotiate and so on. However, the smaller customers just buy the product and act rather independently after that."

The closeness of the relationship was seen as very important, especially from the viewpoint of the suppliers, because, in their opinion, a close relationship is needed to ensure personal relationships with the people who make the buying decisions for the SI. One popular way to get in touch with the customers was the service – i.e., project –

business. The suppliers who were interviewed pointed out that regardless of their willingness to move toward the component and product business they still want to maintain involvement in the service business, as this is a good way to retain a close relationship with the customer and to better understand the customer's business. This understanding of the customer's business was also seen as providing a basis for new product ideas and innovative solutions for customers.

> *Supplier, interviewee H: "We don't want to be a pure product house. We want to offer services to our customers, because this enables us to get new product ideas, too."*

> *Supplier, interviewee G: "We will always retain our service operations, too, because they make it possible to get to know and to influence the right persons inside the customer company. In pure product sales, the problem is in finding the people who really make the buying decisions in a big company."*

However, when the SI is ordered to supply a large and complex system, it is obvious that it generally cannot do so by itself but needs a versatile network of complementary suppliers – not necessarily only component suppliers. Subcontractors and other types of suppliers can be involved. However, the SI must keep rather tight control of the other actors in the network. It is therefore easy to understand that, from the SI's point of view, suppliers are divided into separate groups for each architectural layer. This is not only for manageability of supplier portfolios but also to reduce fallout should something go wrong.

> *SI, interviewee C: "In practice, we have tried to minimise the risk of using an inappropriate component supplier by minimising the dependencies of the specific component on our software, by architectural design."*

Overall, the role of system architecture was very visible when interviewees were talking about core competencies and their supplier networks. As architectural layers were utilised in illustrating which layer is the core competence area of the SI and thus the most protected and critical one, the nature of the supplier relationships was related to that problematisation. At the most critical layer, the use of external suppliers was more limited, but if suppliers and external components were utilised, these relationships were rather close due to the strong need for trust.

Value creation perspective. One important consideration in analysing the software component business as it is emerging in the industrial automation sector is the kind of value that commercial software components bring for the SIs, suppliers, and any possible intermediaries. From the standpoint of the architectural layers, the SI as the customer has different kinds of needs for components for each of the architectural layers, and thus the value of the components is partly related to their position in the architecture. For example, when a component is positioned near the core competence of the SI itself, demands for the software component and for the relationship with the supplier as a whole are greater than they are with components that are not in such a critical position. On the other hand, usually the SI also has greater willingness to pay more for such critical components. This critical role of the component can be labelled the *importance* of the component in the total system solution. It can further be argued that the more important a part of the whole product the component is, the more important the supplier, too, is for the SI. The importance of a particular component can increase the dominance of the supplier over the SI. The *size* of the component is another criterion for categorising components, but usually this is quite closely connected to the importance of the component.

Besides these two criteria, the price of the software component has an impact on the parties in the relationship. If the price of the component is 'low', the SI should buy it in such large volumes that it is profitable for the supplier to tailor it for the buyer. If there is no need for customisation of the component and the supplier can sell the same component to many other customers as well, the question of buying volume is not that important. However, the basic question is whether there is any point in even considering the customisation of cheap components. It is possible for customisation expenses to be greater than profit per component. This customisation question can be labelled that of the *adaptability* of the component. Additionally, the question of *generality* is an important criterion for software component evaluation. The more tied the component is to a specific domain, the less generality there is. The more general the component is, the more potential customers can be found in various industries for the component and its supplier. Thus, the generality of the component can also affect the pricing of the component.

As regards pricing and value of components in more general terms, measuring value in monetary terms is not easy; interviewees pointed out that pricing of the components and performing lifetime cost analysis for components are both very problematic. Pricing is usually difficult because of the nature of the software as a digital product: the initial development and production of software is expensive, but reproducing the software is cheap. This means that a component supplier has to bear large development costs for producing a component for the first time, and if the SI does not purchase the component in large volumes, the supplier has a hard time recouping the development costs. In such a case, the supplier may feel that the small purchase volumes of that particular SI prove that the relationship is not worth the additional effort in strictly monetary terms.

> *Supplier, interviewee G: "The problem in software pricing is caused by unclear specifications at the beginning of the project. Thus, it is hard to predict how much time is going to be needed for the software process. In the case of software component development, these questions still remain, from the viewpoint of the supplier."*

> *SI, interviewee A: "A component should not cost a lot, for the larger entities won't cost much either. That does not, however, offer a wide range of possibilities for SI suppliers. A small component supplier should offer generic solutions to different buyers in order to achieve greater sales volume, but that is problematic as well. From buyers' point of view, small components are easy and cheap to produce in-house, too."*

However, such a conflict could be solved by analysing also the other kinds of benefits that the relationship can create for the supplier and not just the monetary ones. As pointed out previously in addressing perceived end customer value, besides helping achieve profits, the relationship can create volume, security, innovation, market, information-gathering, and access benefits. The relationship with the SI may create innovation value for the supplier through, for example, learning from the customer's requirements or through after-sales co-operation that is needed due to long guarantee times. Additionally, the relationship can provide reference value for the seller in dealings with other potential customers and through offering a means of access to new customers. An intermediary in particular could create value from this, making these benefits explicit and helping the parties to achieve synergy through their value creation processes.

R&D expert, interviewee K: "The utilisation of actual component brokers is quite low; however, consultants can act as agents when they tell their customers about potential sources of good components."

In addition to analysing both the monetary and non-monetary value benefits, it is also important to understand the value created – from the SI's perspective and that of the supplier. When the parties recognise each other's value creation logic, by identifying different sub-processes in the overall value creation process, the possible problems and misunderstandings in the relationship could be easier to overcome. In applying the discussion of the sub-processes thus identified in value creation as provided by Hirvonen & Helander (2001) in the context of the software component business, the following argumentation can be provided. In the context of the software component business, it is not unusual for suppliers to try to understand only the software component *acquisition process* of the SI, although the SI itself is more concerned with the component's actual *reuse process.* This is to say that suppliers are investing in providing certain kinds of trial licences related to the acquisition process, whereas the actual value for the customer related to the purchased component is in fact created as the component is put into use as part of the system engineering process for the final product.

Additionally, there are also other important value-creating processes from the SI's perspective, such as the *process of identifying* the actual component need, in which the key features for the component are determined. Especially in this sub-process, the role of an intermediary might be very useful for providing information about potential component sellers and buyers, as was brought up by the interviewees. Also, the *maintenance process*, which includes, e.g., guarantees and upgrading, entails significant value creation for the customer. Based on the empirical findings, these processes of the SI are, however, not usually well understood by the supplier – because the components provide only partial solutions and the supplier may not be familiar with the customer's entire product architecture, let alone with the overall value of the system solution. Of course, the opposite situation is similar; usually, the SIs require too much of the component suppliers yet do not offer enough value in return. The SI's desire for modifications and concurrent demands for low prices do not leave room for monetary value gains from the supplier's viewpoint.

6.3 Summary of key findings

This chapter has focused on discussion of the typical characteristics and structures of value-creating networks in the software component business as seen in the industrial automation sector.

It was stated that the industrial automation sector stands at the intersection of several other industries and that it is therefore not easy to demarcate clear industrial borders around the industrial automation sector. According to the empirical findings, the industrial automation sector is characterised by high demands for security and quality. Partly because of these demands, the sector has been rather slow in adopting new technologies when compared to the telecommunications sector, for example. However, recently the rate of adoption of new technologies that are utilised in other segments of the ICT cluster has been growing. Also, when it comes to utilisation of the software component business's products and services, the sector is far more advanced than other sectors in the ICT cluster.

The main empirical finding that provides a guide for further study of the value-creating network at a focal net level is that the software component business as seen in the industrial automation sector revolves around layered system architectures. System solutions can be seen as consisting of three adjacent levels or domains: applications, system cores, and device-level products. These levels are becoming more open, and commercial software component solutions are being used more and more, especially at the uppermost level. However, also computing platforms at the two lower levels are becoming standardised. For management of the architectural entity, the different architectural layers should be connected with each other via standard interfaces. This is in principle possible through standards or *de facto* standards but in practice may proceed slowly due to the fact that individual companies seek to ensure and defend their market positions. Overall, the empirical findings indicated strongly that different architectural layers exist and that commercial software components are used in different ways – if at all – at the different layers. That is why value-creating networks are being formed at these layers.

Only the biggest industrial automation companies, the SIs, cover entire solutions, from applications to the core control system and field devices – i.e., all architectural layers. The smaller companies act as suppliers for some of the architectural layers proceeding from their area of core competence. The position of a supplier within the value-creating network and the nature of the relationship with the SI stem from the competencies that the supplier can offer. An especially important question is that of which layer of the system architecture the competence can complement in relation to the core competence of the SI, and also in relation to the competencies of other suppliers.

Although the influence of the architectural layers on the supplier interface is very visible, it affects the customer interface as well. Value created for the end customer always comes from the whole system solution entity; thus, the different architectural layers are not so visible to the end customer, or at least the end customer is not interested in seeing the system solution through the different architectural layers. However, the influence of the end customers' possible demands is usually greatest at the uppermost layer of the system architecture, that of information systems. This is due to the fact that the uppermost layer is the most visible, not only to the user of the system solution but also to the managers of the customer company, while the information system layer is the one that produces information needed in management – e.g., production information.

A focal net is not easy to understand without understanding its broader context, the network. That is why the findings of this network-level analysis, especially the main empirical finding concerning the role of the system architecture in the value-creating networks, provide good bases for the second part of the case study, the focal net study that is presented in the next chapter.

7 Deepening the understanding: the focal net study

In this chapter, the second part of the case study that encompasses value-creating networks from a focal net perspective is presented. The level of analysis applied is that of the net, while the value-creating network phenomenon is studied from a single-actor perspective and the scope of the network analysis is limited to the system integrator itself and its main customers and main software suppliers. The focal net perspective is applied in order to afford a more detailed analysis enabling more specifications for the empirically grounded model of value-creating networks that is under development.

The chapter starts with a brief description of the focal company. In order to maintain the anonymity of the focal company, the description is written at a rather general level and leaving out exact numerical data, such as when the company was established and how many employees it has. The chapter then proceeds to the analysis of the case data, structured in terms of the elements of the preliminary model for understanding value-creating networks.

7.1 The focal company

The focal company can be labelled a high-tech company that operates in the electronics-manufacturing-equipment industry. The company operates in business-to-business markets, providing its organisational customers with a wide range of devices and larger automated production systems based on integration of computing into electromechanical components and products; i.e., the company under study is a typical example of an SI operating in a software-intensive industry. Overall, the focal company is a fruitful example of an SI operating in the ICT cluster, as it can be seen to represent not only the electronics-manufacturing sector but also the industrial automation sector. Moreover, through its main customer base, the company is closely linked to the telecommunications sector, too.

As stated above, the focal company has concentrated on serving customers operating in the telecommunications sector, both large original equipment manufacturers (OEMs) like Ericsson and Nokia and their contract manufacturers (EMSs), like Flextronics and Elcoteq. However, in the past two years, the company has started to search for new customer industries and sectors as well, mostly due to the difficult market situation that has continued in the telecommunications sector.

Additionally, the focal company has not always been an SI providing total system solutions. Rather, it started as a pure device supplier, but in recent years it has started to move toward providing entire system solutions, automated production lines. This shift has led the company toward the role of a system integrator that utilises the newest hardware solutions as well as leading-edge software technology. The shift from device supplier toward system provider has not, however, been easy, as the employees of the company, and especially the salesmen, have not always understood the different business logic that is required in order to be a genuine system provider instead of a device supplier. This lack of knowledge and new situation has been causing several problems not only in the company's customer relationships but also in supplier relationships and within the focal company itself. Moreover, the transformation has been complicated by the decreasing number of employees caused by economic hard times.

The focal company still provides single devices to its customers, but the role of system deliveries is nevertheless growing. What can be called a system delivery is, according to the interviewees, a delivery of a production line that includes not only robotics and all the necessary hardware but also software that manages the entire production line. In this study, the focus is on the software solution that has been developed by the focal company and is provided as an essential part of the total system delivery. Thus, sales of single devices are left out of the scope of this case study.

The focal company started to develop the software solution in order to respond to the growing needs of its customers to shorten the ramp-up time[33] of their production and speed up production, leading to the increasing importance of order-to-delivery process management. The software system the company developed enables flexible production processes by making it possible to create and modify production orders, and it allows simultaneous control of production orders without stopping production. This brings flexibility to the customer's production, by providing the chance to use a single production line for both mass and custom production. Thus, no separate production lines for different product variations are necessary and the customer is able to achieve savings in line investments and in floor space, and to have shorter production times.

The system solution includes embedded software that is called cell software, including software that is embedded as an essential and inseparable part of the robotics of the production line and also a more independent, higher-level software solution that is henceforth referred to as PSS[34], standing for 'production system software,'. Overall, the software solution is moving more and more toward being an independent software product, which is built by integrating software components with each other. Thus, the focal company and the software solution as a more or less independent software product offer a purposeful context for testing the framework developed.

The focal company designs all the software that is needed in the system solution, but most of the actual software development and implementation work has been acquired from three Finnish software suppliers. These suppliers have been operating mainly as

[33] Ramp-up time refers to the time it takes to build and bring into use a production line for a new product.

[34] This abbreviation is developed only for purposes of this study and comes from the term '*production system software'*. Thus, 'PSS' is not the real name of the focal company's software solution.

subcontractors, by charging the focal company at an hourly rate, although recently there has been a strong shift toward acquiring the needed software from the suppliers more as components than on a resource-based subcontracting basis. Besides these three main suppliers of software, the focal company has a few other software suppliers and a greater number of suppliers of hardware. These hardware suppliers are not dealt with in more detail in this study because the focus is on studying software and business built around it. Figure 34 illustrates the area of research in this focal net study.

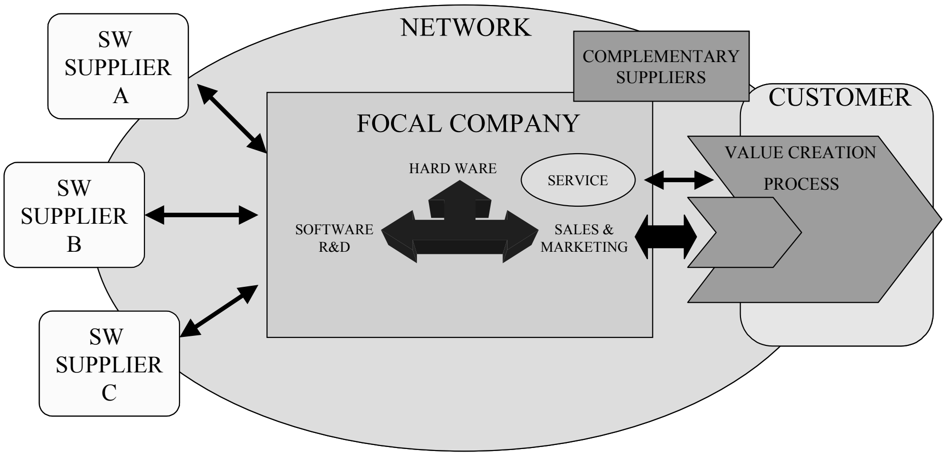

Fig. 34. Illustration of the research area of the focal net study.

In the middle of the figure is the focal company itself. For purposes of this study, software R&D has been identified as one of the main functions of the focal company to be studied. However, because the company is providing total system solutions to its customers, also the role of hardware needs to be taken into account at a general level. Additionally, sales and marketing are important functions to consider in deeper analysis. Customers are shown at the right side of the figure. All the customers of the focal company are industrial customers that buy products and system solutions from said company in order to facilitate their own production; i.e., they do not buy products/solutions from the company studied for further sale as part of their own product. In the figure, the value creation process of the customer, and the buying process (that is, the acquisition process) as an inseparable part of it, are identified. On the left side of the figure, the three main suppliers of software have been identified as their own group. As stated above, the focal company has other suppliers as well, but they are not relevant enough from a software standpoint to take into account in the analysis. The suppliers, customers, and focal company itself form part of a broader network that is also illustrated in the figure. However, rather than to study this larger network, the aim is to study more carefully the focal net of the company through examining the level of the relationship portfolio consisting of both the suppliers and the customers of the company.

Figure 34 illustrates only the starting point for the analysis, not the value net identified for the focal company. In the paragraphs that follow, the value net of the focal company is identified more precisely by utilising the preliminary model for understanding value creation in business networks.

7.2 Value-creating network analysis of the focal company

The following analysis is performed by utilising the preliminary model for understanding value creation in business networks. Perceived end customer value, core competencies, and relationships are each discussed. Additionally, the system architecture perspective is discussed as a theme that emerged as an empirical finding from the macro-network level of analysis.

In the analysis, when direct quotations have been used, the quoted interviewee's role as supplier, focal company, or customer organisation representative is expressed. Additionally, the roles of the focal company interviewees are marked either as sales person or as R&D person. Furthermore, the interviewed customer company representatives are identified either as current EMS customers, current OEM customers or as potential customer. All of the quoted interviewees are also marked by a letter from A to N, as following the marking logic of the list of the interviewees provided in Appendix 2.

7.2.1 Perceived end customer value

As a first step for value-creating network analysis, the preliminary model suggests that one should determine what the customers value. The analysis here is based on understanding value creation from a process-oriented point of view and including not only monetary but also non-monetary costs and benefits. The costs and benefits are discussed with emphasis on the end customer's point of view, as the customer *perceives* them. The main phases of the value creation process are identified through rough-level analysis of the activities carried out by the different actors involved in the system delivery.

7.2.1.1 The content perspective: trade-off between benefits and sacrifices

As the focal company provides automated production lines for the customers, there is an aim of creating value for the customer by *providing more efficient and effective production capabilities*. As the focal company's customers, who currently represent mostly the telecommunications sector, are engaged in tough competition for customers – i.e., end customers – production capabilities play a fairly important role in the company's business processes as a whole. In fact, the focal company's customers place a greater value on production capabilities that enable flexible production processes by providing the possibility of using a single production line for both mass production and production of customised products. Thus, no separate production lines for different product variations are necessary and the focal company's customer is able to achieve savings in line investments and in floor space, and to attain shorter production times. Such changes to the production lines could not be provided without software solutions.

> *Focal company, R&D, interviewee E: "The devices do nothing; it is the software that makes the change."*

In fact, the focal company has already been able to identify these kinds of changes in its customers' value appreciation, as it has started to increase the role of software in its system solution in order to create superior value for customers in the form of the opportunity to achieve more flexible production. Based on the customer interviews, the focal company has also been able to provide general information on its value creation potential; thus, a general-level value proposition has been developed and communicated among the customers. However, there were also some special things that the customers valued a lot, and, furthermore, these things could in fact be provided by the focal company and the then-current version of its system solution. Yet these special wishes weren't communicated between the focal company and the customers well enough. The problem was two-sided: the customers weren't stating what kind of special value they expected from the system solution, and the focal company had not informed the customers well enough of the new developments of the system solution that could indeed offer the extra features the customer desired. One such special feature was component-level tracking, which was valued by all customers interviewed. For some reason, however, the value placed on this feature was not recognised by the focal company.

> *Customer, OEM, interviewee H: "Component-level tracking ability would differentiate their system solution from competing solutions."*

Such problems identifying the things that customers really value are of course related to the nature of the relationship, its closeness, and also sharing of information between the parties in the relationship. In the above case, the customers were able to identify the special need and were also able to communicate their need to the SI. As Möller *et al.* (2002) and Storbacka & Lehtinen (1997) might put it, the supplier should also be able to provide solutions that the customer itself is not even aware of yet. However, to enable such solution provisioning, the supplier should be so close to the customer that it has a thorough understanding of the customer's value creation processes. By contrast, there were lots of changes inside the focal company in terms of the people who had contact with the customers. The changes did cause a decrease in understanding of customers' value creation processes within the focal company. Additionally, the many personnel changes at the focal company led to decreased customer satisfaction.

> *Customer, OEM, interviewee I: "We don't even know who is the responsible person on their side of things currently."*

Dissatisfaction among customers was caused also by the unclear pricing procedure – salespersons might have promised software upgrades at too low a price, and that caused monetary losses for the focal company. In general, the pricing issue was raised as one of the biggest challenges for successful business development built upon the system solution. Although the customers interviewed wanted the role and price of software to be clearly visible in the overall system delivery, they weren't ready to pay that much for the software. This is not in line with the notion that it is the software that really provides the functionality and the valued flexibility of the production line.

> *Customer, EMS, interviewee G: "Software should not make up such a big percentage of the price of the system delivery."*

However, customers also supported the idea of clear pricing for different features of the software. The focal company could set a price for the basic software solution and then price specific additional features separately.

> *Customer, OEM, interviewee J: "The pricing structure is good when the main application is priced as a separate entity and additional features, like statistics, on their own."*

Such pricing, with the main application forming the 'basic software package' as its own entity and the additional features forming separate entities, is related also to a certain desire for componentisation from the end customer's point of view, too. Otherwise, the customers didn't seem to care about how the system solution is built, because they were in any case expecting it to be the focal company that carries the responsibility and takes care of the whole project. However, from the focal company's point of view, and from the suppliers' point of views, the increasing amount of componentisation of the software solution was seen as a way to achieve a 'true software product'. 'True software product' refers here to a software solution that possesses standardised features that make it easy to price and easy to sell by having clear value propositions for the customers. Furthermore, it would also mean better control from the project management point of view, thus also diminishes for its part the need for complex information sharing. Moreover, it was believed by the focal company and the suppliers' representatives that this would enable achieving the customers' desires: only the focal company would be visible to the customer, and the integration work could be done mostly before the delivery phase – i.e., somewhere other than on the customer's premises.

Another interesting question related to the perceived end customer value is that of the value criteria of different customer groups related to the focal company's offerings. For example, one might ask whether the different customer groups have different kinds of purchasing logic – whether there are differences in their acquisition processes. Currently, the main customer industry of the focal company is the telecommunications sector, including both OEMs and contract manufacturers (i.e., EMSs) as the main customer groups. Two important distinctions can be made on the basis of the interview data concerning OEMs (such as Nokia, Motorola, and Sony-Ericsson) and contract manufacturers (such as Flextronics and Elcoteq):

- Contract manufacturers usually do not themselves pay for the kind of software systems the focal company is offering. Instead, the payer is the OEM, because usually the requirement for any given feature needed in production has come from the OEM. However, the contract manufacturer handles the purchasing and the negotiations in practice.

- Contract manufacturers are not so ready to automate their production – the most important sales argument from their perspective is how much they can save with automated operation as opposed to by handling production manually.

In other words, usually the OEMs value the more developed functionalities provided by the system solution, such as the component-level tracking possibility, whereas the EMSs are not so interested in such possibilities. Instead, the EMSs place the highest value on pure cost savings for production. At first glance, it would seem easy to sell automated production lines to the EMSs because they create value in capabilities for more efficient and effective production. However, rather a lot of EMSs carry out production in countries where it is very cheap to do the work manually. Thus, it is not easy to persuade them of the cost savings offered by a system solution that is in fact a rather massive and expensive investment. In practice, EMS companies have been interested in the focal company's offering only when the OEM, which is the principal for the EMS, demands that the EMS invest in some specific feature for production, such as in statistics. However, the OEM is usually also the payer in these cases, although all the practical matters related to the acquisition of the system solution are handled by the EMS. Naturally, this policy makes the situation more complex from the focal company's point of view. In particular, it makes information flow related to the desired features more difficult because there is again one actor more in the value creation network and responsible for the flow of information within the network.

Such differentiation of the value appreciation related to purchasing logic was visible even within a single customer sector, telecommunications as a customer base of circuit production. Furthermore, even the telecommunications sector itself includes two other customer groups, whose roles in the focal company's business are growing. These are plastic parts and packing companies. The picture becomes even more unclear when other customer sectors, like the automotive sector, are added to it.

When it comes to the other customer groups within the telecommunications customer sector, the focal company had in fact carried out the acquisition in the late 1990s of a smaller company in order to gain access to the other customer groups within the telecommunications sector. This smaller company provided production lines, too, but for the customer companies that produce plastic parts for telecommunication devices. This acquisition has benefited the focal company by covering one additional part of the production chain for telecommunication devices. An illustration of this is provided in Figure 35. From the figure can also be seen that the focal company is searching for new customer sectors besides the telecommunications sector. The automotive industry has already been cited as an example.

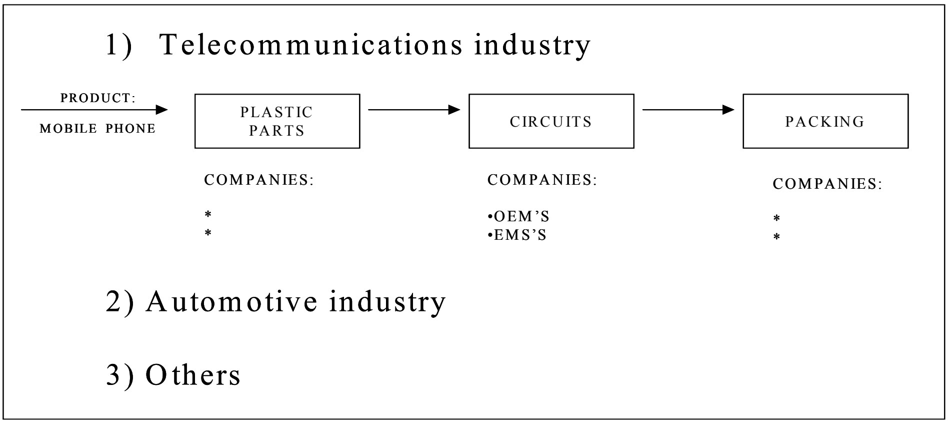

Fig. 35. Customer groups of the focal company.

Besides trying to cover the whole range of automated production lines needed in producing a mobile phone (see Figure 35), the focal company aims at having a more important role in its customers' product design processes. The focal company's representatives argued that they have competencies related to the question of how a telecommunications device should be designed so its production can occur as smoothly as possible. This is a value proposition that has not, however, been communicated yet to the potential customers as loudly as it could be.

In realising the perceived value as a trade-off between benefits and sacrifices in both monetary and non-monetary terms, the system solution provided by the focal company can benefit the customer in the form of more efficient and effective production of its own products. This benefit could be measured in monetary terms, but it also includes value elements that are non-monetary in nature or at least whose benefits are not so easily measured in monetary terms. The main difficulty in measuring 'more effective production' in strictly monetary terms is that the benefits are not always immediate and/or easy to predict. For example, if the customer acquires the system solution mainly because it can provide the ability for component-level tracking, the benefits of the investment become real only if there occurs a real need for component-level tracking. In other words, the benefit of the feature provided by the system solution becomes real in the event of problems during production, in particular involving defective components.

In practice, however, the customers expect that the focal company could provide fairly exact monetary calculations concerning the savings achieved by an automated production line compared to manual production. This is especially true of the 'core package' of the system solution, representing the basic functionalities offered by an automated production line. By contrast, in the case of the more advanced, additional features and functionalities, the role of exact monetary calculations as bases for value proposition and sales arguments diminishes.

It was also identified, from the empirical data that besides expecting direct value in the form of more effective and efficient production, the customers were also expecting indirect value from the focal company in the form of reduced activity requirements, as interaction with several suppliers decreases when the whole system solution is acquired from a single actor. However, as has already been pointed out, this was something in which the focal company had not been very successful.

7.2.1.2 The process perspective: value tied to the whole relationship

The customers who were interviewed discussed the value created for their companies by the SI through identifying different activities. In particular, they brought up activities, or lack of activities, taken by the focal company in their shared relationship history with which the customers weren't pleased. These were activities that could have been identified and taken into account by the focal company if it had more precisely identified the value creation processes of its customers. One of these was indeed the sharing of information. Customers felt that, although they wanted to interact only with the focal company as the system solution provider, they were several times forced to contact the focal company's suppliers, too, in order to get problems solved. Thus, customers would have valued the possibility of decreasing the amount of interaction with several actors during the project, but this could not be provided by the focal company in practice.

> *Customer, OEM, interviewee H: "They should have taken care of the whole project, but we had to contact the subcontractors directly as well – too many times."*

There were also problems in information sharing that were related to the negotiation and sales phases of the overall project delivery, and partly to the actual integration part of the project. In fact, some of the customers who were interviewed pointed out that the phase of integrating the various components and sub-parts of the overall system solution should be complete before any work occurs on the customer's premises, at least as far as possible. However, this has not been the case with the focal company's deliveries, although some interviewees realised that this was caused by the rather immature nature of the system solution as a packaged solution. Thus, it was also recognised to some extent that the offering of the focal company was still at the beginning of its life cycle.

> *Customer, OEM, interviewee I: "Integration work should not be done on the customer's floor. It felt like we were some kind of testing field and idea factory for them.*"

> *Customer, OEM, interviewee J: "It was a pilot project in a way, for us and for them. Thus, problems arose, but in my opinion the project went well in spite of the problems."*

When it comes to the phases before and after the actual purchase and delivery – i.e., the marketing and after-sales phases – it appeared that the customers were waiting for the focal company to take a more active role. For example, customers were saying that more proactive marketing related to the system solution and especially its software solution had been expected but the focal company hadn't always been active in contacting even customers to whom they had already delivered an older version of the system solution. One reason behind this silence on the focal company's part could be the internal changes in the focal company's personnel and organisational structure: after the changes, the staff were a little confused as to each person's tasks; at the same time, decreases in the number of personnel caused a lack of resources for proactive marketing. On the other hand, it could be argued, based on the empirical findings, that some customer projects had been so difficult from the viewpoint of the focal company that the personnel were a little bit cautious about getting in touch with the customer again.

Customer, EMS, interviewee G: "They should also market their product in a proactive manner – sometimes we start to think of different types of solutions and investments if we hear some new improvement ideas and get information about what is technically available at the time."

Customer, OEM, interviewee I: "Currently, I don't know so much about the new version of the solution – or if there is one. I think there have been a few presentation events, but I haven't participated in those."

Customer, OEM, interviewee J: "Maybe they think that if our company needs new production lines and solutions we will contact them."

As regards the time after the actual delivery of the system solution, the after-sales phase, including such things as maintenance and upgrading of the software, customers again wanted more services and competencies from the focal company than the focal company could actually have provided. However, it also needs to be pointed out that no large-scale after-sales services were required by the customers.

Customer, OEM, interviewee I: "There is only a little need for change in the application, but they haven't taken care of it. Several times we have asked for it, and nothing has happened."

Customer, OEM, interviewee J: "We haven't had such big needs for after-sales services, only some that have been caused by changes in other systems of ours that meant small interface upgrades were needed."

Above, perceived customer value was discussed through process-oriented value creation analysis and its different sub-processes. In order to clarify the value creation process from the focal company's viewpoint and that of its customer, Figure 36 is provided. In the figure, the idea is to show that the customer has its own business processes, forming the overall process of value creation, through which it creates value for its own customers (i.e., the end customers) and obtains value itself, too. The figure roughly indicates that sub-processes – named as R&D; production; sales and marketing; and after-sales – constrain the value creation process of the customer. The most interesting sub-process from the focal company's point of view is, naturally, the production sub-process. This is the part of the customer's value creation activities that the focal company tries to support by creating value for the customer in the form of more effective and efficient production.

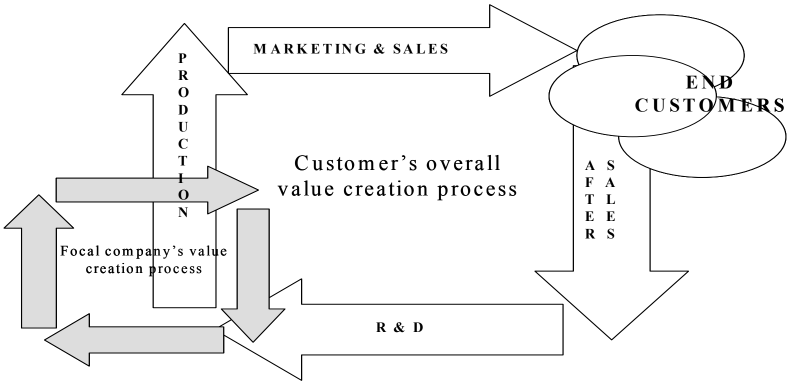

Fig. 36. Joint value creation between the focal company and its customer illustrated.

In Figure 36, the focal company's value creation process is situated almost totally within the production process of the customer. However, the focal company aims at participating more also in the customer's R&D process, in which the item for production is designed. Thus, the focal company aims at sharing activities with the customer so it can better create value for the customer.

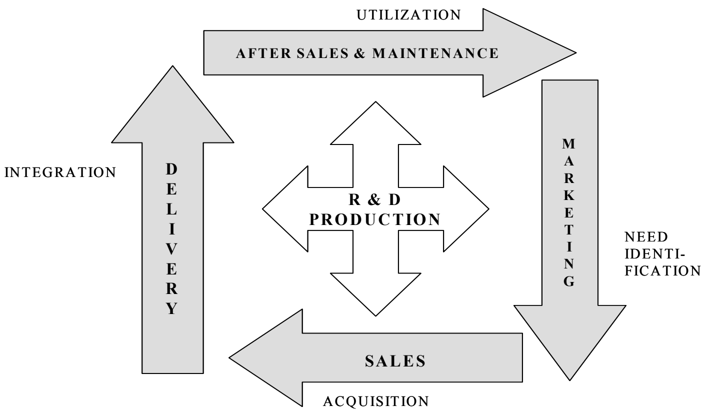

Fig. 37. Value creation activities of the focal company illustrated.

In Figure 37, the value creation process of the focal company itself is illustrated more precisely. From the viewpoint of the focal company, the sub-processes of the overall value creation process can be named as *marketing*, *sales*, *delivery*, *after-sales and maintenance*, *R&D*, and *production* processes. However, in the figure the processes are also named from the viewpoint of the customer as *need identification*, *acquisition*, *integration*, and *utilisation* processes. These value creation process names are familiar from Chapter 4, which addressed value creation from a process-oriented point of view.

The suppliers of the focal company could be positioned in Figure 37 inside the square, as joining the R&D and actual production processes of the focal company. This, however, is the ideal scenario, the way the customers would like it to be: the suppliers of the focal company would stay behind the interaction interface between the focal company and the customer, and thus the suppliers would stay invisible to the customers. However, the situation is currently more complex: the suppliers do participate in processes that are visible to the customer. For example, suppliers have been integrating the system solution on a customer's premises with the customer's other systems. Besides being visible in the delivery/integration process, suppliers have in some cases been visible in the after-sales/utilisation process, in which they provide education to the customers and handle upgrade and maintenance issues. Additionally, they have been visible in the sales/acquisition process, directly participating in requirement-setting meetings and negotiations.

7.2.1.3 The context perspective: differential value

It became evident from the empirical data that the concept of differential value is more useful to understand than absolute value is, from the viewpoint of the focal company. This is because the customers have other potential alternatives for achieving more effective and efficient production. These alternatives aren't provided just by similar kinds of companies to the focal company itself. In fact, in most cases, the competing alternative was the customer's own internally developed solution. When it comes to differential value, the special and additional features and functionalities provided by the focal company's system solution will become the key issue. Thus, the role of software as a modularised solution from which the customers can choose the functionalities that they want offers the focal company a way to defeat competing solutions.

As has been stated earlier in this study, value in differential terms is even harder to understand and measure than absolute value is. According to Parolini (1999), the possibility of false perception increases when there is a presence of intangible elements and services; systemic and complex goods; benefits that are not immediate; post-purchase costs and costs of consumables; products and services that are new to the customer; and infrequently purchased goods. These issues were mentioned in Section 4.1.2, where it was also pointed out in brief that software as the object of exchange is related to many of the issues listed. From the viewpoint of the focal company, the issues of intangible elements and services, systemic and complex goods, benefits that are not immediate, products and services that are new to the customer, and also infrequently purchased goods all characterise the focal company's offering to the customer.

Thus, it becomes rather difficult for customers to compare alternative solutions and distinguish among them. In such cases, the indirect indicators of the value creation capability of the focal company play an important role. For example, acting as indicators of the value creation capability of the focal company are not only the previous relationship history shared by the focal company and the customer but also the reference projects of the focal company. Additionally, the value creation capability of the focal company is viewed by the customers through such things as project management competencies and the ability to handle responsibilities and risks. Moreover, it becomes a matter of reputation and trustworthiness; the focal company should convince the customer of its value creation capabilities and competencies.

7.2.2 Core competencies

The key issue in value-creating network analysis is to determine what customers value and, on the other hand, which kinds of activities are needed in creating value for the customer. However, these activities – and thus creation of value for the customer – should be carried out in a profitable way in order to enable the focal company and its suppliers to obtain value. Thus, it should also be identified what kinds of core competencies are needed in the value creation. Due to the interrelated nature of the elements of the preliminary model for studying value-creating networks, some aspects of the core competence discussion concerning the focal net have already been touched upon in Section 7.2.1, addressing perceived end customer value. In the material that follows, findings from the empirical data are discussed in the sections ‘Organisationally embedded resources’, ‘Knowledge and skills’, and ‘Strategic resources’ as structurally following from the element of core competencies in the preliminary model of value-creating networks.

7.2.2.1 Organisationally embedded resources

As had already been pointed out, the success of the focal company and the overall focal net was rather dependent on the development of software as part of the system solution, as the end customers more and more often are demanding features for the system solution that cannot be provided without software. Thus, the focal company should have competencies in software development. Unfortunately, the situation was far from that ideal, as the roots of the focal company were in hardware and device production and therefore also the core competencies of the focal company were still in those areas. As one of the suppliers interviewed brought up:

> *Supplier A, interviewee L: “Their vision is to be a real system solution provider, maybe even a capacity provider. However, their manner of operation is like that of just device sellers.”*

However, in the case of value-creating networks, it doesn’t matter so much whether the competencies are *owned* by the actor; more important are the competencies that can be *utilised* by the actor. Through the competent software suppliers, this was indeed possible for the focal company. But to really take full advantage of it, the management of the focal company should have understood the strategic significance of software in order to commit more resources to use of the services of these competent software suppliers. In fact, it can be argued that the ultimate reason for the lack of appropriate software-related competencies was that the appreciation and understanding of software throughout the focal organisation was problematic.

Supplier B, interviewee M: "The role of software is undervalued by their management, but also by the sales people and by the workers in the field."

Nevertheless, the focal company used its software suppliers in a reasonable way when it came to the different roles of the suppliers in developing the needed software: each of the suppliers acted in the area in which it was best, as suppliers' responsibilities were defined through the different architectural layers of the system solution corresponding to the suppliers' areas of core competence.

Core competencies are embedded not just in the organisations; in the end, they are embedded in the people of the organisations when core competencies are understood as knowledge and skills. Thus, to make use of the core competencies, the people through whom the competencies are concretised should be encouraged to use them. A good way to encourage people to make use of such competencies is to appreciate their special skills.

7.2.2.2 Knowledge and skills

In the interviews, it was mentioned that sometimes it felt as if people weren't appreciated enough by the focal company's management. Thus, the company culture and atmosphere were not always the best for encouraging the personnel to use their skills and knowledge.

It is also likely that the poor atmosphere within the focal company was one cause of the continuous personnel changes, as already mentioned in Section 7.2.1 in talking about the turnover of the focal company's project managers. Although core competencies are organisationally embedded, they are realised through the individual employees of the company. As pointed out earlier in this thesis in the discussion of core competencies as knowledge, much of core competencies can be in tacit form – thus, it is inside the personnel's minds and not available in an articulated form. Every time a skilled individual leaves the company, part of the competencies of the organisation goes as well.

In the case of the focal company, the team that was responsible for software development was very small. In such situations, each of the team members possesses such important competencies that even one individual may have competencies that can be classified as strategic in nature – i.e., core competencies.

On the other hand, the focal company was competent in advising its customers on how to design products that can be produced as smoothly as possible. This was a competence area that would have benefited the customers quite a bit, but that kind of co-operation hadn't occurred yet. The reason was the lack of trust between the focal company and the customers, as already stated in discussion of the perceived end customer value element. The customers were not ready to give a greater role to the focal company in their product design and development processes, as the focal company hadn't been able to show itself to be a reliable and competent partner. Thus, the customers weren't ready to build closer relationships with the focal company.

However, the empirical findings also indicated that there were sometimes problems also on the customer's side, especially with having a competent person to take care of the whole project as a part of which the system solution was delivered to the customer by the focal company. As sales personnel brought up, sale of the overall system solution including independent software was a competence-demanding task, not only from the focal company's standpoint but also from that of the customer.

Focal company, sales, interviewee C : "In selling this kind of system, there should be an expert involved in the project also from the customer's side."

It was also pointed out during the interviews that inside the focal company people have begun to understand better how important it is to get the right resources involved in the various phases of the project. It was seen as particularly important to have software-competent persons involved in the project right from the beginning, to take care of the critical project management activities.

7.2.2.3 Strategic activities

Inappropriate project management competencies within the focal company were brought up as the problem most affecting activities in the focal net's relationships. This problem was identified not only by the customers but also by suppliers of the focal company that pointed out that their role should stay behind the customer interface but hadn't yet.

Supplier A, interviewee L: "In principle, they are all that should be visible to the customers, but because there is a lack of resources, we have taken care of some parts of the end-customer interfaces, too."

Supplier B, interviewee N: "In some cases, we have organised education for the end customers, although not so much anymore."

In some cases, the problems related to information sharing were caused by insufficient information flow within the focal company, as salespersons had promised too much to the customers when selling the system solution. The main reason for these unrealistic promises was lack of knowledge concerning what kinds of functionalities the system solution and especially its software solution could really provide, and also the prices and the timeframe in which that kind of functionality could be provided.

Focal company, R&D, interviewee E: "We have noticed that the salesmen do not know enough about the software, but still they haven't been asking for education."

Supplier A, interviewee L: "The biggest problems in the projects have been caused by too tight schedules."

Supplier B, interviewee N: "The salesmen are salesmen for devices; thus, their competence in system sales and especially in selling software is not as good as it should be. Too often too much is promised."

Overall, the lack of critical resources related to software inside the focal company led to a more important role for the suppliers within the focal net, as the software competencies came from the suppliers. However, the customers still wanted to be able to interact only with the focal company as the system integrator, not directly with the suppliers. This caused problems in organising the value-creating activities within the focal net, as software-related activities were in fact creating most of the benefits for the customers but these were mostly carried out by the suppliers that were not supposed to be visible to the customer. As a result, the criticality of project management activities within the focal net increased. These project management activities in fact started to play a more important role in the customers' minds in their perception of the value created than the system product and its fine software features did. In other words, the poorly managed project activities had more weight in the customer's mind as a sacrifice and decreased the weight of the benefits achieved through the system product and the features provided by the software.

7.2.3 Relationships

The question of kinds of relationships – dealing with, e.g., the amount of closeness in relationships used in joining the value creation activities of the network actors together – is discussed in the sections that follow. This relationship element is reviewed through the different value-creating network actor perspectives but also in terms of the different exchange attributes and the nature of the relationship.

7.2.3.1 Different exchange attributes

The special nature of software and software components as the object of exchange, information sharing, and social exchange emerged in the interviews as the most critical exchange attributes. Surprisingly, the question of IPRs or legal bonds in more general terms was not cited by the interviewees as such a critical factor. Operational linkages were discussed in the interviews, mostly as a question of which of the end customer's processes the focal company would like to be involved in and, similarly, in which processes of the focal company the suppliers would like to participate. Below, aspects of these different exchange attributes are discussed based on the empirical findings. It is noteworthy that most of the issues – e.g., information sharing and operational linkages – have already been raised in Section 7.2.1's exploration of the value creation processes in the focal net.

Software and software components as the object of exchange were causing problems for the actors of the focal net due to their having a different nature from physical objects. The role of software in the focal system solution had increased fairly recently, and the people involved in selling and buying the system solution were more or less used to dealing only with devices and hardware, not so much with software. This was the case on the customer's part and the focal company's, while the software suppliers in the focal net did not have such difficulties since their competencies had been in software development for years. The difficulties in understanding the role of software in the system solution were partly based on the abstract nature of software compared to hardware: hardware can be seen as a physical thing on the customer's premises, but software has no such physical appearance. Instead, software's value can be measured only by what it does when utilised.

Supplier B, interviewee M: "There is lack of software understanding also on the customer's part, not just inside [the focal company]*."*

Although there had been problems related to the special nature of software as the object of exchange, the aspect of *legal bonds* hadn't been as problematic. There are at least two things that can explain this: the clear division of responsibilities and ownership of software between the focal company and its suppliers, first, and the way the focal company had been ready to make necessary changes and even do extra work caused by the focal system solution. The first issue, the ownership of the software, could be rather clearly addressed, as the source code was owned by the suppliers in most cases and the areas of responsibility of the suppliers corresponded to the different architectural layers of the system solution. The second issue, the extra work and necessary changes, is not as clear, and there were customers that still weren't satisfied with the performance of the focal company and felt that the focal company hadn't been doing enough. However, there were also customers that had noticed the flexibility of the focal company: the focal company had provided a tailored solution and been willing to make necessary changes and do development work to ensure customer satisfaction. These customers did not feel there were any problems in the legal agreements made with the focal company, as almost everything the customer wanted to be done was done. In fact, one customer even expressed a little sadness on the focal company's behalf, as the project must have cost it a lot.

Focal company, R&D, interviewee F: "Suppliers own the source code in most cases."

Customer, OEM, interviewee J: "We hope that they have learned from our project where the line is: what it is profitable to do for the customer and what isn't."

Information sharing was seen as the most critical issue concerning the relationships in the focal net. It is not unusual for information sharing even inside a single company to be problematic, so it is unsurprising that problems exist when several companies are acting in a net. One of the customers volunteered that the causes of the problematic information sharing were mostly the usual ones for a global project, as there were problems caused by language differences and physical distance. However, all other customers interviewed were much more critical and clearly articulated that, in their opinion, the focal company didn't manage well enough the information flows from the customers to the suppliers and *vice versa*. In fact, customers even thought the focal company had misled them at the start of the project to think that it handled everything in-house rather than by using several other actors.

Customer, EMS, interviewee G: "When we started the project with them [i.e., the focal company]*, we thought that they would handle the whole project. If we had known back then how very many subcontractors there are actually doing the job, we would have considered it an information risk and probably would have buried the whole project with them."*

It could be argued that the customers might not have been as unsatisfied with the information sharing if they had known right from the beginning that there would be several actors involved in the project and that the focal company's software suppliers in fact take care of rather a lot of the responsibilities and interaction with the customers. However, the customers hadn't been informed of such things by the focal company's salesmen in the selling phase, as the salesmen themselves did not understand how hard the project would be from a software standpoint and how many resources outside the focal company – i.e., from the suppliers – would be needed in the project. Thus, the problems in the internal information management of the focal company had a compounded effect for customers, as the customers were given incorrect information at the beginning of the project and later were forced to make direct contacts with the suppliers and share the needed information directly with them to get things done properly.

Naturally, all the problems with information sharing affected the nature of *social exchange* between the actors within the focal net. Most of the customers felt betrayed, which is why they weren't that eager to continue the relationship with the focal company any longer. In fact, in some customer organ*is*ations, the management had even decided against further acquisitions from the focal company since the earlier projects had been so problematic. Development of social exchange between the customers and the focal company was also made harder by the constant turnover of project personnel at the focal company.

> *Customer, EMS, interviewee G: "The project manager changed too many times during the project. However, the last project manager was a good one and took control of the job."*

However, social exchange between the focal company and its suppliers was more successful than it was in the customer relationships. Social exchange was rather deep, especially between the focal company and the main supplier.

Operational linkages are usually closely related to the other relationship connectors. This is also the case in the focal net studied, as the focal company would have liked to participate in its customers' product design and development processes but the customers didn't give this opportunity to the focal company, mostly due to their bad experience with the other relationship connectors with the focal company, especially information sharing and social exchange. One of the suppliers was eager to build more operational linkages with the focal company, but the aim wasn't reciprocal, as the focal company had decided to build closer co-operation with another supplier.

7.2.3.2 Actors' perspectives

The different actors within the focal net usually have varying views on the relationships forming the net. In this section, the views of the focal company and those of its suppliers and customers who were interviewed in the study are presented.

Focal company's perspective. What is noteworthy in the focal company's interviews is that opinions varied concerning the customer and supplier relationships and the system solution itself, depending on whether the interviewee represented the sales department or software development department. However, views on the company's internal issues – e.g., upper management's attitude toward software development and the way internal information flows were handled – were seen rather similarly in these two departments. It was stated by both the salespersons and the software developers that there are problems in the focal company, especially in the way the management operates and in the internal information management.

By contrast, the customer relationship management was seen as more successful from the viewpoint of the salespersons than from the viewpoint of the software development personnel. One explanation for this is the customer experiences: the sales staff had made a lot of successful device sales, whereas the software developers had been conducting only the system sales, which had been the problem area, from a sales perspective, with the customers. It is also worthy of note that the salespersons seemed to think that some of the problems related to system sales were caused by the fact that the software development personnel hadn't given enough education to the salesmen though they had asked for it. At the same time, those in software development were saying that the sales personnel didn't want any education although they certainly needed it, given that they continuously had promised too much of the software in the system solution to customers.

> *Focal company, sales, interviewee B: "We have asked for education, but nothing has happened."*

> *Focal company, R&D, interviewee F: "Salesmen have in many cases promised too much to the customer because they don't understand the software. Still, they haven't been interested in education."*

From the point of view of the sales and marketing personnel interviewed, the most important question concerning customers seemed to be the identification of the purchasing group and the decision-makers within the large customer companies.

> *Focal company, sales, interviewee B: "Customers are in many cases large global actors, and that causes difficulties in finding the right persons within the customer company, those who can make the decisions."*

> *Focal company, sales, interviewee C: "There are different kinds of customers: some are patriots who can make decisions rather independently and with whom there exists personal trust, and then there are persons characterised by limited local decision rights. With them, references, both internal and external, influence a lot."*

Salespersons also emphasised in their interviews the tough competitive environment – a lot of work needs to be done for a project sale. There are some partner OEMs with which the focal company has closer relationships. For these partner OEMs the focal company has named key account managers. On the other hand, towards the EMSs the relationships are rather distant. These EMSs are not usually so important customers as they are more willingness to buy single devices, not entire system sales. This is also related to the differing value creation logic and purchasing criteria of these customer groups, as already discussed under Section 7.2.1.

The software development personnel saw both the customer relationships and internal management issues in more negative terms than the salespersons did. The software department had seen large cuts in personnel and other resources; thus, its staff were feeling a bit down and undervalued by the management. They felt strongly that the future success of the focal company was highly dependent on the intelligence of the software solution within the overall system solution, but they felt that they don't get enough support from the management. In fact, people in the software department were aware of the problems perceived by the customers related to the focal system projects, but their scarce resources left them unable to change the situation even though they wanted to.

Suppliers' perspective. Overall, the suppliers who were interviewed were quite satisfied with their relationship with the focal company, although some problems were identified as well. The relationship was seen as rather close, and that is the way the suppliers wanted to keep it in future, too. Although the most recent changes in the focal company's organisational structure and the decreased demand for the production lines had affected the relationship between the focal company and its suppliers, the suppliers wanted to keep the focal company as their key customer and were willing to invest in developing the relationship.

> *Supplier B, interviewee N: "They are not the only customer, but they certainly can be labelled one of our key customers."*

> *Supplier A, interviewee L: "They have been our customer for a long time now."*

> *Supplier B, interviewee M*: "W*hen they haven't been able to sell, it has influenced us and the other suppliers, too."*

The supplier companies interviewed pointed out that the software solution concept provided as an important part of the overall system solution is not an actual product yet, as it still needs a lot of tailoring and the suppliers have direct contacts with the end customers. Suppliers seemed to await the focal company moving forward in packaging the software concept for two reasons: firstly, they felt that this would allow them to become as invisible in the end customers' eyes as they should be, and, secondly, they felt that the focal company had lost a lot of money in tailored software solution projects and that the profits could increase after successful packaging. Although the development of the software concept takes work away from one of the suppliers, that specific supplier still wanted the focal company to succeed in developing the software concept further.

> *Supplier B, interviewee M: "It has eaten our job away, because the need for customisation has decreased."*

> *Supplier A, interviewee L: "Hopefully they will succeed in packaging the solution as a real product."*

Suppliers were ready to have direct contact with the focal company's customers in future, too, but mostly they would like to have a less visible role – because this is what both the focal company and the end customers want. However, one of the suppliers would like to be involved in some way in the requirement-setting phase in the future.

> *Supplier B, interviewee N: "We would like to get more influence by creating the software specifications. We already have processes for the specification phase ready."*

That supplier was not, however, regarded as the key supplier in the focal company's plans for the future. In fact, the focal company was considering giving a larger role to one of the suppliers that had already been involved in different roles in the system solution development and marketing.

> *Supplier A, interviewee L: "Although we haven't been involved in making the business decision when it comes to the system solution, we have been developing the system from the technical side and also we have carried out some internal marketing of the PPS software solution for them* [i.e., inside the focal company]*."*

When it comes to the suppliers' opinions on the other suppliers of the focal company, there were varying and even inconsistent views on their reciprocal relationships. This variation was most visible in discussion of the joint development project for software components. That project was the focal company's idea for developing software components that are shared between the key software suppliers. Co-operation was successful in the beginning, but then the development project lost steam. The suppliers had different opinions on the reasons behind the failure of the joint development project: one of the suppliers said the project was ended because of hard economic times, while another supplier said that the co-operation was not so successful even in the beginning.

> *Supplier A, interviewee L: "We had development of shared components, however, this kind of useful co-operation was put on hold when the harder times started."*

> *Supplier B, interviewee N: "There were problems in joint component development, disagreement especially on technical solutions."*

The suppliers had varying views on the successfulness of the co-operation in broader terms, too. The supplier that had the closest relationship with the focal company and that the focal company intended for a more important role in future had a more positive view of the co-operation between the suppliers than did, for example, the supplier whose role as a software supplier was decreasing due to the smaller amount of integration work.

> *Supplier A, interviewee L: "No competition. Interfaces between the different architectural layers are created in co-operation. We jointly set the rules for communication and also those related to business rules."*

> *Supplier A, interviewee L: "The chemistry between people is very good; all of the suppliers are committed to co-operation with them* [i.e. the focal company]*."*

> *Supplier B, interviewee N: "At one time project management came from one of the suppliers – that was not a good thing."*

It could be seen that the focal company was planning to change the roles of its suppliers, but the suppliers had not yet been informed about these plans. It was surprising that the focal company planned to give a more important role to a supplier that seemed less enthusiastic about increasing its role in the focal net than to the supplier that specifically articulated a willingness to have more influence in the net. Additionally, the focal company was seeking new software component suppliers with whom the relationship could be more distant than those with existing suppliers. Some potential suppliers had already been evaluated: common to these suppliers was that they weren't domestic actors and, additionally, were larger than the current suppliers. Furthermore, operations were more product- than project-oriented in these new, potential supplier companies.

Customer's perspective. The focal company had two different main types of customers within the telecommunications sector, the EMS and OEM companies, as stated earlier. However, even in cases where the EMS is the direct customer of the focal net, the role of the OEM as the principal is still rather strong. Such a derived customer relationship causes problems in, e.g., information sharing and obscures the decision-making.

> *Customer, EMS, interviewee G: "We are responsible for the whole process, although the customer* [i.e., the OEM] *pays the production line costs. We handle all the price negotiations with the production line supplier, although the customer is the one that pays. Sometimes, the customer may ask us why the price is so high, but usually the high price is explained by the high demands set by the customer itself for the production line."*

From the customers' point of view, there aren't many potential suppliers for the total system deliveries – i.e., for intelligent production lines. That is especially true at the domestic level, where there are only two larger actors providing these kinds of system solutions. However, even though there had been several potential suppliers, the customers still value a procedure involving co-operation with only a few carefully selected suppliers. Customers have a list of acceptable suppliers from whom bids are solicited when the need arises.

> *Customer, EMS, interviewee G: "We have a list of acceptable suppliers – that list we update regularly. Also, personal relationships do count."*

Identification of the purchasing group and especially the decision-makers within the customer companies was felt to be difficult by the focal company, and the customers themselves brought up the same issue. As the customers are usually rather large corporations, there are several different levels involved in the process of making a purchase decision involving larger investments such as an intelligent production line.

> *Customer, EMS, interviewee G: "It is a problem that purchasing decisions are made at the corporation level and only the specifications at the local factory level. They don't always see the need for total system solutions at the corporation level; instead, they prefer to acquire devices. However, here at the factory we see how things should be in practice – we value the holistic operation capabilities offered by total system solutions."*

As has already been pointed out, most of the customers were rather unsatisfied with the way the focal company had served them. But there were also conflicting opinions: one of the customers interviewed was very pleased with the focal company and the joint project. This customer differed from the other customers interviewed in one important respect: that customer had known right from the beginning that a pilot project was involved. Thus, the customer had been prepared to face difficulties during the project, as is typical for pilot projects generally. It is interesting, however, that the focal company saw that particular project as the most difficult and least successful one, although the customer didn't feel that way. Thus, the view of the focal company and that of the customer differed remarkably in that specific case.

7.2.3.3 Nature of the relationships

Naturally, the nature of the relationships within the focal net varied rather a lot. There were different kinds of relationships between the focal company and its different suppliers, but variations were also seen in the relationships between the focal company and its various customers. Additionally, the nature of the relationships between the suppliers was interesting, as was the nature of the derived customer relationships between the EMS and the OEM as the principal.

The focal company had some close relationships with its customers, even partnerships. The definition of a true partnership applied in these relationships: sharing of the profits was accompanied by sharing of the risks.

> *Focal company, sales, interviewee B: "Customer relationships are close with a few key accounts, for which there are key account managers. These are defined as partnerships – by definition, risks are shared."*

The situation involving suppliers was rather similar – there were a few suppliers with whom the profits and risks were shared, but the majority of the supplier relationships could not be called true partnerships.

> *Focal company, sales, interviewee B:"There are few suppliers that are defined as partners – shared risks."*

> *Focal company, sales, interviewee A: "Although there has been slight development towards closer supplier relationships, there are only a few real partnerships."*

One of the software suppliers was physically located near the focal company; the focal company's closest relationship was with this supplier. However, it is not possible to argue based on the empirical data that this status as main supplier was caused by the physical proximity. Still, it is noteworthy that all of the current software suppliers of the focal company were domestic ones. In fact, one of the suppliers had used its global subsidiaries in one of the focal net's system solution projects. This utilisation of a global actor, although a subsidiary, had brought even more complexity to the operation of the focal net. This situation led to a joint decision of the focal company and the relevant supplier to reduce the utilisation of the foreign subsidiary.

It was already mentioned that the focal company's suppliers saw their reciprocal relationships rather differently. For example, the main supplier in the focal net saw the reciprocal relationships more positively than the supplier with a decreasing role in the focal net did. Thus, the varying views can be explained in part by a certain amount of envy caused by different positions within the focal net.

Via the empirical material, it is also possible to shed light on the nature of the relationship between the EMS and the OEM. In the telecommunications sector, there is a trend for OEMs to outsource their production to contract suppliers – i.e., to the EMS companies. Although the EMS companies were eager to build true partnerships with the OEMs, true partnerships were still absent. It was usual for an OEM to use one EMS company as an expert in an item's design phase, but when the design phase was over, it was by no means clear that this EMS would get the production deal. In other words, several rival EMS companies usually competed for the actual production deal.

7.2.4 System architecture

The role of the system architecture was visible in many ways in the focal net. Naturally, it dictated the structure of the system solution itself, but it also acted as a tool for division of responsibilities among the software suppliers. The role of the system architecture was very visible to the customers, as the system solution provided by the focal company had its own place in the overall system architecture of the customer. Figure 38 depicts the system architecture of the focal company, but also it illustrates the position of the focal system solution in the customer's architecture.

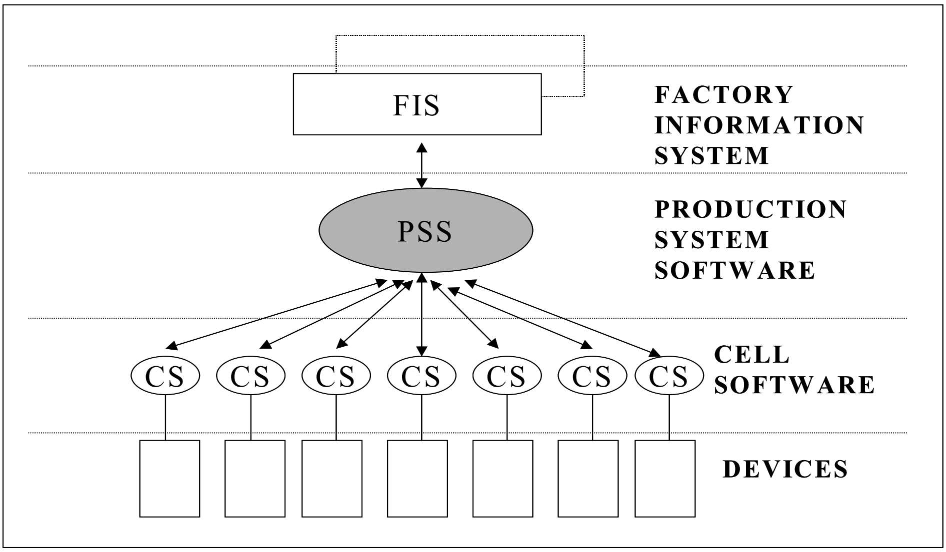

Fig. 38. Illustration of the system architecture of the focal system solution.

The factory information system (FIS) shown in the figure represents the customer's system to which the focal system solution must be integrated successfully. The FIS is a broader system than the focal system solution is. Most of the problems related to the project sales of the focal system solution were related to the interface between the customer's FIS and the focal system solution's uppermost layer, the production system software (PSS). Such interface and integration problems are caused by the lack of standardised solutions for the interfaces between different architectural layers.

> *Focal company, R&D, interviewee F: "Problems occur especially in the interfaces between the PSS and the customer's factory information system: customisation needs to be done on both sides. These kinds of problems have not occurred at the lower layers so much. The reason behind the problems is the lack of a standard interface leading to the need for customisation from both directions."*

The focal system solution itself is formed of three main layers: the uppermost layer of PSS, the cell software, and the field device layer. The PSS is the most intelligent and independent software portion of the system. It manages the lower layer of cell software.

The cell software, for its part, manages single devices. Although the architectural layers seem rather clearly defined in the system solution, there still are problems to be solved. There are problems not only within the interface between the uppermost layer of the focal system solution and the customer's own factory-level system but also in the interfaces internal to the system solution. That is one reason the interviewees felt that that one cannot talk about a true software product, yet.

> *Supplier B, interviewee M: "Although through standardisation development the interfaces between the different architectural layers become clearer, there still is going to be a need for customisation for a long time."*

> *Supplier A, interviewee L: "Not yet a real product, because the suppliers are extensively involved in many phases of project sales."*

At the same time, the persons interviewed noticed the importance of developing the architectural design of the system solution, especially in work to increase utilisation of software components in the system solution in the near future.

> *Supplier A, interviewee L: "As the role of software components is intended to be increased in the near future, the role of the architecture becomes even more important."*

Additionally, the responsibilities of the focal company's software suppliers were clearly defined as following the structure of the system solution.

> *Supplier A, interviewee L: "The focal company's idea is to have the three main suppliers deal with different architectural layers."*

> *Supplier B, interviewee N: "Suppliers are operating at different architectural layers – clear division. The supplier that acts at the uppermost levels has a role more visible to the end customers."*

Furthermore, the development of relationships with the suppliers and the importance of the suppliers for the focal net can be seen through the architectural layers. When it comes to the development aspect of things, one of the suppliers had been asked to deliver pieces also to other architectural layers. This was a case of leveraging the specific supplier's role in the system solution and within the focal net. The importance of the suppliers is also related to their position in the architectural layers: a supplier that operates in the uppermost layer has the most challenging but most visible position in the functionality and successfulness of the whole system solution, as these responsibilities are related to the interface between the customer's total system solution and the focal system solution.

7.3 Key findings of the focal net analysis

The focal net level of analysis presented and discussed in this chapter provided interesting insights concerning the value creation problematic in business networks, although the scope of the analysis was limited to a particular focal net. The findings from the empirical material were discussed in the previous sections, but a concluding discussion emphasising these key findings is provided in this section. The discussion is started by presenting the key findings in the form of a figure showing the value-creating network model with the key findings positioned in it (see Figure 39).

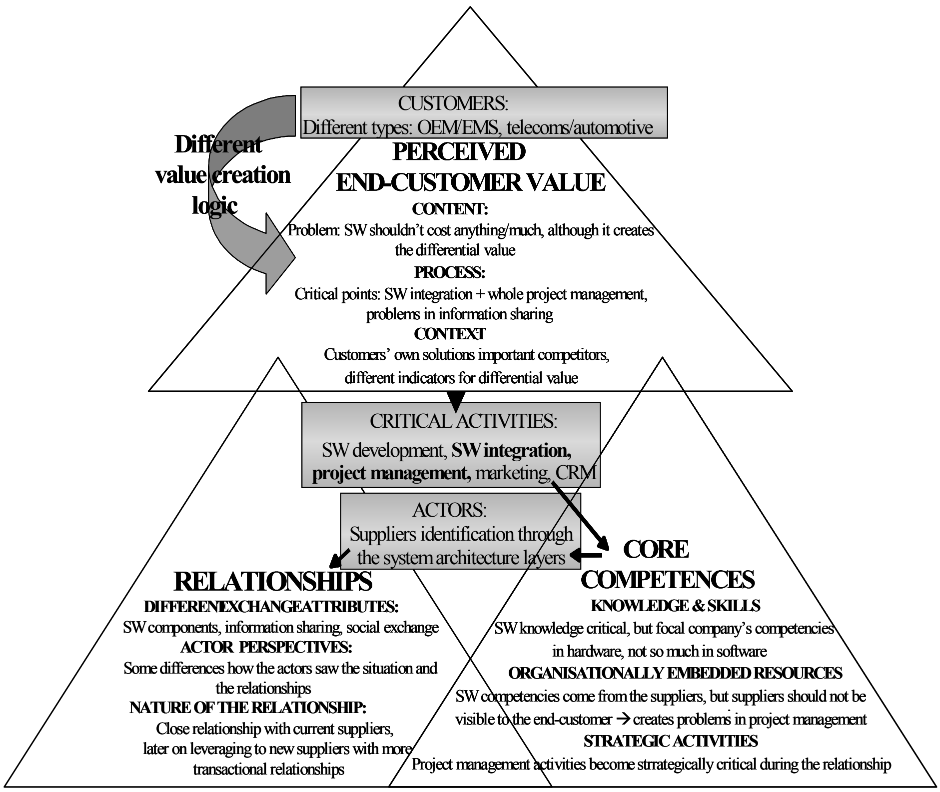

Fig. 39. Key findings of the focal net study.

Identification of the different customer types served by the focal net was an important starting point for the analysis, as the value creation logic of the different customer groups varied, an example being the varying business models of the OEM and EMS companies. However, all customers interviewed, regardless of the customer group they represented, undervalued the role of software in the focal system solution, as they weren't ready to pay so much for software, even though the software provided most of the added value for them. As regards the process perspective on perceived end customer value, the biggest shortcomings were in the software integration and overall project management phases. From the viewpoint of the customers, the most problematic matters were the information sharing and forced interaction with several actors, as their desire was to just interact with the focal company. The context perspective on the perceived end customer value was rather interesting in the focal net being examined, as there were only a few competitors that would have been able to provide differential value for the end customers as competing solutions to the focal system solution. However, the customers themselves had in fact developed system solutions competing with that provided by the focal company. In order to defeat such an internal competitor, the focal company should have developed arguments that clearly indicate what kind of differential value the focal system solution can provide. The component-level tracking ability is an example of such an argument.

Identification of the perceived end customer value also led to guidelines for identifying the critical activities of the focal net. In this case, the most critical activities were software integration and project management, but also CRM, marketing, and software development were rather critical. The next step is then to determine what kinds of resources and core competencies are needed in order to carry out these critical activities as successfully as possible. In this case, the focal company didn't posses enough software development competencies, and the importance of the software suppliers within the focal net increased as a result. However, this increasing role of the suppliers within the focal net was rather problematic, as the end customers did not want the suppliers to be visible in their relationship interface with the SI. This led to an even more critical and strategic role for the project management activities of the SI.

The system architecture dictated to a rather large extent the division of labour and responsibilities of the different software suppliers within the focal net. The various suppliers saw their reciprocal relationships rather differently, although they all had rather similar viewpoints on the nature of the relationship with the focal company and, furthermore, with the end customers. In practice, the nature of the different relationships did vary. Through the different exchange attributes, consisting of information sharing, social exchange, the object of exchange, and legal and operational bonds, the nature of these relationships can be explained.

As the preliminary model of value-creating networks made up the analytical eyeglasses at the focal net level of analysis, few evaluative words concerning the model itself and its applicability in practice can be provided. The model was applicable as such in the focal net analysis, and it allowed for multiple views on the phenomena of value-creating networks. However, the different elements of the model are so highly interconnected that it is not easy to place clear boundary lines between them. In carrying out the analysis, it became evident that certain things had already been dealt with in addressing some other element – e.g., in the discussion of perceived end customer value – while they could be dealt with also under sections on the element of core competencies or relationships. Furthermore, as concerns the relationships element, a distinction between different exchange attributes, different actor viewpoints, and the nature of the relationship was even harder to make in practice, as these three issues are so highly interconnected. Additionally, the element of core competencies was far more difficult to use as a tool in analysing the empirical material than the elements of perceived end customer value and relationships were.

Part IV: Conclusions

8 The empirically grounded model of value-creating networks

In this chapter, the main findings and outcomes of the study are discussed. The discussion is divided into three parts. Firstly, the results of the theoretical elaboration are discussed in the form of a summary of the theoretical chapters of the study. Secondly, the empirical research on the phenomenon of value-creating networks related to the software component business and the conclusions proceeding from it are presented. Lastly, a synthesis of the theoretical and empirical findings, including presentation of the empirically grounded model of value-creating networks, is provided. The model of value-creating networks developed here covers the elements involved in carrying out value creation processes related to software component business networks. Based on these empirically grounded elements and variations identified within them, a *typology of value-creating networks related to the software component business* can be provided at the end of the chapter.

8.1 Step 1: theoretical elaboration

Although this study's primary contribution is as an empirical study concerning value-creating networks, the level of success of the whole study depends on the theoretical elaboration of the concepts of value creation and business networks.

The theoretical discussion began by defining value creation as the *raison d'être* of any business. The discussion of value creation was followed by theoretical review concerning both the industrial network and strategic network streams of research and by comparison and synthesis of these views under the theme of network management. It was pointed out that the two differing research streams have a lot in common, although their focus has been on different levels of analysis – the net and network levels. These two levels can be differentiated from each other by their manageability. By way of summary, it was pointed out that both of these levels consist of single dyadic relationships. Networks as the broadest level for analysis can be broken apart for net-level examination, and nets in turn can be studied at the level of their constituent single dyadic relationships. Under the general network discussion, the ARA model developed by researchers in the loose IMP Group was presented and discussed as well.

The theoretical discussion continued by bringing together the concepts of value creation and business networks, in a review of existing theories and models of value-creating networks. Three kinds of models were discussed and evaluated in more detail, those developed by Kothandaraman & Wilson (2001), Parolini (1999), and Möller *et al.* (2002). Each of the models is very comprehensive, and they provide multiple views of the phenomenon of value-creating networks. However, through an evaluative review of these models, it became evident that there were shortcomings in their empirical applicability as such to the specific industrial setting of the software component business.

The model of Kothandaraman & Wilson (2001) provided a good basis for developing elements for the preliminary model of value-creating networks, as it pointed out the interrelated nature of superior value, core capabilities, and relationships as the foundation for any value-creating network. However, a shortcoming of this model is that the elements forming the model were defined only at a rather general level. Thus emerged a need for clarification of the concepts used as building blocks of the model in more detail before an empirical analysis of the software component business could be carried out.

The model provided by Parolini (1999) offered possibilities for fleshing out the concept of value, but it had shortcomings in its view of one of the most basic elements of any business network, that of the relationship, as, e.g., the role of social exchange between the network actors was not taken into account at all in the model. Furthermore, Parolini's model focused on understanding a value-creating network through activities; the importance of actors within a network was de-emphasised. However, the issue of interaction and social exchange did seem to play a role in the software component business, and the biggest business-oriented problems in the field were identified in the literature as related to the new style of interaction between the sellers and the buyers, as the nature of the object of exchange, the software, is being transformed from a service into more of a standardised product as part of the development of the software component business.

The model of Möller *et al.* (2002) was able to provide interesting insights not only on the competence element of value-creating networks but also on the different levels of value-creating networks as seen in a network management framework. However, their work focused on the supplier's capabilities and network management, leaving the general structure and value creation logic out of the scope of the analysis.

Thus, as none of these models could be used as-is in the empirical study, a new model for studying value creation in business networks was developed. The preliminary model was developed as a synthesis of the models reviewed, and by keeping in mind both the strengths and weaknesses of each of these three models.

This preliminary model of value-creating networks addresses perceived end customer value, core competencies, and relationships. The content of each of these three elements was detailed and clarified through reviewing literature related to the concepts. A summary of each element and their interconnected nature is provided in Chapter 4 and thus shall not be repeated here. Additionally, an illustration of the preliminary model is provided as Figure 28 in Chapter 4. Further considerations can be outlined:

A first step in increasing our understanding of value-creating networks is to identify who is the end customer and what kind of value the end customer considers differential. Differential value refers to the trade-off, for the customer, between the benefits and sacrifices created by the specific offering of the specific value-creating network compared to a competitive offering. Evaluation of the trade-off between the benefits and sacrifices is in the end done in the customer's mind; thus, the value created and obtained is subjectively perceived. As conceptual tools for understanding the perceived value, monetary and non-monetary perspectives and the product and process (i.e., relationship value) angles can be differentiated as standpoints from which to view value.

A second step toward understanding the value-creating networks is to clarify what kinds of core competencies as main resources of the network actors are needed in order to carry out the value creation activities that can create the differential value. This is not an easy task, for core competencies are rare and somewhat hard to identify. From a value-creating-network perspective, the necessary core competencies should be considered in close relation to the end customers' value perceptions: if the end customer, e.g., puts weight on the logistics questions related to the offering, then those network actors that are strong in logistics have a good position in the value-creating network. Another important consideration in looking at core competencies from a value-creating-network point of view is that the emphasis should be on those competencies that the actors are able to utilise, not on those that the actors possess.

The last conceptualisation is related to the relationships element of a value-creating network. It needs to be clarified what kinds of relationships are formed in joining the core competencies and value creation activities of the network actors. There are several relationship types, differing from each other in their closeness and dominance/balance level, and also in their emphasis on the other relationship connectors. These relationship connectors are legal bonds, operational linkages, and social and information exchange. It is noteworthy that value can be created also through more arm's-length relationships and not just through close, long-term relationships. Thus, a value-creating network is not composed of only relationships that can be labelled partnerships; it can also consist of short-term and more arm's-length relationships.

8.2 Step 2: empirical research

Empirical research plays an important role in the present study, as the purpose of the study is to build an empirically grounded model of value-creating networks. The key findings that can be derived from both levels of analysis – the macro network and net levels – of the empirical study are provided in this section. The key findings are related to the special nature of a software component as the object of exchange; its influence on the nature of the relationships within the value-creating network; and, lastly, the special role of the so-called system architecture in the value-creating network. These key findings are discussed below.

The software component as the object of exchange and the nature of the relationship. Based on the empirical findings, the object of exchange can be analysed more thoroughly in the context of the software component business by examining the characteristics of software components: *generality*, *importance in the overall system*, *adaptability*, and *size*. An obvious relationship between the nature of the component and the nature of the business relationship of the SI and the supplier was identifiable from the empirical material. For example, the more general the component under exchange is, the more distant the relationship between the SI and the supplier usually is. Furthermore, the potential for an intermediary to exist between the SI and the supplier also increases when general software components are involved.

Additionally, when it comes to the nature of relationships within the value-creating network, there were two relationship connectors that were identified as the most critical in the context of the software component business: information sharing and legal bonds in the form of IPRs. This is due to the complex integration of components and the need to protect one's own core competence and future potential businesses in a turbulent environment. Both of these two relationship connectors were seen as an obstacle to building closer relationships with other actors within the network.

Based on the utilisation of the aforementioned aspects of the object of exchange and the relationship connectors, two main relationship types (namely, *transactional and partnership*) were identified as having their own special influence on the structure of the value-creating network related to software component operations. Furthermore, it was evident from the empirical material that both of these relationship types are going to exist, as they both can be a source of differential value creation. These two relationship types are discussed below as the extremes of the spectrum of SI/supplier relationships in the software component business context. Furthermore, as the empirical study was carried out with attention to the different actor perspectives in the software component business, a discussion concerning both the problems and opportunities of the software component business from the different actor perspectives (those of the SI, supplier, and possible intermediary) can be provided below.

Transactional and partnership-type relationships in value-creating networks related to the software component business. Based on the findings from the empirical data, both transactional and partnership types of supplier relationships are likely needed in the emerging software component business. Although close relationships were emphasised, no clear scenarios for the popularity of these two opposite modes of relationship behaviour could be developed. However, based on the empirical data and utilising the relationship connectors identified in Figure 26, the basic characteristics of partnership and transactional relationships within the context of the software component business are summarised in Table 7. The two relationship types are compared not only in terms of the relationship connectors – information exchange, legal bonds, operational linkages, closeness, and dominance – that illustrate the nature of the relationship but also in the elements – generality, importance, and adaptability – characterising the software component as the object of exchange.

Table 7. Partnership vs. transactional relationships in value-creating networks related to the software component business.

Value creation	Partner relationship	Transactional relationship
Nature of Relationship		
Information exchange	More open sharing of information (e.g., future product development plans)	Standard and narrow information exchange
Legal bonds	'Handshake' agreements preferred, IPRs shared or buyer-owned	Standard legal agreements, mostly licence-based trade, seller-owned IPRs
Operational linkages	A lot of operational linkages exist – e.g., in terms of shared product development	Indirect operational linkages – mainly concentrated in selling and purchasing activities
Closeness	Close co-operation (including shared risks and mutual adjustments)	Arm's-length relationship, lack of direct contacts, utilisation of an intermediary
Nature of Component		
Generality	Mostly application-domain-specific components	Mostly general components
Adaptability	MOTS, modifying and tailoring done in co-operation	COTS, standardised components, narrow possibilities for tailoring
Importance	Usually quite critical for the buyer (e.g., an important piece of the final product)	Less critical and important parts – at least not closely related to the buyer's core competence area

The different types of software component buyer/supplier relationships can be positioned in relation to each other in terms of the closeness and dominance that occurs, referring to Figures 25 and 26. For example, partner relationships can be positioned in the middle of the relationship continuum based on how close a co-operation the supplier and the SI are emphasising. However, at the same time, such a relationship leaves space for the dominance of the other party. Based on the empirical data, it can be argued that in most cases the SI is going to have a more dominant position than the component supplier. However, especially in cases where the component acquired is 'large' or critical to the SI, the component supplier may increase its dominance in the relationship, too. This can also occur when a domestic SI is sourcing standard components from a global supplier.

Of the relationship connectors that have been identified, that of legal bonds is very important, based on the empirical findings. This is not a surprise, as IPR policies are not well structured even in the software industry in general, not to mention the software component business, which is still in the beginning of its development. For example, licensing may be more complex for software components than for whole software products merely because of the 'small' size and 'low' price of the components. Also, the need for a component to be as flexible as possible can easily result in problems in creating appropriate licence agreements. Because the actual use of the component may be quite hard to specify beforehand from the SI's viewpoint, control over IPRs can become a serious problem for the supplier company. Depending on who does any necessary customisation of the component, there arises the question of how the IPRs for the modified parts of the component are divided. One possible solution is shared IPRs, but this involves some major risks, too. Shared IPRs require clear instructions and procedures concerning the division of management of the IPRs. For example, which party is going to act and in what way in the event of possible infringement of the shared IPRs?

Additionally, because the software component is going to be assembled and used as part of another product, the SI usually needs to have access to the source code of the component. The consequences of such access are extremely difficult to monitor and control; the buyer may be able to change any part of the source code at any time. (Halligan 1995) Thus, besides the risks and liability each party assumes, also the confidentiality of the licensed component should be addressed. Usually the question of modifications is very important (Chávez *et al.* 1998). The modification problem may be solved such that the supplier takes the responsibility for carrying out the necessary modifications. However, the SI must in this case trust the supplier so much that it is ready to provide enough information concerning the whole product. On the other hand, the SI can make the modifications itself. In this case, the problem is that the supplier should trust the SI enough to reveal the necessary portions of the source code. This problem can be solved either by an escrow agreement, in which the source code is returned once predetermined conditions have changed, or by supplying only as much of the source code as is necessary and making sure that it will be used only as specified (Rosenberg 2000).

IPR issues can be seen as one of the problems standing in the way of software component business development. However, as stated earlier in this section, another major problem is the question of information sharing, which in fact is closely related to the IPR issues. Based on the empirical data, in Table 8 the problems are summarised alongside the opportunities of the software component business. Both the opportunities and problems are viewed from the perspectives of the SI, supplier, and possible intermediary.

Table 8. Problems and opportunities in the software component business.

	Opportunities	Problems
Supplier	Easy distribution channel to use	How to get the attention of a big SI
	Can help to reach new end user groups	How to deal with IPR issues
	Does not require brand-building skills	The lack of one's own brand visibility, if aiming at COTS markets
	Support from the SI (e.g., educational)	Profit margin
		General vs. specific nature of the component
		Component maintenance
SI	Can concentrate on its own core competence	Finding good suppliers
	New ideas from supplier for product development	Component evaluation
		Component maintenance
		Shared IPRs
		If a big SI supplier, whether tailoring needs can be taken into account
		Existence of product architecture
		Component tailoring needs
Intermediary	Can help in finding the right partners	Is an intermediary even possible in close supplier/buyer relationships?
	Can help with IPR issues	
	Can help in component evaluation	Electronic marketplaces vs. component tailoring
	Possible value-added offerings	ASP: is it possible to rent a component in a product that is sold further down the chain?

These opportunities and problems will, naturally, affect the way the software component business develops within the industrial automation sector, and in the ICT cluster in general.

The role of the system architecture in value-creating networks related to the software component business. Empirical data concerning both the macro network level of analysis and the focal net level of analysis strongly indicated that although the preliminary model is suitable also for the software component business context, it certainly should be developed further by adding the element of system architecture at the heart of the model. Addition of this element is justified because it was found to have major effects on the value-creating network as a whole. Firstly, it structures the supplier network of the SI. Secondly, the influence of the end customer on the system solution is better understood when one takes into account the different architectural layers. Thirdly, it enables identification of the SI's core competence area and thus determines the extent to which the SI opens up the different layers for utilisation of commercial software components and what type of relationship with the component suppliers is most suitable for each of the layers. Lastly, the system architecture acts as a value system router as it gathers value streams from several suppliers at different system layers and then leads the value stream through the integration process to the end customer, which sees the provided system solution as one value creation entity.

The role of the system architecture in the value-creating network is discussed more in the following section, in which the outcome of the theoretical and empirical material in the form of an empirically grounded model of value-creating networks is presented.

8.3 Step 3: the outcome

'What are the specific features of the software component business that influence the structure of value-creating networks?' is the question to be answered in order to present the empirically grounded model of value-creating networks related to the software component business. Some answers have been provided in the previous section, but an integrative discussion is still missing. In this section, such a discussion of conclusions is provided, starting with a reminder of the importance of the system architecture as a specific feature of the software component business that influences the structure of value-creating networks.

As stated earlier, through the concept of system architecture the informants in the empirical part of the study expressed the value created for the end customer, their core competencies and those of their supplementary suppliers, and the nature of the supplier relationships. Thus, the value-creating network and its interconnected elements (perceived end customer value, core competencies, and relationships) must be mirrored through the concept of system architecture in the context of the software component business. For that reason, the heart of the empirically grounded model of value-creating networks has a fourth element added, the system architecture (see Figure 40).

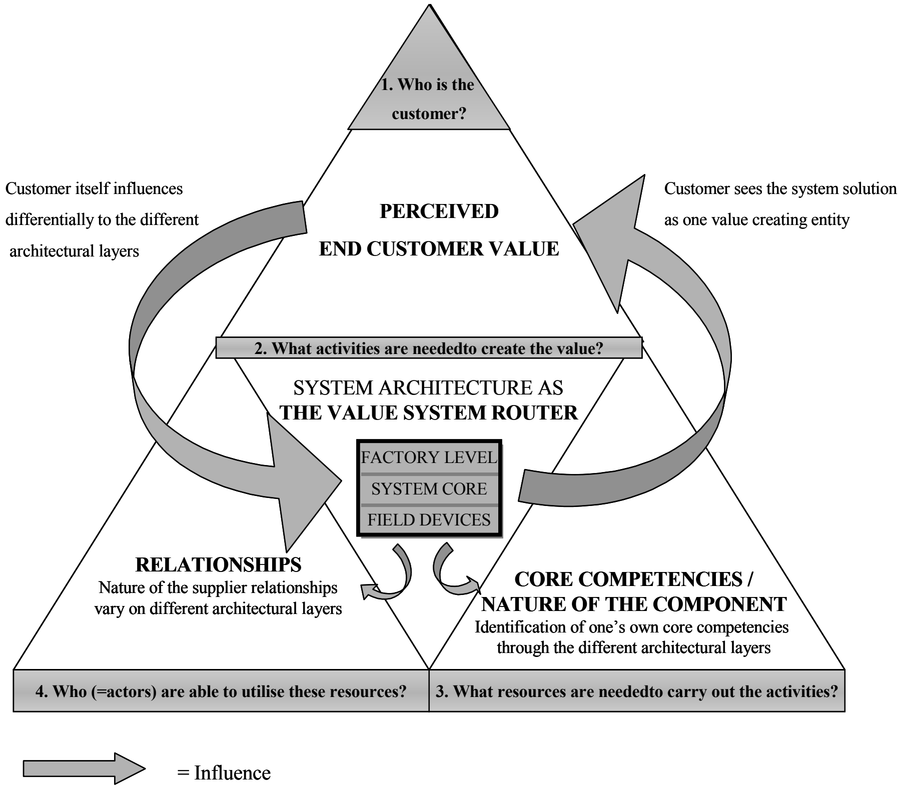

Fig. 40. The empirically grounded model of value-creating networks related to the software component business.

Thus, the system architecture establishes the layered framework for integrating different components and sub-parts in order to build an effective total system solution for the end customer. As has been stated in Section 8.2, it thus acts as a *value system router*, as it joins value streams from several suppliers at different system layers and then leads the value stream through the integration process to the end customer, which sees the system solution as one value-creating entity. Thus, the value system router element highlights the essence of a value-creating network: the end customers are in a very important role, as they define the differential and superior value created by the network actors. Through the value system router the end customer gets what it has wanted – a total system solution. In order to guarantee that the process behind the system delivery is functional and thus provides process-related value, there needs to be a procedure for the SI and the suppliers to maintain the network's coherence and ensure the quality of the value creation.

The system architecture is thus the single most specific feature of the software component business that influences the structure of value-creating networks. However, there were also other specific features of the software component business that were found to influence the structure of the value-creating network through the elements of perceived end customer value, core competencies, and especially the element of relationships. These features are somewhat related to the special nature of software components as the objects of exchange.

As regards the element of value as perceived by the end customer, software as the object of exchange presents difficulties for the network actors in identifying and articulating the value created by the software. In the eyes of the end customer, it doesn't really matter whether the software included in the system solution is developed in traditional projects priced by the hour or as software components, as the end customer in all cases assumes that the functionality of the overall system solution is the SI's responsibility, and demands this. However, as software is an intangible product that is valued in terms of what it does, the perception of value on the part of the end customer is related more to the process value added than to the product value added.

In a similar way, the element of core competencies is characterised in the software component business by the intangible and knowledge-intensive nature of software as the object of exchange. Software is a very knowledge-intensive object of exchange, and the successfulness of software can be argued to be more dependent on the individual's competencies in creating the code than is the case with, e.g., more physical goods. Thus, one idea behind software componentisation is to diminish the danger of losing important competence when a software coder and his/her tacit knowledge leave the company. However, even with software components there remains the demanding task of integration and architecture design; thus, the role of people cannot be diminished even by utilising software components.

Based on the empirical findings, the nature of the component and the core competencies of the network actors are closely connected to each other, as software componentisation is one way to try to codify the tacit knowledge. Although documentation created during software development has the same aim, software componentisation goes one step further. Additionally, the connection between the nature of the component and the competencies was seen through the generality of the component: it is a demanding task to develop general components, but when a supplier is competent enough to develop one, it can enter wider markets in which it can become the critical supplier for many SI companies operating even in different industries.

However, the specific features of the software component business are particularly visible in the element of relationships, as the significance of the different relationship connectors is clearly emphasised, especially in terms of the information sharing and IPR issues as the legal bonds. The significance of both of these relationship connectors is derived, again, from the intangible and knowledge-intensive nature of software as the object of exchange. To take an example, in the software component business the legal agreements on what is done with the source code of the component are important. It is possible for the supplier to retain all control of the source code and then suddenly go bankrupt, leaving the SI in big trouble if the component plays a critical role in the system solution and the SI doesn't have rights to get the source code from the supplier.

In summary, the specific character of software components as the objects of exchange influences what kinds of relationships the SIs and, on the other hand, the suppliers are willing to develop. From the SI's point of view, the three most important questions related to software components are 1) how *critical* the component is for the overall functionality, 2) if there is a need for *modifications*, and 3) how closely *related* that specific component is *to the core competence* of the buyer. The answers to these questions usually determine how important such other component-related matters as IPRs, documentation, testing, quality, and maintenance services are. Furthermore, the answers determine much of what is required of the suppliers and also the nature of the software component acquisition process, including, e.g., evaluation of potential suppliers. For example, if the component is not that critical for the SI, evaluation of the potential supplier may be less involved, and the component can even be bought from a company that sells the same component to competitors, too.

From the supplier's point of view, the most important software-component-related value question is the *generality* of the component. The more general the component is, the wider the markets are. Additionally, the supplier usually owns the IPRs of components that do not need any modifications, and the need to supply the source code to the SI is not evident. However, the problem is that it is never possible to produce and sell totally general components – all software products are used by specific companies and persons, possessing not only unique needs but also unique competencies to make use of the components in a manner not employed by other actors.

The question of the nature of the component is in broader terms related to that of how critical the competencies are that the supplier of the component possesses, as has already been discussed. If the supplier possesses critical competencies, it has the chance to gain a more dominant position in the value-creating network than suppliers who possess easily replaceable competencies do. Although it would seem that those SI/supplier relationships in which critical competencies play a role would all be rather close and co-operative, that is not necessarily what occurs, based on the empirical findings. Empirical data indicated that if the component is so general in nature that it has wide markets, the supplier usually has an opportunity to maintain more distant relationships with certain SIs.

Based on these two concepts – the nature of the relationship and the criticality of the competence – familiar from the model of value-creating networks, a typology of value-creating networks related to the software component business can be provided (see Figure 41).

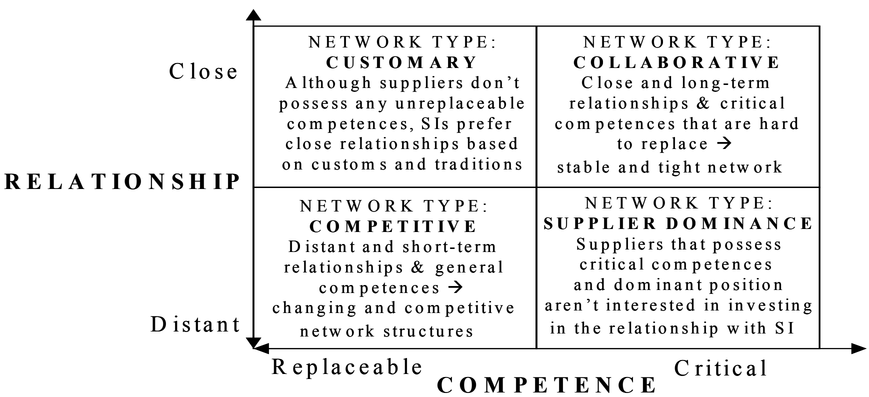

Fig. 41. Typology of value-creating networks related to the software component business.

The different types of value-creating networks are named as Competitive, Collaborative, Customary, and Supplier-Dominance value-creating networks, as these names characterise the nature of the relationships making up the structure of the network rather well. These types of value-creating networks related to the software component business vary from each other in terms of the elements of relationships and core competencies. As the nature of the relationships and the criticality of the core competencies vary at different system architecture levels, multiple network types can be encountered in relation to creation of a single system solution. Although these different types can be found at any of the architectural layers, the empirical data indicated that some of the types are more typical of the lower layer of the architecture, while other types are more characteristic of the upper layers of the architecture. In Table 9, these different network types and the influencing elements behind them are provided.

Table 9. Characteristics of the elements influencing the different types of value-creating networks.

	Type A) Competitive	Type B) Collaborative	Type C) Customary	Type D) Supplier Dominance
Relationships				
Different exchange attributes	Product and financial exchange emphasized	Information and social exchange emphasized	Social exchange emphasized	Financial exchange emphasized
Actor's perspectives	Supplier goals: Make an even better deal next time. Try to achieve critical competence as a tool for ensuring own position in the supplier network	Supplier goals: Further develop own competences and take care of the relationship with SI to ensure your position	Supplier goals: Take good care of relationships for ensuring future business, win-win relationships	Supplier goals: Keep the dominant position by developing competences constantly
	SI goals: Seek for new deals	SI goals: Gain innovations and long-term success through close co-operation	SI goals: Ensure competitiveness of the suppliers, win-win relationships	SI goals: Try to strengthen your position in the supplier's eyes, or support development of new substituting suppliers
Nature of the relationship	Distant and short-term, suppliers do not compete with the SI, but suppliers compete against each others	Close and long-term, biggest suppliers can become a threat to SIs. Cooperation occurs also between suppliers	Close and long-term, trust plays a remarkable role as well as personal relations and informal insiders' mutual agreements	Distant and short-term, suppliers are not interested in investing in relationships with small-scaled Sis
Core competencies				
Critical resources	Due to rather general and replaceable competences accessibility to new network participants is easy in principle	Competences are critical and hard to replace. Accessibility to new network participants is easy in case of proper timing and evidence of critical competence	Evidence of critical competence does not matter as much as long shared relationship history: difficult accessibility to new network participants	Few suppliers possess critical competences and have dominant position in the markets: they can choose with which customers they do business
Nature of knowledge and skills	Generic, codified knowledge	Relationship- specific / substantial knowledge	Relationship-specific, even tacit knowledge	Generic, codified knowledge
System architecture				
Typical architectural layer and its relation to created value	Typical network structure for the lowest architectural layer, where *enabling* value is created	Typical network structure for the middle architectural layer, where *core* value is created	This network structure can occur in all of the architectural layers, while it is a chosen procedure based more on traditions and shared history than on value creation logic	Typical network structure for the uppermost architectural layer, where *added value* is created

The perceived end customer value is the foundation for the different value-creating network types, as it defines what competencies are the critical ones. Based on the criticality and importance of the competencies, different actors have varying positions and roles within the value-creating network. However, based on the empirical findings, the perceived end customer value does not directly differentiate the value-creating network types from each other. Instead, the network types can be distinguished through the other two elements of the empirically grounded model: relationships and core competencies.

In looking more closely at the element of relationships, the nature of the relationship in closeness and dominance/balance terms acts as an important criterion for classifying networks as various types. Distant and usually rather short-term relationships are characteristic of the Competitive type. It is noteworthy that although the suppliers are not competing against the SI, competition between the suppliers is usually rather tough. Distant relationships between the suppliers and SIs are characteristic also for the Supplier-Dominance network type, although this time the desire to maintain distant relations comes from the supplier, not the SI. Close and long-term relationships between the suppliers and the SI are characteristic of the other two types of value-creating networks, the Collaborative and the Customary. In a Collaborative network, close co-operation is typical also between the suppliers, not only between the supplier and SI.

The different value-creating network types are also characterised by varying emphasis on different exchange attributes. Product and financial exchange have a major role in the Competitive network type. In the Supplier-Dominance network type as well, the role of financial exchange is emphasised. When it comes to the Collaborative and Customary networks, the role of social exchange increases, as is typical for close and long-term-oriented relationships. For the Collaborative network type, also information exchange is important.

In the different types of value-creating networks, the goals of the actors vary as well. In the Competitive network type, both the suppliers and the SI concentrate on gaining short-term benefits, although the suppliers are at the same time trying to achieve critical competencies that would differentiate them from other suppliers in other ways than just financially. In the Collaborative network type, both the suppliers and the SIs are seeking to obtain shared value through investment relationships. A search for win-win relationships is characteristic also for the Customary network type, whereas the Supplier-Dominance network type involves the goals and perspectives of the suppliers and the SI differing from each other a great deal. Although the SI in a Supplier-Dominance network tries to strengthen its position in the eyes of the supplier, the SI usually tries to ensure sufficient supplies that are competently delivered, by trying to find new, substitute suppliers.

Alongside the element of relationships, the core competencies element acts as an influencing and differentiating factor for the value-creating network typology. The criticality versus replaceability of the competence determines the positions of the actors within the network. The Competitive network type is lively as long as rather general and replaceable competencies are involved, but in the opposite scenario, where only a few suppliers possess the needed competencies, the Supplier-Dominance network type is the lively one. On the other hand, evidence of critical competence does not matter so much in the Customary network type, as the closeness of relationships and willingness to co-operate closely are based on shared history and old customs, and not so much on competencies. In the Collaborative network type, the actors have realised the importance of nurturing relationships in which the critical competencies are involved.

Closely related to the criticality of the competencies is the character of the knowledge and skills of the network actors. Generic, codified knowledge is characteristic of the Competitive and Supplier-Dominance network types, whereas relationship-specific and even tacit knowledge is more typical of the Collaborative and Customary network types.

Empirical findings also indicate that the Competitive network type is usually found in the lower layer of the system architecture. This layer is not usually close to the core competence of the integrator company, and it is not so visible to the end customer. This is the layer that can be understood as creating *enabling* value, as it is impossible to create the system solution without this layer. Collaborative-type networks are typically seen in the middle layer of the system architecture, as this is the layer where the core competence of the integrator company is concentrated. In order to protect its own core competence area, the SI is usually ready to open this architectural layer to only a few carefully selected suppliers, with whom close co-operation is carried out. This can be seen as the layer where the *core* value of the system solution is created. Based on the empirical findings, the Customary network type is not so easy to classify as typical of just one of the architectural layers, as this network type is not based on the criticality of the competencies. Instead, it is based on customs and the shared history of the suppliers and the SI. The fourth type of value-creating network identified, the Supplier-Dominance type, typically is seen in the upper layer of the system architecture. Although this is the layer where the *added* value is created for the end customer, the solutions utilised are usually rather general and thus the suppliers of these solutions are large actors operating in several sectors and segments thereof. The suppliers have a dominant position, especially from the viewpoint of smaller SI companies, as was found from the empirical data.

Through such a typology of value-creating networks, the interrelated nature of the elements forming the empirically grounded model of value-creating networks can be highlighted. The starting point is the perceived end customer value, which determines what the critical competencies are. In addition, the position of the actors in the network is dictated through their competencies: the more critical the competence to which the actor has access, the more dominant a role the actor has in the network.

9 Discussion and implications

This chapter starts with an evaluative discussion of the present study. Then, the contribution of the study is discussed in both theoretical and managerial terms. At the end of the chapter, limitations of the study and possible avenues for further research are outlined.

9.1 Evaluation of the study

Any study must be evaluated by its results and how significant those results really are. Nevertheless, a scientific study is also evaluated as an overall research process, in terms of its research design and in the way the researcher has obtained the results described for the study. In other words, scientific methods should have been used appropriately. When it comes to the evaluation of qualitative research, varying views on relevance and the ability to speak of reliability and validity have been presented[35]. In quantitative studies, how to apply these two metrics is to some extent obvious, but as the present study is qualitative, I will apply the concepts of validity and reliability as appropriate.

As stated above, criteria for evaluating the quality of research designs can include reliability and validity, where the latter comprises construct validity, internal validity, and external validity (Yin 1994, Lincoln & Cuba 1989). In the evaluation of the present study, reliability as it refers to the replicability of the research procedure is the hardest to prove. This is because qualitative research includes a great amount of interpretation on the part of the researcher. It is not easy to say whether the data collection could be repeated with the same results. However, there are some tactics that **can** be applied to increase the reliability of qualitative research. In this study, in the course of carrying out the interviews, a list of issues[36] that it was important to discuss with all of the interviewees was created. Reliability would have been increased even more, of course, if specifically defined questions and a more structured method of carrying out the interviews had been

[35] This is due to the belief that in qualitative research there are multiple perspectives that need to be presented but it is not possible to establish which is the best view (Stake 1995).
[36] This kind of list of interview themes utilised is provided in Appendix 4.

used, but that would have gone against the idea of conducting interviews that are discussion-oriented and allow surprises and new views from the informant. Thus, the basic nature and purpose of qualitative research and unstructured interviews run counter to the traditional means of ensuring research reliability in some respects. However, the idea of increasing reliability by developing a database of the empirical material (see, e.g., Yin 1994), is appropriate for both quantitative and qualitative research. In the present study, a database, which includes narratives of each of the interviews, project workshops, and meeting memos; focal-company-related documents; and categorised secondary data, was developed to organise the large amount of empirical data.

The validity of the present study can be measured in terms of construct validity, and to some extent by internal and external validity, too. Construct validity involves establishing correct procedures and can be increased by using multiple sources of evidence and having key informants review the interview reports or the draft case study report (Yin 1994). In the present study, besides gathering primary data, also large amounts of secondary data were gathered from a variety of sources – e.g., professional magazines, academic journals, and the Internet. Additionally, in the gathering of the primary data, several interviews were conducted, representing different perspectives on the issue under study – e.g., the supplier's, SI's, or customer's point of view. Furthermore, most of the interviewees were asked to review and comment on either the actual interview narrative or a summary that was made for a group of interviews.

Although it has been argued that internal validity is relevant mainly for explanatory or causal studies (Yin 1994), in this study an attempt was made to increase internal validity by choosing several interviewees who either had extensive experience in the sector of industry or company studied or in other ways were evaluated as able to offer interesting insights on the issues studied. For example, in choosing the interviewees for the first part of the empirical study (the macro-network level)[37], both academic experts and company representatives were selected, in order to gain different perspectives on the development of the industrial automation sector and the software component business as a part of it.

External validity refers to establishing the domain to which the study's findings can be generalised. When it comes to case studies, a more appropriate term would be 'analytical generalisation' instead of 'statistical generalisation'. In other words, the aim is to generalise a particular set of results to some broader theory, not to a larger population (Yin 1994). Besides analytical generalisation, the concept of petite generalisation, as opposed to grand generalisation, has been utilised in qualitative studies and case studies (Stake 1995). Such modifications of the traditional content of the term 'generalisation' for qualitative and case studies may give the appearance that generalisation is not relevant to studies that aren't quantitative. However, as Alasuutari (1995) points out, also in qualitative research the researcher should discuss in what respect it can be assumed or argued that the study has general validity beyond the individual case explored.

Analytical generalisability of the results. In this study, the aim has been neither to develop a general theory that is free of all industry-specific ties nor to generalise the results obtained in the software-intensive context to other contexts and industries. Rather, the aim has been to develop a model of value-creating networks that is applicable in the specific industrial setting of the software component business. By building an empirically

[37] Presented in Chapter 6.

grounded model tied to that specific context, this study has focused on *local theory development*.

Thus, the general theories about value-creating networks are developed so as to be more specific and suitable for study of a software-intensive industry, in particular the software component business. In other words, analytical generalisation arises from the aim to add new, software-related dimensions to the discussion in the previous literature concerning value-creating networks in general, and thus, in the chosen context, analytical generalisations are drawn for the research stream of value creation.

However, there are also two important issues related to the present study that indicate the potential for applying the local theory development done in this study with slight modifications to other value-creating networks in which complex system types of solutions are produced. Firstly, *the choice of the specific industrial setting*, the software component business, *was made carefully in order to find an industry that would allow a multifaceted view of the phenomenon under study*, the value-creating networks. Thus, the aim was to find such an industry as the empirical context, in order to make as substantial a contribution as possible to the development of the relevant theory. Because the software component business, in part due to the special nature of software as the object of exchange, captured the complexity of value creation, and the problems in understanding the value created in practice, rather well, the choice of industrial setting for the study of value creation can be argued to be successful. Furthermore, because software components are not valued by the end customers as such, as their value exists only in that they are part of a wider system solution that is produced in co-operation with many component and sub-part suppliers, the network approach is a very suitable approach.

Secondly, *the richness of the data* (see Easton 1995) obtained in the present study points in addition toward the potential for applying the local theory developed in this study to other, comparable business networks. The richness of the data was increased by employing an empirical study in two parts that supplement each other, by use of a series of in-depth interviews of different types of actors within the industry, and by an exhaustive review of secondary data concerning the industrial setting of the study. The main finding of the present study, the role of system architecture as a value system router in a value network creating a system solution, was supported by all of the types of empirical data mentioned. Based on details and in-depth analysis (see, e.g., Easton 1995), it is possible to theorise that a similar kind of value system router procedure can be found in other business networks built around a complex system solution, and that it may have similar kinds of influences on the network structure and relationship management as were found in the case of system architecture in the software component business.

Generalisability of the results to other segments of industry within the ICT cluster. Because this study has been carried out in large part (the empirical portions) in the industrial automation sector, it is relevant to ask how valid the model developed for value-creating networks and the results of the study in fact are in other sectors of the ICT cluster. In order to shed some light on this matter, I will shortly compare the industrial automation sector and another important part of the ICT cluster, the telecommunications sector. The comparison is based on three different data sources, namely the research report provided by Niemelä *et al.* (2000), in which the telecommunications, automation, and electronics sectors as a part of the Finnish ICT cluster have been studied; the general ICT cluster data gathered in the first part of the empirical study; and, lastly, a discussion with an academic expert possessing knowledge from both the automation and telecommunications sector[38]. Thus, in order to address the level of generalisability of this study within the ICT cluster, data triangulation (Patton 1987) has been used.

As was stated at the beginning of this study, the automation sector has been considered more advanced in utilising commercial software components than other sectors of the ICT cluster have been. Thus, it might be argued that the other sectors of the ICT cluster could follow the example of the industrial automation sector in the software component business, at least to some extent. However, there are some differences between the automation sector and other sectors in the cluster – e.g., the telecommunications sector – that need to be taken into account before such direct generalisations may be made. First, the automation sector has a longer tradition of utilising all kinds of components in building system solutions than does the telecommunications sector, for instance. A longer tradition in utilising hardware components and especially the tradition of *buying* components outside the firm rather than producing as much in-house as possible has its influence on the level of competence in buying software as components, too.

However, there are also other differences that are significant from the software component business angle. One major difference is that technological generations are usually longer in the industrial automation sector than they are in the telecommunications sector, in general. These slower technological changes leave room for utilisation of commercial software components, as discussed previously in this study. Derived from the slower technological changes, another important difference is the more mature level of technical solutions in the industrial automation sector as compared to the telecommunications sector. For example, mature product architectures are major facilitators of, or even prerequisites for, successful utilisation of commercial software components, as discussed earlier in this thesis. The automation sector and telecommunications sector differ from each other further in their tradition of standardisation; in the latter sector, everything usually begins with standardisation, whereas the automation sector still has some important areas, like field buses, that have been in a confused state for years when it comes to standardisation. This standardisation-related difference indicates that the telecommunications sector would be more ready to use commercial software components than the automation sector, whereas the technology-cycle-related differences indicates the opposite.

Thus, there are some major differences between the telecommunications and industrial automation sectors that most likely influence the maturity level of the specific sector, leading it to move toward true software component business operations. It can still be argued that these differences do not affect the applicability of the empirically grounded model developed in this study, as the basic idea of the three different architectural layers of software-intensive system products is visible in both sectors of the ICT cluster discussed. Although these layers are given different names in the two sectors, they have the same basic purposes. For example, in both sectors the uppermost layer is the information system level (closest to the user of the system as a unit); the middle layer is the core competence area of the specific industrial sector; and the lowest layer is the device layer, in which hardware, and furthermore the suppliers of electronics, play a

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[38] The discussion, held on the 14th of January 2002, lasted approximately 1½ hours and covered the theme 'the software component business in the automation and telecommunications sectors'.

significant role. Based on this discussion, I argue that the model developed is applicable in studying software component operations in other sectors of the ICT cluster, too, not just the industrial automation sector.

9.2 Theoretical contributions

The result of the study, the empirically grounded model of value-creating networks and the typology of value-creating networks that originates from the elements of the model, contributes to the industrial network research tradition. Studies dealing with value creation in inter-organisational relationships, at the level of both dyads and networks, have gained increasing attention from industrial network researchers in recent years. The number of studies that have *empirically* dealt with the value creation phenomenon at the level of *dyads* has been far greater than that of empirically oriented value-creating *network* studies. The present study goes some way toward redressing this lack of empirically oriented studies about value-creating networks by providing a local theory that is grounded in the context of the software component business. This contribution can be considered via the question ‘What is new in the conceptual basis for the empirically grounded model of value-creating networks?’

Studies concerning technology, high-tech markets, and even the software business from the industrial network perspective are not a new thing for IMP Group researchers. However, the present study has delved more deeply into the technology and software industry, as it has also examined even as technical an element as the system architecture actually is. In fact, the main theoretical contribution of this study can be argued to be *the identification of the influence of the system architecture* as one major factor affecting the structure of the value-creating network. *In the previous literature concerning value creation and industrial networks, such a viewpoint centred on the system product has not been taken into account in as much detail.* Based on the empirical findings of this study, it can be argued that this element has quite an important influence on the network structure. If it is omitted from the network analysis of a software-intensive industry, the outcome may differ considerably from that of analysis that does include such an element. This is because in order to manage the complex process of software development, software companies have been forced to develop and implement product-line architectures that allow a more precise structuring with respect to where and how the different pieces of software should be positioned. This is clearly the case in system products and system solutions because usually they are such large and complex entities that they need special tools in order to be manageable.

The importance of understanding the concept of system architecture in a value-creating network, however, arises from its role as a *value system router* that has multiple effects on the value-creating network. These effects and roles were examined in more detail in Section 8.3, but as a brief summary, the significance of the value system router for the whole value-creating network was identified through its role as an end customer value filter and integrator, as a tool for identifying the network actors’ core competencies and actors’ positions in the network, and as a tool for supplier network management.

Additionally, the present study *in part supplements and adds detail to the discussion of value creation in business networks* by using also references outside the value creation studies carried out by industrial network researchers, although the main emphasis has been on reviewing the conclusions of that research tradition. The elements of perceived end customer value, core competencies, and relationships, together forming the preliminary model of value-creating networks, were each detailed through identification of relevant aspects of these concepts. Views on these elements were not only sought from the industrial network research tradition but also from, e.g., the North American research tradition addressing strategic alliances and networks.

A special contribution was made through *summarising the different aspects of business relationships that it is essential to understand in a value-creating network*: different exchange attributes, actor perspectives, and relationship types based on the nature of the relationship. These aspects are very interrelated in nature; for example, the different relationship types vary in their emphasis on the different exchange attributes. On the other hand, the actors within the value network may have varying beliefs on the nature of the relationships in the network. For example, it was typical for a supplier to name as its partners all the SIs it was involved with, while the same SIs did not consider most of these suppliers to be their partners. Instead, the SIs named their customers as their partners. Such subjective perspectives are always present in a value network, and that is why the data on which the empirical results of the study are based should be gathered in a network study involving different kinds of actor representatives, as was done in the present study.

This study also makes a contribution to thought concerning the nature of the relationships between the network actors: the network analysis in the present study follows the assumption that there potentially exist also short-term and transactional relationships between the network actors, not just long-term, close ones. More arm's-length relationships were seen as important to consider in the analysis, although they have not been the central focus of most industrial network studies (see, e.g., Möller & Wilson 1995). However, in order to get a holistic picture of the value-creating network in the software component business, such more distant relationships need to be included in the analysis, as it is also through them that value is created in the network, though with a different logic than that applied in long-term and close relationships. Indeed, based on the findings of the study, it can be further argued that *the nature of the relationships in a value-creating network can vary considerably. Thus, a value-creating network consists not just of the very close and long-term relationships; the value is created in the network also through more short-term and transactional exchange relationships.*

This study also contributes to the rather limited literature concerning the software component business, as the study describes the value-creating networks *related to the software component business*. As a research area, the software component business lies between the sciences of information technology and marketing. So far, the literature in both related fields has lacked a description combining the technical and more marketing-oriented perspectives when it comes to value-creating networks related to the software component business. In order to overcome the obstacles that are currently hindering the development of the software component business, both technical and marketing issues need to be understood. It can be argued that the more technical, purely software-related matters and more general marketing concerns such as the value creation, business relationship, and network angles have multiple, mutual influences on each other. For example, the criticality and uniqueness of the software component acquired determine which party in the relationship, the buyer or the seller, has the dominant position in the relationship. On the other hand, the choice between a relationship based on transactions and one based on co-operation affects what kinds of IPR agreements the parties are ready to make. These influence relations are, however, extremely interrelated and thus hard to explain in an unambiguous manner. Nevertheless, it is useful to recognise these influence relations at least to some extent, as is addressed more thoroughly in the discussion of managerial implications provided in the next section.

9.3 Managerial implications

Through the empirically grounded model developed for value-creating networks, understanding of the software component business can be increased. As was pointed out at the start of this thesis, utilisation of commercial software components has mainly been studied from a more technical point of view, although it is evident that there are many business-oriented problems standing in the way of the true emergence of the software component business. These business-oriented challenges can be seen most clearly by examining the software component business from the value-creating network angle.

Most importantly, this study emphasises the role of system architecture as an element that ties together the technical and business-oriented views, both of which are needed to enable successful utilisation of commercial software components. Many obstacles to the development of the software component business can be identified that have both a technical and a business-oriented nature. For example, unsuccessful standardisation or inadequate integration and documentation processes hinder the software component business's development. Standardisation is usually understood as technical work, but it also has business aspects, especially from the strategic and relationship points of view. It is a strategic-level decision whether a company joins a certain group of companies that together push a selected standard forward. Furthermore, as a relationship aspect of standardisation, an important question is how to co-operate with the members of the standards committee, as they can even be one's worst rivals. The integration and documentation processes indeed have a technical nature, but integration and documentation in the end involve sharing information and interaction with others. A relationship point of view can shed some light on these matters.

The importance of understanding the role of system architecture is evident also because it appeared inadequate to try to identify and influence value-creating networks, and especially to manage value nets, without taking into account software product architecture. This is due to the role of software architecture in determining the focal company's core competence area and, furthermore, in determining the structure of the supplier network. Also, the possibility of utilising intermediaries and the influence of the end customer are not the same at different layers of the architecture. Although the end customer always sees the system solution from a holistic perspective by viewing the solution as a single entity, the claims and demands that the end customer may make concerning the system solution are usually related to the parts of the system solution that are most visible to the end customer, hence the uppermost layer of the system architecture as the layer forming the operating environment for the user. However, possible end-customer demands for the uppermost layer may, naturally, affect the other layers of the system architecture, too, due to the interconnected nature of the architectural layers.

It can also be stressed that managers can better understand the essence of network management by viewing the network through different layers. The network concept is a very fashionable one nowadays, but usually it is not easy to understand or to apply that understanding as a tool for management. It can be argued that the network concept is easier to understand if it is clearly pointed out that a network consists of single exchange relationships. These single relationships then together form portfolios of relationships and, further, broader entities of nets. Each of these layers has its own managerial challenges and is manageable to a certain degree. At the broadest level, the network level, management in the strict sense is impossible; however, the possibility of influencing and orchestrating does remain.

Influencing and orchestrating at the network level is not possible without first gaining an understanding of the structures and value creation logic of the network. This study has contributed in this area by developing an empirically grounded model through which this understanding of value-creating networks can be better attained. The essence of a value-creating network can be captured via the lenses of perceived end customer value, core competencies, and relationships, but also by identifying the actors, resources, and activities forming the network. *Core competencies* are necessary in order to *create differential value for the end customer*, but usually one company's competencies are not enough to create such differential and superior value. Thus, the company as one *actor* needs to build *relationships* with other actors that have competence *resources* supporting the value creation perceived as superior by the end customer. Based on these resources, value is created through co-operative *activities*.

One practical question for the managers who are responsible for software component sourcing is whether to make the components in-house or to buy them from another company. A third option is to connect with some other company and together develop the components. The make/buy/connect decisions related to software components are easier to make if the elements of *value-creating networks coupled with the influence of system architecture*, both of which have been discussed throughout this study, are taken into account. For example, one important issue for managers to consider when making the make/buy/connect decision is how closely related the component is to the core competence of the company. If the component should be integrated in an area near the most precious core competence in the company's field, then questions of information sharing and the need for legal protection become more relevant. Based on the findings of the study, it was obvious that managing a value net that produces a system solution based on software is not easy. In particular, handling the changes within the value net was problematic – the move toward utilising commercial software components is a telling example. The focal net under more detailed study, presented in Chapter 7, was in fact a rather simple one due to the limited number of the SI's software suppliers, but still the net seemed to be an entity that was hard to control; e.g., one change in some part of the net caused changes in another part of the net that were very unpredictable and had major influences on the relationships making up the net.

However, the empirically grounded model developed for value-creating networks, with its various elements, aids in the establishment of a number of guidelines for managerial decision-making by identifying the influencing factors and views from which to consider value-creating networks.

Guideline 1: The essence of a value-creating network is the aim to create differential value for the end customer. Thus, the role of the end customer should be emphasised. The necessary value-creating activities and the core competencies of the network actors should always be determined through identification of the added value for the customer.

Based on the empirical findings, this was not, however, always understood by the SIs and their suppliers. Furthermore, it was shown to be difficult to identify what kind of value the customer really wants.

Guideline 2: Customers always evaluate the value created from a holistic perspective; thus, customers do not separate different layers of the system solution in their minds, nor do they separate the supporting services needed in each phase of the value creation process from the object of exchange and the SI's performance. In order to create differential value for the customer, this holistic perspective of the end customers needs to be understood.

Besides realising that the end customer has a holistic view of the value created and the performance of the SI, it is also important to understand the direct and indirect added value – i.e., the value added to the product and relationship – the customer seeks. As customers value a decrease in relationship connectors with several actors, the use of commercial software components should not cause any changes in that respect. Thus, all the integration changes caused by moving over to the utilisation of commercial software components should not increase the amount of work that needs to be done on the end customer's premises, nor should it affect communication processes involving the end customer.

Guideline 3: As the complexity of system solutions is growing and end customers want to concentrate on their own core competence, customers are eager to get turnkey deliveries from a single SI. Behind the end customers' desire to obtain the whole solution from one SI is the value end customers place on being able to interact with fewer actors and in that way to reduce communication and information sharing needs, as well as the number of legal bonds. In sum, besides naturally expecting from the system solution direct added value for their own value creation activities, end customers expect indirect value in the form of fewer interactions and fewer relationship connectors with several other actors.

Differential value for the end customer must be created in such an efficient way that all net actors participating in the value creation can capture as much value as possible for themselves, too. This does not, however, indicate that one should favour opportunistic behaviour, although opportunities for opportunism are always present in value networks. High value-capturing potential without harming other actors within the network is at best achieved by concentrating on one's own core competencies and by forming relationships in which all actors supplement each other's core competencies as resources needed to create the differential value for the end customer.

Guideline 4: Differential end customer value should be created based on joining the core competencies of the value-creating network's actors together in a way that enables each of the member actors to capture value.

Identification of the needed competencies as resources for creating differential end customer value is not, however, an easy task. A system architecture view can help in this, as it provides a way to position one's own core competence at a certain layer. Moreover, it enables the focal company to plan how trustworthy and close relationships it needs with different component suppliers based on how close to the critical parts of the system architecture and the focal company's core competence the necessary components are.

Guideline 5: The system architecture view enables the focal company to better identify its own area of core competence and, furthermore, to evaluate the need for complementary competence providers and determine their role in the value-creating network. Naturally, the roles and positions of these complementary competence providers influence the type of relationship with these actors that is desired.

9.4 Limitations of the study and avenues for future research

During the research process, many choices and limitations of scope had to be made to avoid the research becoming too fragmented. These limits have left many interesting areas open for further research. In this section, firstly, the limitations of the study are discussed. Then, avenues for future research are considered.

Limitations of the study. This study is bounded by the context of the Finnish ICT cluster, in particular the industrial automation sector, and software components as the objects of exchange in inter-organisational relationships occurring in that industrial sector. Thus, the results of the study cannot be generalised without reservation to other contexts. The potential for generalisation of the results of the present study has already been discussed in Section 9.1.

The SI's perspective was chosen for emphasis in this study for two reasons. Firstly, it has been predicted that SIs' role in the Finnish ICT cluster is going to grow in the future (see Meristö *et al.* 2002). Thus, SIs' role in the structure of the Finnish ICT cluster and in influencing networking activities is important. Secondly, selection of one particular perspective helped the researcher to maintain a coherent holistic analysis of the software component business.

Certain specific aspects of business relationships – e.g., intellectual property rights (IPRs) – were identified as influencing factors in the software component business, but they were not discussed in detail. The reason is that, as opposed to individual characteristics of relationships, the overall setting was studied.

In this study, software components were defined in rather broad terms[39] for two reasons. Firstly, the broader definition is appropriate for purposes of this study and the research setting, as the study does not take a technical perspective on software components. Secondly, the academic and professional experts used a rather broad definition for software components in the interviews, so their views are reflected in this study.

One reason for choosing the software component business as the industrial setting of the study was its rather slow growth irrespective of the huge benefits expected from it. However, it is not the purpose of this study to make predictions concerning the future of the software component business[40]. Although network analysis could be used as a method for future-oriented studies, this study is not about predicting the future; instead, it is about gaining an in-depth understanding of the phenomena under study, value-creating networks related to the software component business.

Avenues for future research. First of all, as the choice was made to conduct the empirical study in only one specific field of industry within the ICT cluster, the industrial automation sector, the results of the study are to some extent tied to that sector. This leaves room for applying the model developed for value-creating networks in the other segments of the ICT cluster to see how adequate the model is in practice for *other software-intensive industries*.

Secondly, besides applying the model in industries that are very closely related to software, it would be interesting to further develop the model in some other, *more traditional industry*. It may very well be possible that also other industries where product architectures are used exhibit a tendency for the structure of the product and the product architecture to dictate the way the focal net of the company is formed. For example, it would be interesting to study whether car manufacturers have layered supplier networks corresponding to the different parts of the car, as it has been noticed that platform and product architecture strategies are commonly used in the automotive industry (see, e.g., Muffatto 1999). Besides product architecture studies, there have also been carried out some studies concerning modularisation and componentisation in the automotive industry (e.g., Hsuan 1999). In fact, on the level of single supplier relationships it has already been identified in previous research that the more critical the part or the component is, or the larger the entity the supplier is delivering to the SI (Hsuan 1999), the more obvious an option it is to have a closer relationship with the supplier. However, similar distinctions have not been made at the level of networks; instead, the network structures of car manufacturers have been presented as rather uniform and simple.

Thirdly, it would be interesting to study whether other businesses employ *similar procedures* to those involving product architecture, via parallel means. For example, many travel companies offer their customers packaged solutions that include not only the actual transport to the destination but also accommodation, dining, leisure activities, and other additional services. Such packages are in fact ‘system solutions’ of a sort, and it

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[39] For the definition of a software component utilised in this study, see Chapter 1.

[40] Ulkuniemi (2003) provides insights applicable to COTS-type software component market development by presenting alternative development paths based on differentiating supply of and demand for COTS products by their heterogeneous vs. homogeneous nature.

would be interesting to study the logic and procedures behind the specifications for and development of such system solutions for customers by service businesses.

Fourthly, in this study, the point of view chosen in exploring the value creation within business networks has been more or less the *SI's perspective*. Although the analysis at the level of networks was intended to be as holistic as possible, the SI perspective is nevertheless visible throughout the study. For thorough evaluation of the model developed for value-creating networks and its adequacy, the model should be applied also in studies that concentrate more on the SI supplier's or the end customer's point of view. It would be especially interesting to study what happens if the net is orchestrated more by an actor other than the SI. It would also be fascinating to study what happens if the customer interface is not in the SI's hands. Exploration of the role of intermediaries is one possible direction for future research, as the present study could not address this in depth.

Fifthly, due to its rather general-level analysis of value-creating networks, the present study has not taken into account in a detailed manner such important issues in the software component business as *IPRs* and the *management of knowledge and information flows* within the value-creating network, yet the findings from the empirical data indicated that these two issues are going to require more detailed analysis in the future, when the software component business starts to develop toward a more mature business model. In particular, such issues as the ownership and management of the various IPRs for software components and the management of customer requirements in complex value-creating networks seem to represent a challenging and essential field for future research. Furthermore, as stated at the beginning of this thesis, *open source software* components were not within the scope of the present study. However, the near future could well see the utilisation of open source solutions grow remarkably. Because open source software components provide a totally different way of doing business, not only for the developers but also for the potential integrators and buyers, it is likely that more research in the field is going to be needed.

A sixth interesting avenue for future research arises from one of the elements of the value-creating networks, *the element of core competencies*. Based on experiences gained in conducting the present research, it is clear that core competencies in a value-creating-network context are such a complex and multifaceted phenomenon that completing an in-depth analysis of the core competencies of network actors requires, and merits, its own study concentrating only on this particular element.

Additionally, it would be useful to elaborate further on each of the architectural layers in terms of maturity of the software component business. For example, it would be interesting to identify business life cycles for each of the architectural layers and to compare their evolution

Lastly, this study has revealed the *complex nature of software as an object of exchange* and its multifaceted nature as something that does not fall directly under the category of pure service (e.g., it can be produced and consumed at different times, thus it can be stored) yet is not a pure good either (e.g., it does not have a clear physical appearance and it cannot be smelled, touched, etc.). Such an interesting characteristic of software and its nature as the object of exchange would certainly be a challenging area for further study.

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Appendices

Appendix 1 List of secondary data used in the empirical study

http://www.automaatiovayla.fi/: Professional journal published by Automaatioväylä Oy.
http://www.automaatioseura.fi/index/
http://www.isa.org/: The Instrumentation, Systems, and Automation Society
http://www.opcfoundation.org/: OPC Foundation home page
http://www.open-control.com/: Open Control Foundation home page
http://www.plcopen.org/: PLC Open home page
http://www.oacg.org/:Open Architecture Control Group home page
http://www.arcweb.com/omac/: OMAC home page
http://www.fieldbus.org/Default.htm: Fieldbus Foundation home page
http://www.interbusclub.fi/: Interbus Club Finland home page
http://www.arcweb.com/ : Automation Research Corporation home page
http://www.iaona.com:The Industrial Automation Open Networking Alliance
http://www.ncsu.edu/IEEE-RAS: IEEE Robotics & Automation Society
http://www.measure.org/: Measurement, Control and Automation Association

Appendix 2 List of interviews

Macro network interviews

SI interviews:

a) Process automation / Vice president R.K: 7.8.2001

- Company information: Represents one business area in a large, nationally based corporation (personnel over 26 000) that operates globally; founded in 1990s after a merger; amount of personnel ~ 3300

b) Process automation / Development Manager J.P: 20.8.2001

- Company information: A part of a large global (American based) corporation; corporation founded in 1880s; amount of personnel in the corporation is over 100 000

c) Process automation / Technology Manager J.V: 7.8.2001

- Company information: Represents one business area in a large, nationally based corporation (personnel over 26 000) that operates globally; founded in 1990s after a merger; amount of personnel ~ 3300

d) Production automation / Sales Director P.P: 7.8.2001

- Company information: Represents one business area in a large, global corporation (European based); amount of personnel in the corporation over 400 000, corporation operates widely in the automation sector

e) Machine automation / Manager J.P: 22.8.2001

- Company information: Represents one product area within one of the four business areas of a global company group (personnel of the group over 35 000); founded in 1990s after a merger; amount of personnel in the product area ~ 1000

Supplier interviews:

f) Process automation/ Vice President J.A: 28.6.2001

- Company information: A business unit of a globally operating corporation (Finnish based); founded in 1990s after a merger; amount of personnel in the unit ~ 450

g) Process automation / Design Manager V.N: 7.12.2001

- Company information: A small national company; operates in a narrow segment; amount of personnel under 10

h) Production automation / Quality Manager J.S: 16.8.2001

– Company information: A medium-sized national company that operates globally and is owned by a multinational corporation; founded in 1980s; amount of personnel ~ 200

i) Machine automation / R&D Manager A.P: 26.6.2001

– Company information: A national subsidiary of an independent company that is part of a global (American based) corporation; founded in1990s; amount of personnel ~ 30

R&D industry expert interviews:

j) VTT Automation / Dr. O.V: 19.6.2001
k) Tampere University of Technology / Prof. S.K: 22.8.2001
l) University of Jyväskylä / Prof. P.T: October 2001 (e-mail)
m) Finnish Automation Associety / Chairman (former) E.S: 10.8.2001

Focal net interviews

Focal company interviews:

a) Marketing Communications Manager/J.L.: 17.10.2001
b) Regional Manager/P.S.: 31.10.2001
c) Key Account Manager/P.T.: 31.10.2001
d) Product Group Manager/A.L.: 05.12.2001
e) Project Manager/J.K.: 10.12.2001
f) Product Group Manager/H.R.: 27.02.2002

Customer interviews:

g) Electronics, EMS, Production Manager/J.K.: 04.12.2001

– Company information: Finnish based company that operates globally; founded in 1980s; amount of personnel ~ 12 000

h) Telecommunications, OEM 1 / Business Unit A, Application Specialist/K.K.: 12.03.2002
i) Telecommunications, OEM 1 / Business Unit A, Release Manager/A.K.: 27.03.2002
j) Telecommunications, OEM 1 / Business Unit B, Project Manager/R.H.: 27.03.2002

– Interviewees H, I and J represent same globally operating telecommunications corporation, but two different business units

k) Automotive, subcontractor, Manager/I.B.: 10.04.2002

– Company information: A Finnish company that operates as subcontractor for a few global customer; age of the company ~ 30 years; amount of personnel ~ 1700

Supplier interviews:

l) Company A, Project Manager/K.S.: 20.12.2001

- Company information: A Finnish software company group that operates also globally; founded in 1980s; amount of personnel ~ 500

m) Company B, Manager&Founder/J.S.: 20.02.2002

- Company information: A Finnish software company; founded in 1990s; amount of personnel ~ 60

n) Company B, Manager&Founder/P.K.: 20.02.2002

- Company information: A Finnish software company; founded in 1990s; amount of personnel ~ 60

Appendix 3 Workshops and project meetings

Project meetings / workshops

Private project meetings:

- Meeting 1: 20.6.2001
- Meeting 2: 19.9.2001
- Meeting 3: 14.1.2002
- Meeting 4: 12.3.2002
- Meeting 5: 14.5.2002

Shared project meetings/workshops:

- Meeting 1: 21.08.2001
- Meeting 2: 02.10.2001
- Meeting 3: 13.11.2001
- Meeting 4: 27.11.2001
- Meeting 5: 10.12.2001
- Meeting 6: 12.02.2002
- Meeting 7: 14.05.2002

Appendix 4 Interview themes

The general industrial automation sector part of the interviews included following themes:

– Industrial automation sector vs. other high tech sectors from the viewpoint of software
– Development of the industrial automation sector and future trends
– Industrial structure of the sector
– Technology development in the sector
– Standardization
– Software components in the sector
– Impacts of Internet

The company specific part of the interviews included broader themes of the company's:

– Background and history
– Business strategy and objectives
– Core competencies
– Customer relationships
– Supplier relationships
– Other relevant business relationships
– Role of software components and software architectures in the company's operations