

JENS HULTMAN

Rethinking adoption

Information and communications technology interaction
processes within the Swedish automobile industry



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Dissertation
Series

No. 041

JENS HULTMAN

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Information and communications technology interaction
processes within the Swedish automobile industry

Decisions made regarding information and communications technology (ICT) are strategic and embedded in complexity, change and a dynamic and competitive environment. For the business manager, ICT paradoxically poses both potential promises and potential problems that need to be considered. Just as a “right” decision on ICT adoption can be fortunate, a “wrong” decision can have unfortunate consequences and affect the ability for a firm to develop and fulfill market needs. This thesis proposes that ICT adoption in an industrial context needs to be understood and evaluated through a processual and longitudinal approach, thereby considering the embedded nature of ICT applications.

The empirical material in this thesis was collected through in-depth interviews with key actors and through observations and documentation, with a focus on capturing rich descriptions concerning five cases of organizational level ICT adoption processes. Through an analysis of ICT adoption in the industrial context, it is concluded that prevalent theory often fails to function as a foundation for understanding adoption and the dynamics and complexity found in the industrial context. Through its approach and empirical foci, this thesis contributes with an alternative view on adoption in the industrial setting with its focus on adoption as a process of interaction.



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To Jenny

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July 2007, Bankeryd
Jens Hultman

Executive summary

On different levels and with different strategic importance, business managers face technology decisions every day. These decisions concern not only which technologies to use, but also which ones not to use. Technology is a strategic issue in business in the sense that decisions to reject or adopt a specific type of technology, at either firm or industry level, can in the long run have an impact on the ability to develop and fulfill market needs. The purpose of this thesis is to empirically explore information and communications technology (ICT) adoption in an industrial context in order to challenge prevalent conceptualizations of adoption. The thesis proposes that ICT adoption in an industrial context needs to be understood and evaluated through a processual and longitudinal approach. The thesis specifically concerns organizational level adoption (cf. individual/user level adoption) of ICT applications for processual support (cf. manufacturing technology or product technology) in an industrial marketing context (cf. consumer marketing context). Through an empirical exploration of five cases of ICT adoption processes found in the Swedish Automobile industry, this thesis presents a view on adoption as interaction that is different from prevalent conceptualizations within the field.

The empirical material was collected through in-depth interviews with key actors in the five adoption processes and observations made over time in the adoption processes under study. The study has a focus on capturing rich descriptions concerning five entities constituting a conceptualization of adoption: object of adoption, subject of adoption, process of adoption, outcome of adoption and context of adoption. The thesis contributes with an alternative view on adoption in the industrial setting with a focus on adoption as a process of interaction. Through an exploration of my empirical materials, I challenge prevalent conceptualizations of adoption. I conclude that given the embedded and organic nature of the adoption process, it is necessary to approach adoption as a process of interaction. For the presented conceptualization and given the industrial context, this thesis asserts that the object of adoption technology is to be viewed as an open solution (cf. given product), that the subject of adoption is to be viewed as something ongoing between and within an actor (cf. adoption as a single-firm issue), that the process of adoption is to be viewed as an ongoing process of interaction (cf. linear), that the context of adoption is to be viewed as embedded interaction and context as part of the process (cf. context as 'out there'), and that the outcome is to be discussed in terms of status (cf. binary).

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CHAPTER 1

Introduction

This thesis proposes that information and communications technology (ICT) adoption in an industrial context needs to be understood and evaluated through a processual and longitudinal approach, thereby taking the complex and embedded nature of ICT applications into consideration. In this chapter, I aim to outline the general purpose of this study and give an overview of the empirical context in which the study has its focus and the theoretical foundation that this thesis builds on and ultimately aims at contributing to. I will also present and discuss the general structure of the thesis and the six chapters it is built upon.

1.1 The strategic importance of information and communications technology adoption

Whether it is an investment decision on a machine or new computer system, or a decision on how to apply these in operations, the choices made regarding technology are strategic. On different levels and with different strategic importance, business managers face technology decisions every day. These decisions concern not only what technologies to use, but also what technologies not to use and when these choices of use should be implemented. Technology is a strategic issue in business in the sense that decisions to reject or adopt a specific type of technology, on either firm or industry level, can in the long run have an impact on the ability to develop and fulfill market needs. A well timed decision regarding technology adoption can be an important source of competitive advantage. This thesis concerns the adoption of information and communications technology (ICT). I will focus on information and communications technology as process technology (cf. product technology) and have studied ICT adoption in an industrial context (cf. consumer context) and on an organizational level (cf. individual level).

ICT is defined here as technologies that store, search, retrieve, copy, filter manipulate, view and receive information (Shapiro and Varian 1999). In some way or another, ICT deals with or creates digitized data. ICT, in the form of hardware such as mobile phones and computers or software such as word processors or e-mail

applications, is something that most of us encounter and use on a daily basis. ICT is sometimes hidden components in products we use, like cars, and when this is the case we use them as features that are virtually taken for granted. Business-related data are constantly produced for various reasons, and must be managed. ICT is often used without us truly taking notice of it. We also use ICT in our professional lives. The following sections and subsections of this chapter will discuss the seemingly inherent promise and problem with technology in general and ICT in particular – this paradoxical nature of ICT is the starting point of this thesis.

That information and communications technology can be strategically important and that a timely decision to adopt can be prosperous for the faith of businesses has been seen over and over again. For example, in the waves of development in Internet technology, perhaps especially during the dot.com hype between 1995 and 2000, its actual and perceived impact in business was shown all too well. The World Bank recently published a report summarizing data showing the strategic importance of ICT in a global context (World Bank 2006:57-85), presenting empirical evidence on the relationship between firm performance and ICT adoption. Just as a “*right*” decision can be fortunate, a “*wrong*” decision can have unfortunate consequences. Due to technology decisions, customer contacts are made or lost and market shares are gained or lost. For example, in the automotive industry firms’ decisions to implement EDI (electronic data interchange) during the 1980s and 1990s have shown to have had great impact on these firms’ ability to serve the automotive industry. I will return to the case of EDI implementation shortly. At this point, however, one could assert that how to deal with technology has shown to be one of the most current executive concerns (e.g., Carter et al. 2000).

The problems and promises of new technology do not end with the decision to adopt or reject a certain application. In the case of ICT, despite the powerful hype that followed the dot.com era, research has firstly shown that the transformation of business behavior takes a much longer time than we might expect. In their study on business transformation and the use of new Internet technologies, Dutta and colleagues (e.g., Dutta and Biren 2001; Dutta and Segev 1999) present several reasons for the lag in exploitation, also among large firms. A key reason seems to be that the new technology seems to clash with traditional business models and that the risks involved create an inertia to take large steps (e.g., Webster 1971). In addition, multiple studies have shown that the failure rates of ICT projects are significant. One typical study was presented by the Standish group (Standish Group 1994), and showed that more than 30% of IT projects were cancelled before ever being completed. Further results in the study indicated that more than half of all

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ICT projects exceeded their original budget estimates by almost 200%. This survey was replicated by the Standish Group in 2005 (Standish Group 2005), and reported 70% failure rates on IT projects. Several questions arise here: What constitutes a failed ICT project? And how does failure come about? An additional question is why prevalent research on ICT has put relatively little energy into studies that concentrate, to some extent or fully, on non-adoption. It seems as if the business environment has a great deal to learn from previous experience.

For most firms, expenditures in ICT are significant in both absolute and relative terms. These expenditures can, however, be difficult to uncover and isolate due to the nature of ICT. ICT covers most operations of a firm and such expenditures therefore cannot be isolated to an IT department. We find ICT in marketing, purchasing, logistics, product development and so on. Some studies have attempted to systematically estimate ICT expenditures. These studies find that ICT expenditures are not only sizable but are also a current concern among managers. According to the European Commission, a European firm with 250 or more employees has an average annual ICT expenditure (e.g., ICT infrastructure and software) of € 581,000 (European Commission 2005:19). As expenditure increases with firm size, also in relative terms, large firms are likely to spend much more on IT than are medium-sized firms with 250 employees. ICT expenditures can vary significantly between industry sectors.

This thesis approaches ICT adoption as an industrial marketing problem and challenges prevalent conceptualizations of adoption as presented by, for example, Rogers (1995). I will assume a view of marketing as a process (cf. function) of exchange and interaction¹, thus arguing that marketing in an industrial context is characterized by long-term orientation and stability and mutual dependence, and that the industrial market is constituted by a set of connected exchange relationships (Johanson and Mattsson 1994). The interactional and processual view of marketing in the industrial context, I will argue, will also affect the way ICT is received and adopted. It will also affect the way one needs to approach adoption in order to understand ICT adoption processes in an industrial context. The view of ICT will also affect the way ICT in itself is viewed. On the following pages I will outline a general problem discussion around the strategic importance of technology and the empirical and theoretical challenges on which this thesis is built.

¹ I will develop at length my reasoning and standpoint on industrial market and industrial marketing and my fundamental assumptions on the nature of the industrial context in Chapter 2.

1.1.1 The promise of technology adoption

Technology has always seemed to captivate and fascinate us in both our professional and personal lives. Daily, we place a great deal of trust in technology to help us make things more efficient and effective. In business life, bookkeeping is digitalized and to a large extent automated. In industry, production is coordinated and automated with the help of product and process technology (e.g., Karlsson and Lovén 2005). Firm managers use ICT for strategic business decisions, with data that are analyzed through applications using mathematic models so complicated that they are beyond the comprehension or even imagination of most managers. Much trust is put in ICT to rationalize business activities and to automate what employees previously put pride and effort into doing themselves. Technology seems to be all around, and most often we take this for granted. We fly airplanes that are more or less fully automated from the point of departure to the point of arrival. We write academic papers and theses and save our written material on diffuse and intangible networks, trusting the network and PC technologies to safely store the material until we open the files again. We tend to think of technology as something helpful and useful. In the technology literature, the institutionalized promise inherent in technology is sometimes brought up. It is an interesting, and definitely understudied, phenomenon. For example, Ford and Saren (2001:1) elaborate:

Everyone knows that technology is somehow “a good thing” – rather like having a reputation for being warm-hearted and friendly – but most people have little idea how to develop it or how to capitalize on it when they have it. Technology is rather like a grey mist which floats behind a company’s products and the processes by which they are made: they are tangible, it is not; they are easy to describe, it is not. There is a parallel between the ways in which many companies think about and discuss technological issues and how individuals talk about politics. In both cases the discussion is likely to be based more on prejudice than knowledge, with self-consciousness rather than self-confidence and in both cases the parties are likely to substitute bluff for reason.

An interesting review of the problems and challenges of the technological forecast can be found in the works of Schnaars and colleagues on technological forecasting (e.g., Lynn et al. 1999; Schnaars 1989). Schnaars points specifically at the tendency to overvalue new technology in numerous different aspects (1989:9):

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The most prominent reason why technological forecasts have failed is that the people who made them have been seduced by technological wonder. Many forecasters paint a bright future for new, emerging technologies. New technologies, they claim, will spawn huge growth markets, as the technology is used in dramatically new products. It is only the beginning, they preach. This technology will play a large part in our everyday lives. Most of those forecasts fail because forecasters fall in love with the technology they are based on and ignore the market the technology is intended to serve.

ICT was clearly an important driving force in the economy during the second half of the 20th century. Ever since the innovation of the semiconductor in the Silicon Valley in the 1960s, ICT has been energetically discussed as something that will influence, and to a great extent already has influenced, the way businesses function and are managed. The focus on exploitation of new technology seemed to reach new heights with the broad commercialization of the Internet in the mid-90s² (e.g., Press 1994). During this time and onward, the interest and promise of ICT was often referred to as paradigmatic and societal. One of the most outstanding examples of this view is the works of Manuel Castells (1996) on the information society. Additionally, the business literature during this time was influenced by the progress of ICT. Well established textbooks were rewritten and reoriented under the assumption that new ICT required a complete rethinking of a company's marketing strategy and the transaction and communication models on which it built its business. For example, marketing professor Philip Kotler wrote the following in the preface of the 2003 edition of his book *Marketing Management* (2003:xxii):

Companies have stopped thinking of the internet as an information channel or a sales channel. The internet requires a complete rethinking of a company's marketing strategy and the models on which it builds its business. Every company occupies a position in a long value chain connecting customers, employees, suppliers, distributors, and dealers. Today intranets improve internal communication and extranets

² The worldwide web was already introduced in 1989, the first browsers in 1990, and through a policy change by the NSF (National Science Foundation) the Internet was gradually commercialized during the mid-90s. 1994 seems to be a commonly accepted milestone for commercialization. Before this, the Internet was restricted to military and academic users.

facilitate communicating with partners. As markets change, so does marketing.

The development of the Internet as a marketing arena has had an impact on both marketing theory and marketing practice. However, the degree of impact and the general scope of impacts have been disputed. There seem to be at least two contradicting views of the technology's potential. One is to see it as something that completely alters the way business is conducted. A quote from the book "*Paradigm shift: the new promise of information technology*" illustrates this view, and time, quite well (Tapscott and Caston 1993:xi):

The paradigm shift encompasses fundamental change in just about everything regarding the technology itself and its application to business. The old paradigm began in the 1950's. The late 1980's and the 1990's are a transition period to the new paradigm. Organizations that do not make this transition will fail. They will become irrelevant or cease to exist.

The expectations on ICT during the period from the mid-90s to the beginning of the economic recession in 2001 have been post-rationalized as the ICT-hype period³, characterized by irrational exuberance in terms of expectations of effects on society and business (e.g., Lennstrand 2001). This period is an example of exceptional belief in the promise of ICT. The ICT hype can also be traced not only in stock market expectations or business literature, but also in the industry discourse from the period between 1994 and 2000. At business conferences and in consultancy reports, the promise and inherent good of ICT and applications like e-business and e-commerce were proclaimed without much critical thought. There are also quite a few interesting scholarly reports from this hype period that prove the point more than well. In previous publications (e.g., Hultman and Axelsson 2005:170-172), I have used the following quote when pointing out how the promise of ICT has been described in the literature (Wen et al. 2001:5):

The Web is one of the most revolutionary technologies that changes the business environment and has a dramatic impact on the future of electronic commerce (EC). [...] Electronic commerce is no longer an alternative, it is an imperative. The only choice open is whether to

³ The ICT hype is one among many technology hype periods over time. Another example is the hype that surrounded artificial intelligence during the 60s and 70s.

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start quickly or slowly. Many companies are still struggling with the most basic problem: what is the best EC model?

PricewaterhouseCoopers (1999) presented a survey on managerial expectations in 1999 that showed that 50% of participating executives considered innovative new economy actors like e-marketplaces or intermediaries a significant threat to their business. In addition, the majority of participants in the survey assumed that e-business would have a significant impact on their business. Scholarly work pointed in the same direction when surveys found that how to exploit ICT was one of the most important current concerns among managers and purchasing and supply executives (e.g., Carter et al., 2000). Examples of how ICT was expected to change business dynamics and how new business models emerged are probably infinite, and examples of those that swam against the current are few. These authors present a somewhat contrasting, or moderating, view of the role of ICT and how firms should deal with and exploit it. This view basically concludes that although ICT will have a dramatic impact on many businesses and will demand new requirements from many managers, the basic rules of business will not be altered (e.g., Porter 2001). This means, still, that ICT is very important, but rather as a prerequisite than a source of competitive advantage. In a recent and thought-provoking article, this view is stressed by the claim that *"IT doesn't matter"* in an article authored by Nicholas Carr (2003). The point made in Carr's article is that ICT is becoming so taken for granted in our daily business processes that it does not form a base for the creation of competitive advantage as it perhaps did a decade ago.

1.1.2 The problem of technology adoption: choice, interdependence and change

Just as we can see technology as a promise, or means, for some firms to reach their goals, it can also be a hurdle or challenge for others. As mentioned in the beginning of this chapter, in the long run a decision to reject or adopt a specific type of technology can affect a company's ability to develop and fulfill market need for many years. On the other hand, a timely and from all aspects *"correct"* decision can be a source of competitive advantage. Ford and Saren (2001) have formulated this challenging situation as *"the problem of technology"*. In their view, technology becomes a strategic problem due to both its relative importance and the fact that managers need to actively choose between different technologies as well as take an active part in innovating new technologies as solutions to problems. For example, according to Dussauge et al., the problem of technology entails three aspects of choice (1992:87):

- How to select technology – identifying and selecting new or additional technologies that the firm seeks to master. This decision largely determines how resources are allocated to technological development.
- How to acquire technology – determining the specific means for acquiring a given technology. The means through which a technology is acquired determines its costs, the time required and the level of competence developed by the firm, as well as the latitude the firm enjoys when it uses the technology.
- How to exploit technology – selecting the ways of implementing or deploying the firm’s technologies. The way in which the firm decides to exploit its technologies is one of the basic components of its strategy and directly influences its patterns of development.

The stakeholders’ choice of technology can be related to the roles in a buying situation developed by Webster and Wind (1972), showing that the organization as a whole is only a subset of the organizational actors involved. With this delineation, the choice of a certain technology is made by the technology decider, influenced by the technology influencer. I will later in this thesis use the terms technology provider and technology receiver, pointing out that the adoption process represents a type of exchange. A certain technology also has a developer with a specific user in mind. These stakeholders can have overlapping but still distinct roles. Other researchers emphasize the circumscriptions in the range of options as well as the unpredictability of technology development problems that lie before the industrial marketing manager. In their study on technological development, Håkansson and Waluszewski offered the following observations on technological development (2003:3-4):

The first, and perhaps most striking observation, is that there is no linear connection between intentions and outcome of a change process. However, intentions still appear as important, since they initiate and drive change processes. A second observation is that there is no single, clear and true picture of a certain development process. [...] A third observation is that neither existing technologies nor innovations are neutral or simple in relation to the individual company.

Naturally, these observations have implications on how the authors view choice and management of technology. An example of the significant importance of choice regarding technology and how this sometimes also entails certain aspects of force (i.e., lack of choice) is the case of EDI implementation in the Swedish automotive industry, driven by the OEMs (original equipment manufacturer, e.g., automobile

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manufacturer) and Odette during the 1980s⁴. In 1984, through a joint statement, all purchasing executives of the two key actors in the automotive industry at that time (Saab-Scania and the Volvo Group) called for a broad acceptance of a new communication technology (Document Excerpt 1).

Document Excerpt 1. Letter to all Nordic automotive component suppliers regarding Odette (originally in Swedish, emphasis added)

To all Nordic suppliers to the Swedish automotive industry

Increased computer support in the collaboration between the automotive industry and its suppliers

With this letter, addressed to all Nordic suppliers to the Swedish automotive industry, we would like to inform you of a recently launched project. The project, named Odette, is a joint initiative that includes virtually the entire automotive industry in the Western world, in nine countries. The broad purpose of the project is to enable direct computer communication between the automotive industry and its suppliers. The aim is to enable digital information transfer without, for example, orders and delivery plans, between customer and supplier. Other parties, i.e. insurance agencies and transportation firms, will be incorporated into the system. [...]

The tone in the letter is sincere but firm. In the document, the suppliers are asked to agree to participate in the Odette project. For firms involved as suppliers in the automotive industry, this was presented as an offer that could not be refused. The few customers and their relative importance made it virtually impossible for those who wanted to stay in the automotive industry to refuse participation in the Odette project. The pressures placed on suppliers in EDI development has also been noted in the broad field of scholarly work on EDI implementation (e.g., Webster 1995b).

⁴ This example is based on interviews with the president of Odette Sweden and the purchasing and materials management manager at Volvo Cars during the 1980s. During the 1980s, Odette Sweden was an important factor in the development of EDI use in the Swedish Automotive industry.

The quote from the study on technological development by Håkansson and Waluszewski (2003) draws attention not only to choice but also to the complex and interdependent nature of technology. This interdependence presents an additional perspective on the problem of technology. The interdependence can be described as structural complexity. Ford et al. (1998:272) summarize this view of a technology as a complex and shared resource:

The successful operations of many companies in business markets are not based on their own internal technological strengths. Instead, it is their skill in managing relationships with a number of others that are important, as well as their ability to bundle together these technologies to supply a product that meets the requirements of a particular set of users. Our view of technology is not company-bound. A company's technologies only have value when they are combined with those of other companies. The manager's task is not about developing new technology in splendid isolation over a long period of time; he is likely to need much more flexibility than this. He needs to examine and match his own technologies with those of other companies. With those other companies he has to synthesize or change technologies and bring them to new applications, often in different forms.

Interdependence as a managerial problem in an industrial context can exist in both the process and product dimensions (e.g., Ford and Saren 2001). For example, Gadde and Jellbo (2002) reported on the interdependent nature of technology through their description of the interdependence of different technologies (in this case, components and systems) in an instrument panel in a passenger car. The example below covers both the product and process dimensions of interdependence (Gadde and Jellbo 2002:45-46):

[...] in many cases the product architecture is far more complex. In integral architecture most functions are implemented by more than one component (or subsystem) and several components (subsystems) each implement more than one functional element. For example, the instrument panel of a car is the physical location of components with a number of different functions. [...] there are strong interdependencies between the components of the instrument panel and other subsystems of the car. The design of the instrument panel has to take these interdependencies into consideration. This is handled in the third step

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of the process of partitioning, where appropriate interfaces among the physical components/subsystems are defined.

An additional perspective on the problem of technology is change. Paradoxically, both the inertia to change and the speed of change can be seen as a managerial challenge. Several researchers have shown that technological change occurs in waves. The most typical example of this is perhaps the research conducted by Abernathy and Utterback, who observed that technological development in a specific industry shapes waves of stability and change (Abernathy and Utterback 1978; Utterback 1994). Managing within these waves of innovation and change proposes an important managerial problem (or opportunity). If early adoption is followed by broad diffusion, the firms adopting early might have first-mover advantages. One such case is that of Dell, a firm that early on adopted Internet technology to support business activities (e.g., Hagel and Brown 2001). If adoption is not followed by broad diffusion, firms adopting early might be stuck with a relatively difficult decision to either stay with their decision or change and adapt to some other technology that has gained broad diffusion. Another possible scenario related to change is the firm that does not notice the changes in their industry. One such case is that of Facit, which has come to be a classic case of a firm that misjudged the market and the changes in its immediate environment and could not keep up with the speed of change when the market for office equipment was moving from mechanical to electronic calculators (e.g., Starbuck and Hedberg 1977).

1.1.3 The prevalent conceptualization of adoption – a problem discussion

How technology is received or spread is an established research issue dealt with by several disciplines, and there are many different theoretical concepts to help understand and intervene in the process. It is often argued that the foundations of adoption research were laid out by the French sociologist Gabriel Tarde in the early 20th century (e.g., Kinnunen 1996). Adoption is a term that describes the decision to adopt a specific technology, and is frequently used in management literature. As most firms are involved in some adoption projects, and with thought to the strategic importance of ICT already discussed in previous subsections, there is no surprise at the fact that many studies have focused on critical success factors (e.g., Hong and Kim 2002), factors that affect the rate of adoption (e.g., Vlosky et al. 1994), factors that affect the intent to adopt (e.g., Chwelos et al. 2001) and factors that affect the adoption decision (e.g., Iacovou et al. 1995). However, the literature in both mainstream management (Hodgkinson and Johnson 1994; Pettigrew 1990)

and more recently in industrial marketing (Woodside and Biemans 2005a) and management of ICT and ICT systems (e.g., Kurnia and Johnston 2000) has argued for the need for a processual and longitudinal approach. In this study I will propose that ICT adoption needs to be understood and evaluated through a processual and interpretative approach, thereby taking the complex and embedded nature of ICT applications into consideration.

This thesis approaches ICT adoption as an industrial marketing problem and will challenge prevalent conceptualizations of adoption that concern this context. For example, the prevalent conceptualizations of adoption seems to treat adoption as a single-firm problem where a single decision-making unit, after evaluation of the comparative advantages of the technology it replaces, decides whether or not a technology will be implemented. The view on the managerial room for maneuvering and view of technology that this exemplification represents does not square with the discourse of industrial marketing. Instead, the interaction and processual view on marketing in the industrial context that I apply in this thesis squares better with the views of scholars that argue that a processual approach is an important part of a broader understanding of technology adoption. The argument of approaching organizational level ICT adoption in an industrial context with a study designed to study the process has been suggested by others, for example as a justification for the study in question (e.g., Damsgaard and Lyytinen 1998; Damsgaard and Lyytinen 2001; Kurnia and Johnston 2004; Kurnia and Johnston 2000) or as a result of an analysis and the (lack of) understanding of the phenomenon in question (e.g., Min and Galle 2003; Woodside and Biemans 2005a). I will discuss this further in an overview on empirical studies on organizational level ICT adoption in Chapter 2. The need for further processual research within the field is related to the complexity of the phenomenon under study, the linkages and the problems and promises of ICT that the industrial marketer needs to take into consideration. For the process to be understood, several aspects need to be included in the analysis. For example, Damsgaard and Lyytinen (2001:207) argue that in studies on technology diffusion “*knowing deeper is often better than knowing broader*”; the complexity of the phenomenon under study will not be fully understood if it is in depth investigated.

1.2 The empirical context of this thesis – the automobile industry

In some way, either directly or indirectly, the automobile industry⁵ is part of the empirical context of all five cases of ICT adoption processes described and analyzed in this thesis. The automobile industry has often been referred to as the “*industry of industries*” (e.g., Drucker 1946) – a just description even today more than half a decade later, one could claim, considering that the automobile industry is one of the world’s most powerful important industries. The automotive industry is a bit more than 100 years old. During these 100 years, the industry has developed across roughly four major phases: craft production (1880-1910), mass production (1910-1970), lean production and kaizen influenced by Japanese production methods (1970-1990), and commonality and globalization (1990-onward) (Holweg and Pil 2004; Rubenstein 2001; Womack et al. 1990). The automobile industry is an important part of the industrial development in Sweden (Elsässer 1995).

The automobile industry is often considered to be in the forefront of management practice and technological development. For example, it was in the automobile industry that Henry Ford developed his ideas on mass production that laid the ground for a more effective industrial production and the development of the industrial age. Two main applications in mass production are often ascribed to Henry Ford (Rubenstein 2001): His development of sequencing in production (i.e., vehicle manufacturing became faster and cheaper if the machine operations were arranged in a logical sequence), and the moving assembly line (i.e., final assembly of a vehicle is made efficient through stationary and specialized work positions along an assembly line).

Automobile production has taken significant leaps in development since the heyday of mass production. Two important concepts have consecutively replaced mass production as the modus operandi in the automobile industry. In the 1980s, much scholarly and practitioner attention was given to the promise of lean production and the question of why Japanese automobile manufacturers could be so much more effective than Western automobile manufacturers. In the 1990s and onward, much scholarly and practitioner interest has been given to the focus on core

⁵ From here on I will use the term automobile industry when I refer to the empirical boundaries of this thesis unless I explicitly refer to the automotive industry in general terms, then including both the automobile industry and heavy trucks industry.

competencies (e.g., Prahalad and Hamel 1990), leading to a pattern of broad outsourcing and specialization, as well as to build-to-order principles (e.g., Holweg and Pil 2004), leading to much more focus on customer needs through flexible production.

1.2.1 The automobile industry and its significance and scope

The political and economic influence of key industry actors in the automobile industry is significant. For example, the purchasing power of one of the Big Three – Ford Motor Company, General Motors and DaimlerChrysler – is comparable to the gross domestic product of a relatively large nation. General Motors reported global purchasing volumes of approximately € 69 billion for 2005 (Beer 2005), and in 2005 the Ford Group had a purchasing budget of approximately € 72 billion (Holweg and Pil 2004). In most countries where the automobile industry is present with production, the scale and scope of the industry is shown by its significance for the country's general economic performance. In Sweden, for example, with more than 1,200 individual companies and an annual turnover of more than € 11 billion, the automobile industry is one of the largest and most important industries. The industry interest organization Automotive Sweden reported in 2005 that the Swedish automotive industry (including the supplier network) employed 140,000 people (Automotive Sweden 2005a).

Due to the industry's relative political and economic importance, it has received a great deal of scholarly attention over the years. Perhaps the most important and influential research project within the industrial management and marketing domain is the IMVP project, launched in 1979 at MIT. The project, which is still ongoing, has tracked developments and trends in the industry for almost 30 years. A key publication is the work presented by Womack and colleagues on lean production (1990), a book that highlighted and sought answers on how to resolve the large gaps in productivity between automobile production in Japan and in the Western world during the 1980s. Other studies reporting the progress of the IMVP project include further development of the lean thinking and product development project (Cusumano and Nobeoka 1998), as well as other build-to-order principles (Holweg and Pil 2004). The IMVP project has international linkages to universities in many countries, including Sweden through the IMIT project at Chalmers University of Technology in Gothenburg.

In Sweden, automobile production has been driven by four brands: Scania Trucks, Volvo Trucks, Saab Automobiles and Volvo Cars. The first Volvo car rolled out through the factory gates in 1927, a year often considered the birth year of Volvo

(e.g., Plate 1986). Since then, a number of car models have passed the production lines at Volvo, first at the Lundby plant and beginning in 1964 at the Torslanda plant and a handful of other production facilities in Europe. For many Swedes and others as well, the Volvo brand is considered a symbol of Swedish engineering excellence and quality. However, since 1949 Volvo has been accompanied on the international automobile production stage by Saab Automobiles. The first Saab vehicles reached the Swedish market in early 1950 (Elsässer 1995). Some studies suggest that part of the success of Volvo and Saab can be traced to the domestic rivalry between the two firms, in car manufacturing as well as in heavy truck and bus manufacturing (Sölvell et al. 1991). The two automobile brands were fully owned by Swedish interests until the 1990s when Saab transferred its automobile production to Saab Automobiles, owned partly by General Motors (Elsässer 1995). During the 1990s, the management of Volvo was also interested in an international alliance. Such an alliance almost became reality when Volvo and Renault began cooperating during the 1990s through a joint venture established in 1990 (Olsson and Moberger 2002). Since 2000, the Volvo Cars and Saab Automobiles firms share the fate of having sold all their car manufacturing operations to US firms. In 1999, the Ford Motor Company (FMC) acquired the automobile division of the Volvo Group, and in 2000 Saab Automobiles was sold to FMC rival General Motors.

1.2.2 Major challenges for the automobile industry

Two main challenges face the actors of the automobile industry. Firstly, it is burdened with significant profitability problems (e.g., Holweg and Pil 2004; Nieuwenhuis and Wells 1997). Secondly, customer demands are simultaneously growing and changing (e.g., MacNeill and Chanaron 2005b; Nieuwenhuis and Wells 2003; Nieuwenhuis and Wells 1997). In this subsection I will discuss these problems and their implications. Furthermore, I will discuss how ICT is a possible tool to allow automobile firms to handle the challenges they currently face. For a more extensive and focused outlook and analysis, I suggest the studies by Landmann (e.g., 2001) and MacNeill and Chanaron (e.g., 2005a; 2005b).

A key issue leading to profitability problems in the industry has been argued to be the over-capacity of the industry, leading to price cuts and diminishing profit margins. In their book on build-to-order principles, Holweg and Pil (2004:67-72) argue that scale advantages are traditionally seen as the variable in automobile production or, as they label it, the *“holy grail”*. According to MacNeill and Chanaron (2005b:112), an excess capacity arises from a failure to meet expectations in terms of market development; or in other words, when the industry fails to

realize that the market demand does not meet the market supply. Although the excess capacity may differ within the industry both across regions and over time, it has been a problem for the industry as a whole for quite some time. MacNeill and Chanaron (2005a:89-90) elaborate:

Manufacturers plan capacity to achieve economies of scale. In Western Europe there is an estimated car capacity of 18.8 m [...] against production of 15.2 m in 2002. Companies are often overconfident in sales predictions. [...] The issue of capacity has a strong influence on industry economics. Vehicle prices are calculated on forecast capacities. Reduced capacity means higher unit costs. Vehicle makers, therefore, often attempt a balancing act where a proportion of the excess is discounted heavily through the dealerships.

The automobile industry has, like most other industries, traditionally been divided into the three major markets of North America, Asia and Europe. These markets have their own specific characters and challenges. With political and economic change in other parts of the world, new markets including Eastern Europe, India, China and South America have emerged. Since the fall of the Soviet Union, Western automobile manufacturers have placed significant investments in Eastern Europe (MacNeill and Chanaron 2005a). These new regions, with China in the spotlight, are interesting not only as markets but also as sourcing and production areas. With welfare development and economic growth, the Chinese market alone presents an enormous opportunity for car manufacturers. For example, in 2005 Volvo Cars announced that they will follow the pattern of other automobile manufacturers and begin to produce the S40 in China (Automotive Sweden 2005b). With new entrants coming from China and other parts of the developing world, the excess capacity problem is growing.

Consumer demands on the automobile industry are growing in terms of demand for choice regarding options on vehicle configuration (MacNeill and Chanaron 2005b). At the same time as consumer demand is changing alongside with economic development, significant change in preferences is also taking place. The automobile industry is far from where it once was, as described by Henry Ford in the famous quote “any customer can have a car painted any color that he wants so long as it is black” (Ford 1922:62). Although this quote is often used in a consumer marketing context, it should rather be seen as an expression of the production orientation of the firm at that time, as it was stated in an internal context and not in public. A modern buyer can select among a number of different variants of several components to customize a vehicle according to personal or regional

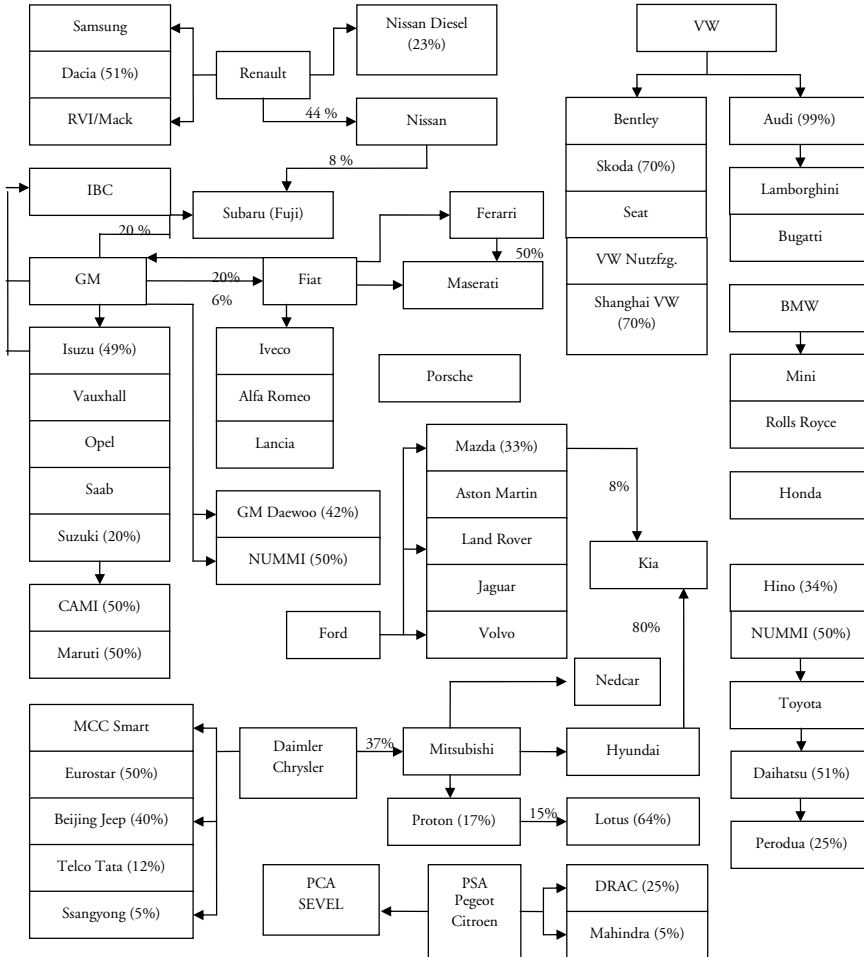
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preferences. The options reach much further than color, and include both exterior and interior components and configurations (e.g., interior instrumentation and exterior vehicle body configuration). In addition to customization, demands on a greater speed of delivery have also increased. In addition to the demand for more options, the environmental and social pressure on the industry seem to have increased significantly during the past decades (e.g., Nieuwenhuis and Wells 2003; Nieuwenhuis and Wells 1997). Albeit perhaps slowly, the environmentalist movement is affecting consumer demands for reducing pollution and congestion, handling the problem of global warming and consuming resources in a sustainable way.

One key reaction to the profitability problems in the automobile industry has been to aim for scale economies by consolidation through mergers (e.g., DaimlerChrysler in 1998), acquisitions (e.g., GM-Saab 2000) or strategic alliances (e.g., Renault-Nissan 1999, GM-Fiat 2000). Through consolidation, the tendency has been for the big to get both bigger and broader in scope. Consolidation also changes the power balance in all directions on a local, regional and sometimes global level. With the USD 92 million merger between Daimler-Benz and Chrysler in 1998 (Holweg and Pil 2004), consolidation changed the industry dynamics in all aspects. However, the merger between Daimler-Benz and Chrysler lasted for less than a decade. In May 2007, DaimlerChrysler sold Chrysler to Cerberus Capital Management. For a single market or region, changes that are in relation to the Daimler-Chrysler merger can also have important effects, at least on a regional and local level. With the FMC acquisition of Volvo Cars in 1999 and the GM acquisition of Saab Automobiles in 2000, the Swedish automobile industry has been affected by the industry consolidation through a power shift from Gothenburg/Uddevalla in Sweden to Dearborn/Detroit in Michigan in the US. These two acquisitions have had a seemingly great impact on the Swedish automobile industry dynamics, and will likely affect the future of Swedish automobile production. Figure 1 presents an illustration of the complexity and interconnectedness of the automobile industry in 2004.

The consolidation issue is not solely on an OEM level, but is also on a supplier level. Two interrelated issues are the development of system suppliers and the consolidation of the automobile component supplier industry. In reducing the total number of suppliers to a few and simultaneously giving these select few suppliers a greater responsibility, OEMs have been able to push a significant part of expenditures for research and development upstream. Since inbound logistics have shown to be a significant cost, these costs can also be pushed upstream.

Figure 1. Financial structure of the automobile industry (Holweg and Pil 2004:68)



A study on sourcing trends in the automobile industry conducted by von Corswant and Fredriksson confirmed this view (2002), presenting empirical findings on empirical data from 11 automobile OEMs and 16 1st tier suppliers and showing significant and consequent increase in the suppliers' share of the total development resources for the years 1988, 1998 and 2003. The push of product development

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costs has been argued to be more evident in some areas, such as electronics (MacNeill and Chanaron 2005a). However, the supplier consolidation has had interesting effects on the balance of power between OEMs and the supplier network. Holweg and Pil (2004:71) elaborate:

Supplier consolidation has interesting implications for the balance of power in the system. Whereas previously the relationship between the vehicle manufacturer and supplier was more like Goliath and David, today some of the top suppliers are in the same league or even exceed the turnover of their smaller vehicle manufacturer customers.

Systems sourcing means that a firm reduces its sourcing to a few suppliers from which they source components integrated and assembled in a system (e.g., the instrument panel) rather than buying each component from separate suppliers. One additional important reaction to the profitability problem and the need to pressure costs in the industry is outsourcing, the strategic consideration of whether an activity (e.g., production or assembly) should be handled internally or externally (van Weele 2002). A recent study presented by von Corswant and Fredriksson (2002) noted a trend that the level of outsourcing in the automobile industry had leveled out and was not expected to increase. The study also showed that automobile manufacturers outsource more than suppliers do, but that the suppliers intend to increase their share. Strategies of outsourcing and sourcing systems differ among automobile producers. For example, according to Gadde and Jellbo (2002:43), the different sourcing strategies of GM and Honda present such an example:

General Motors uses a supplier of a complete instrument panel, including glove compartment, air conditioner, entertainment system and the gauges for gas, speedometer, etc. Honda, on the other hand, buys most of the components from suppliers and does the assembly in-house. Thus, the strategy of GM is to rely on system sourcing, while Honda prefers to stay involved in component procurement.

To reap scale advantages in production, a strategy that has evolved over the years is to develop automobile production based on commonalities across models and to produce cars based on similar platforms (Lundbäck 2002; Lundbäck and Karlsson 2005). Employing platform production is a way for automobile manufacturers to compensate for high development costs and falling volumes per model, and to reach scale economics in production (Holweg and Pil 2004). Development of platforms is also a way to handle the otherwise high costs of supplying a range of car models

with high variety and flexibility in a build-to-order production system. Platform production is an important variable in reaching flexibility through production building on build-to-order principles. Today, the build-to-order production system is an important part of automobile production. Production builds on the idea that the firm needs flexibility along three dimensions: process, product and volume. For example, Volvo Cars has employed the principles of build-to-order since the early 1990s with the objective of achieving operational efficiency and flexibility (Fredriksson and Gadde 2005; Hertz et al. 2001).

Outsourcing, systems sourcing, build-to-order, consolidation and other concepts that dominate the automobile industry today require coordination and collaboration across firm borders. These new concepts have also shown to develop new challenges for the automobile industry. For example, due to the increased level of outsourcing, inbound logistics to the production plant account for as much as 10% of manufacturing costs and 1.5% of finished vehicle cost (Holweg and Pil 2004). New structures and activities demand new ways to support and monitor production. For example, outsourcing, build-to-order, consolidation, and integration are all current changes occurring in the industry that require coordination and collaboration across firm borders. Through recent studies, ICT exploitation has shown to be a key ingredient in the reaction pattern following the challenges in the industry. The promise of ICT is that these costs can be decreased through the exploitation of ICT. In the two following subsections, I will outline a general discussion on ICT exploitation in the automobile industry and present a few current applications.

1.2.3 An outlook on ICT exploitation in the automobile industry

A key characteristic of ICT is the speed of development and the laws of digital assets, which firms that exploit ICT need to learn to cope with (e.g., Cairncross 1997; Rayport and Sviokla 1994; Shapiro and Varian 1999). The challenge of ICT was nicely summarized with incredible foresight by Gordon Moore (1965) almost half a century ago, in what has later been labeled Moore's Law, stipulating the law like a relationship between increasing circuit capacity and decreasing component costs in the integrated circuit industry. Along similar lines, Fine (1998) develops a reasoning on the industry dynamics in the automobile industry as well as the relationship between technological development and the importance of being able to successfully handle windows of opportunities to gain increasing performance. He argues, for example, that successful firms are those that can adapt to and handle industry change. From this and other literature cited on the following pages, it

Introduction

seems obvious that ICT is an important force driving development in the automobile industry.

Given the problems that have challenged the automobile industry during the most recent decades, ICT has been considered to play an emergent and crucial role as a means to develop a response to these challenges. Some researchers even suggest that ICT has caused an acceleration of these challenges and structural changes in the automobile industry (e.g., Münge et al. 2004). The exploitation of ICT in the automobile industry has influenced a large set of functions and key processes, for example production management, product development, supply management, purchasing and ordering, and sales management. With the development of data processing support systems like EDI and MRP (Material Requirements Planning) and management information systems like CAD, and inter-organizational systems like e-mail and networks, ICT has become a strategic ingredient in the automobile marketing process. In fact, it has been argued that even in heavy industries like the automobile industry, information processing and information handling have come to be a key variable as well as a substantial cost (Holland and Naude 2004). In the matter of automobile manufacturers' ICT expenditure, Howard and Holweg assert (2004:357):

In the automotive sector, considerable investment in new IT systems by vehicle manufacturers can be observed. For instance, Internet trade exchanges (e-hubs), customer configurable websites, and WebEDI have recently been introduced. [...] the average total spending on IT by volume vehicle manufacturers in Europe is around 2-3% of total turnover [...]

On the extreme end of the development – and there are quite a few examples of this extreme in the automobile industry – is the development of super systems that cover either one or several actors in the industry and their operations in one aspect or another. Two such recent examples are the systems COVISINT and eVEREST. eVEREST was a global purchasing e-Business project driven by the Ford Motor Company to improve efficiency and effectiveness in sourcing and standardizing procurement processes between ALL FMC regions and brands, and ALL suppliers, ALL over the world. eVEREST was launched in November 1999 and was cancelled in August 2004 (Songini 2004). For the purchasing staff at FMC and its subsidiaries, the benefits from a super system like eVEREST were obvious. Having all sourcing activities on one platform facilitated efficiency and enhanced control. Within FMC, the expectations regarding cost savings were enormous. For suppliers, the benefits were less clear and the expectations were a bit more blurred.

The second example is the COVISINT project. When launched in February 2000, COVISINT soon became a symbol and icon of the promise of electronic business. Created by some of the largest players in the automobile industry (e.g., the Ford Motor Company, DaimlerChrysler, General Motors and others), it was meant to be a US-based online e-business exchange for OEMs and automobile component suppliers. The project received approval from the US Federal Trade Commission in September 2000. However, certain problems were identified for COVISINT at an early stage (Arbin and Essler 2005). The project failed, but during the time COVISINT was a reality in the automobile industry it probably created quite a few concerns among supplier managers in the automobile industry (Konicki 2000; Konicki 2001). COVISINT was established to serve the automobile industry with a platform for electronic procurement. Through the presence of products and prices, as well as applications enabling price comparisons and electronic auctions, suppliers in the automobile industry were exposed to a competition that had not been at all so evident before. COVISINT was sold to IT solution provider Compuware in 2004 and the scope of the marketplace has changed significantly since then.

1.2.4 ICT as a tool in the automobile industry

The promise of ICT is a managerial concern that has attracted scholarly attention, not least in the automobile industry. For example, for some years the automotive research journal *International Journal of Automotive Technology and Management* has shown considerable interest in the potential of ICT in an automotive context and In 2004, a special issue on ICT in the automotive industry was published (Martínez Sánchez and Pérez Pérez 2004b). There are several examples of studies that analyze and structure the promise of ICT in the automobile industry (e.g., Funk 2001; Howard 2005), however it seems that a more comprehensive overview of current applications has yet to be developed. To outline the promise of ICT in the automobile industry, current applications of ICT could be summarized and structured as tools that either support or boost competition, communication or coordination (Hultman and Axelsson 2005). On the following pages I will discuss ICT applications that represent tools that boost competition, communication and coordination in the automobile industry. I will also, given the purpose and focus of this thesis, solely look at the ICT application that concerns the automobile industry. Therefore, despite the fact that there are several very interesting developments underway in the automobile industry in this aspect, I will not consider automobile ICT applications that concern the consumer marketing context (e.g., Shioji 2004).

Competition

The changes in the competitive structure that recent ICT applications have created are quite challenging (sometimes threatening, sometimes attractive and beneficial) in their nature. Commercialization of the Internet and the broad diffusion of electronic marketplaces created expectations that ICT would rapidly affect competition and create much more commonplace transparency. This was seen as a threat to prices and brands from a marketing (cf. purchasing) perspective (Sinha 2000). Even though this general view on market transparency has been challenged, the concept of market transparency implicates associations to both threats and opportunities. One key application to boost competition is the electronic marketplace. There is an abundance of literature in the electronic marketplace and perhaps especially in marketplaces targeting industrial buyers and sellers. According to Kaplan and Sawhney (2000), who presented an often-cited typology of electronic marketplaces, the marketplace can apply one of two value-creation mechanisms, either matching (e.g., e-auction) or aggregation (e.g., cataloguing and structuring). Since the commercialization of the Internet, many attempts to set up either horizontal or vertical marketplaces have been made. A key problem, especially for third-party marketplaces, has been developing an offer attractive enough to attract both buyers and sellers. For an e-marketplace, with the most common revenue model being commission on the exchanges, this has been described as a *chicken and egg problem*, meaning that buyers do not want to engage in exchanges in the marketplace unless there is a sufficient number of sellers, and sellers do not want to engage in exchanges in the marketplace unless there is a sufficient number of buyers (Kaplan and Sawhney 2000).

As already mentioned, the electronic auction can be part of an offer in an electronic marketplace. Electronic auctions have attracted a great deal of attention during the past decade, even though the expectations on the spread have perhaps not been met. Electronic auctions can take various forms with forward (seller-initiated) and reverse (buyer-initiated) auction as the two main types (Bidgoli 2002). A few of the circumstances that make electronic auctions applicable can be mentioned. First, volume is important for making auctions worthwhile. Second, it is important that the demand be possible to clearly specify. Third, the cost of switching suppliers seems to be vital for applicability. Even though e-auctions are perhaps not as common as was expected a few years ago in the heyday of the Internet era, a number of firms are assessing whether or not electronic auctions are applicable to their business environment. This assessment is even more important in the light of recent studies showing that the implementation of auctions can be harmful, as it is argued that buyers initiating e-auctions risk destroying previously established

relationships and that a lack of trust could emerge in the long run (Smeltzer and Carr 2003).

In addition to the reverse e-auction, there are also several other types of procurement systems that enable enhanced competition. These procurement systems can also take on various forms. In an article by de Boer et al. (2002), a classification and structuring of different types of procurement applications was presented with the argument that there is a danger of simplification of the e-procurement phenomena when it is treated as a general application of ICT. Instead, there are several different types of applications existing in practice. When addressing open marketplaces for procurement, a classification between what firms buy (i.e., either operating inputs or manufacturing inputs) and how firms buy (i.e., either in spot basis or through systematic sourcing based on long-term contracts) can be made (Kaplan and Sawhney 2000). For sourcing purposes, a distinction between open (neutral) and buyer-oriented (biased) marketplaces can be made here. In the automobile industry, COVISINT has been considered the role model of marketplaces, presenting a buyer-initiated and biased marketplace (e.g., Arbin and Essler 2005; Fujimoto and Oh 2004).

An additional way to exploit ICT in order to boost competition is to implement applications that enforce relationships as competitive advantage. However, there are two sides to the coin: the technology can be used either to enforce the linkages in a relationship, or as a competitive weapon against other firms. A typical study that exemplifies the latter is that by Webster (1995a), in which EDI is used as a competitive weapon to lock suppliers into a relationship. In the coming pages, an outlook on ICT that enables communication and coordination will be presented. In industrial marketing and purchasing in general, business relationships have been argued to be stable and long-term oriented. This view is strengthened by the fact that initially transactional and competitively oriented efforts, like the developments of the automobile marketplace COVISINT, have shifted toward the adoption of increasingly relationship-oriented (cf. transaction-oriented), when it comes to what applications they provide. We can thus see that a transactional as well as a relational approach to purchasing and supply management could benefit from the application of ICT. The basic issue is what fits best when and in what ways. Regarding the enhanced ability to communicate and reach, the promise of ICT can be summarized with the view that firms can overcome the trade-off between reach (how many and how far it is possible to reach with a message) and richness (how much information that message can contain) that traditional communication applications suffer from (Evans and Wurster 1997). Another benefit of using ICT applications is that communication can be conducted either synchronously or

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asynchronously. Telephone-based and personal communication, in comparison, need to be synchronous; i.e., the two or more individuals involved in communication need to be available at the same time. One main ICT-based communication tool that has spread immensely during the past years and yet often is forgotten or taken for granted is e-mail. In a recent study on present and future usage of communication tools among industrial firms in the UK, it was found that in 2002 the telephone was still the most frequently used communication tool but that e-mail had a strong, and growing, position (Leek et al. 2002).

Communication

Recent studies by the Swedish Industrial Research and Development Corporation (IVF) report an increasing interest, especially from firms in the automotive industry, in ICT applications that support collaborative efforts and distributed engineering across firm boundaries (Pramås et al. 2003). Several different types of systems are offered by several actors – one of the large ones seems to be Quickplace by Lotus Notes – ranging from very specific to very general in terms of what tasks the platform is to support. Common features are that they, when the system is set up, can be easily maintained and that they can be accessed through the Internet by its users. In addition, most collaborative platforms seem to contain functions that enable document handling and filing, and functions that enable notification and planning. Vlosky et al. (2000) present an analysis of the extranet as an application to enhance customer service and information sharing in an industrial marketing context, and find that the use of an extranet requires changes in business culture and argue for broad acceptance and involvement in the adoption process. Bajwa et al. (2005) outline different types of collaborative platforms including web-based collaborative tools (e.g., intranets and message boards), proprietary groupware tools (e.g., Quickplace) and electronic meeting systems (e.g., project platform systems). The study by Pramås et al. (2003) specifically considers collaborative product development systems, which are applications that support spatially distributed communication in product development projects. These enable both synchronous and asynchronous communication and have specific functions – for example inbuilt viewers for CAD/CAM – that are designed for enhanced efficiency in product development.

Through a single case study of a Swedish automotive firm and its product development operations, Nittmar (2000) showed how inter-organizational systems with the purpose of facilitating communication in distributed product development affected inter-organizational boundaries. Through three levels of analysis, the study pointed out that new ways of communication in product development projects

created intensity in both the internal and external networks of product development project participants. However, with the introduction of new technology and increase in communication, Nittmar (2000:183) also points out that integrative gatekeepers might be necessary to intermediate in the communication through new ways to communicate. Along similar lines, when investigating the ways ICT creates transparency in buyer-supplier relationships, Hultman and Axelsson (2007) found that although ICT on the one hand might create an organizational transparency, the technologies also created problems of filtering and handling increased amounts of data. In this study, a firm that implemented an application of ICT to support the buyer-supplier communication process was able to reduce uncertainty in some respects but as an effect of implementation, the case revealed an increase in uncertainty in other respects.

Alongside e-auctions, other applications that have gained widespread attention are CRM (customer relationship management) and SFA (sales force automation). Both these applications are ICT solutions that enable a systematic approach in dealing with business customers. Both CRM and SFA have shown to be quite problematic to implement (e.g., Avlonitis and Panagopoulos 2005; Speier and Venkatesh 2002). For example, in a study of CRM in the automobile industry, Lindgreen et al. (2006) acknowledge that business firms may simultaneously have different types of business customers they may wish to develop different types of relationships with, leading to a situation in which CRM might or might not suit a specific relationship. They argue that not all business customers necessarily want or require a relationship, hence a portfolio of business customers requires a range of CRM solutions (Lindgreen et al. 2006:64).

Coordination

There are several ICT applications that enhance coordination; those that perhaps come to mind are ERP (Enterprise Resource Planning) systems. ERP systems are widely diffused and used among both large and small industrial firms. The scholars that studied the SABRE system in the 1980s found that there was a need for, and a potential benefit in, overcoming double feeding in the different systems used in making airline reservations (e.g., Malone et al. 1987). Twenty years later, creating seamless connections across firm boundaries is still something many IT managers aim for. The principal idea is that the need for coordination of the chains of activities both within and between firms increases, as the demand for efficiency increases. The major objective of an ERP system is to enable the integration and control of resources across departments and functions in order to obtain coordination of transactions. The focus is primarily to coordinate functions within

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a firm, even though later developments show efforts to coordinate and control flows across firm boundaries.

An ERP system is today a relatively widespread application, not only within large firms but also gradually among medium-sized firms, especially in northern Europe and the US (Kumar and Van Hillegersberg 2000). Given the scope of an ERP implementation, research that specifically looks at ERP has found it important to study factors that drive and hinder implementation (e.g., Hong and Kim 2002; Motwani et al. 2005). Studies that look at these factors become even more important in the light of critical studies showing that ERP implementation often suffers from exceeded budgets, missed deadlines or complete or partial failure (e.g., Hong and Kim 2002). Several interesting studies on ERP adoption have been conducted during the past couple of years. For example, Hirt and Swanson (1999) presented a case study where they, among other things, discuss the pros and cons of different implementation approaches (e.g., step-wise or all-in-one-leap) in a case at Siemens Power Corporation, an adoption process that took a number of years to complete. Given the time and financial resources needed to implement ERP, one way to achieve successful implementation might be to take smaller steps and adopt some modules at a later stage.

There are other specific applications supporting coordination across firm boundaries; these have been labeled SCM (Supply Chain Management) systems. The logic behind stretching the focus from a within-firm or between-two-firms perspective is that firms thus obtain the ability to change and adapt their sourcing activities to an ever-changing environment. The key lies in viewing their supply from a chain perspective. A chain perspective can be applied to communicational as well as physical flows through the supply chain. In a study of the role of the Internet in supply-chain management (Lancioni et al. 2000) reporting findings from a survey study covering a broad range of industries, it was found that the most popular SCM application enabled by web-technologies was management of transport. With this application, supply managers were able to control arrival times and identify potential delays through tracking services. Information sharing is a key aspect of functioning supply-chain management. For example, in a study of the Korean automobile industry, Kim et al. (2006) discuss the importance of information sharing in the development of modularization and systems supply. They find that ICT exploitation and the development of modularization capabilities among automotive supply chains are tightly intertwined processes and that there is a relationship between information quality and effective coordination, which in its turn supports modularization.

The ICT application concerning coordination that has perhaps attracted the most attention is EDI (electronic data interchange). The development of EDI has been driven largely by the automotive industry. In Sweden, the development has been driven by Odette Sweden and the OEMs. Through a number of studies of EDI, the factors driving and hindering EDI adoption are quite well researched (e.g., Chwelos et al. 2001; Damsgaard and Lyytinen 1998; Damsgaard and Lyytinen 2001; Hausman and Stock 2003; Iacovou et al. 1995; Martínez Sánchez and Pérez Pérez 2004a; Martínez Sánchez and Pérez Pérez 2004c; Vlosky et al. 1994). Two studies that specifically examine EDI adoption in the automotive industry are by Rassameethes et al. (2000) and Tunnainen (1999). In a survey on 1st tier suppliers in the US automotive industry, Rassameethes et al. (2000) found that firm performance correlates with EDI integration and that the further up the supply chain, the lower the likelihood is of finding a supplier with EDI capability. The study by Tunnainen (1999) confirms the high level of adoption among automobile manufacturers and specifically looks into the problems that small firms with EDI face. She finds that in most cases, EDI was perceived mainly as a means of survival as its use is a prerequisite in the automobile industry. With easy access and low cost applications like web-EDI, the technology has reached further upstream than was possible in the early stages of development, as the Internet has tended to reduce the previous disadvantages of high costs and lock-in risks (Chaffey 2002:103).

One of the more recent applications in the automotive industry is RFID (radio frequency identification) and related applications such as tracking systems (e.g., Brewer et al. 1999; Strassner and Fleisch 2005). RFID first appeared in tracking and access applications during the 1980s but has transformed into sophisticated tracking systems through the development of active and intelligent RFID tags. In a supply chain, RFID can be used to allow location tracking for the coordination of production and logistics through identification and calculations of expected time of arrival of a certain package or component, often transported in containers or batches marked with an RFID tag. In a study of the potentials of RFID, Brewer et al. (1999) conclude that the areas of application in the supply chain are manifold and that the real innovation in RFID is not the technology itself but in its application in real situations, solving real problems in the supply chain.

1.3 Purpose and overview of this thesis

In this first chapter I have made an attempt to outline that the starting point of this study is in the complex and strategic nature of ICT adoption decisions. On the strategic level, a decision to reject or adopt a specific type of technology can in the long run affect a company's ability to develop and fulfill market need for many years. On the other hand, a timely decision on technology can be a source of competitive advantage. On the operational level, adoption of technology can make the everyday situation for firm purchasing assistants, production planners and administrators less monotonous and more effective, and give them time to perform other tasks. In this study I will address ICT adoption in an industrial context. I have also outlined the automobile industry as the context in which the study has its focus. I have briefly introduced the proposition that prevalent conceptualizations, implying for example that adoption is a single-firm problem where a single decision-making unit handles the problem and promise of ICT, perhaps needs to be rethought.

1.3.1 The purpose of the thesis

Based on the discussion above and the conclusions made in the problem discussion, the following purpose has been formulated:

The purpose of this thesis is to empirically explore information and communications technology adoption in an industrial context in order to challenge prevalent conceptualizations of adoption.

1.3.2 Thesis disposition

The second chapter of this thesis outlines a theoretical framework that aims to provide the reader with an overview of how I will frame ICT adoption. I start the chapter by discussing technology and technology adoption, and I continue by outlining how I define and delimit the industrial context. A key feature of Chapter 2 is that I present a conceptualization of adoption that I later in the thesis apply and refer to as a framework that has guided my fieldwork and analysis. The third chapter outlines my research approach and design. I frame my study as a multiple case study and my approach as processual and interpretative. I discuss this approach from both a practical and philosophical perspective. I present in detail my conduct

in the field and outline principles applied for case and respondent selection. Chapter 4 presents the empirical base of my thesis, five cases of ICT adoption processes. The five case studies are a product of fieldwork conducted between the years 2001 and 2006 and are all in some way related to the Swedish automobile industry, either directly or indirectly. Through application of the conceptualization outlined in Chapter 2, I have structured all the case descriptions so that they present: 1) a general description of the focal firm and the context in which the adoption took place, 2) a description of the object of adoption, the technology, and 3) a description of the adoption process of the application under study. Each case is concluded with a within-case analysis on drivers and barriers identified in each case. In the fifth chapter, I present an analysis of my empirical materials and aim to provide a cross-case exploration and analysis of the empirical materials to build a basis for fulfilling the purpose of challenging prevalent conceptualizations of adoption. The sixth chapter presents my conclusions. In this chapter, I challenge the prevalent conceptualization of adoption by discussing how we instead need to view the subject of adoption, the object of adoption, the process of adoption, the outcomes of adoption and the role of the context of adoption in the interactive context that the industrial context provides. I also outline theoretical and practical implications. I 'close' the book by providing the reader with an epilogue where I return to the empirical setting. By doing this, I corroborate my case of describing and analyzing adoption as an interactive, ongoing and complex phenomenon.

CHAPTER 2

Framing information and communications technology adoption in an industrial context

In this chapter I will outline a theoretical framework, providing an overview of my understanding of information and communications technology (ICT) adoption. The aims of this chapter are threefold. First, I aim to outline the conceptualization of adoption I have applied when studying ICT adoption. The conceptualization is based on five entities: the object of adoption, the subject of adoption, the process of adoption, the outcome of the process in question and the context of the adoption process. Second, I aim to frame my study theoretically through outlining a description of the industrial marketing context. Third, through an overview of previous empirical studies on ICT adoption, and based on the criticism found within the field of adoption, I will propose that organizational level information and communications technology adoption needs to be understood and evaluated through a processual and interpretative approach, thereby taking the complex and embedded nature of ICT applications into consideration.

2.1 The fundamentals of technology adoption

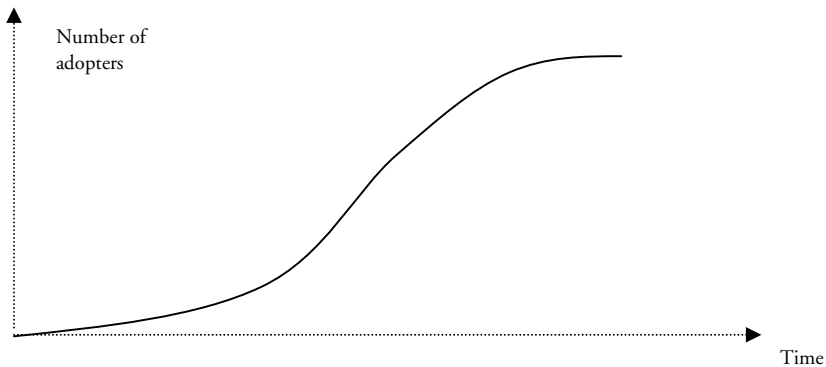
This study concerns adoption and has as its purpose to explore information and communications technology adoption in an industrial context in order to challenge prevalent conceptualizations of adoption. Used as a term describing the decision to adopt or not to adopt a specific technology, adoption is established and commonly applied in a broad set of scholarly fields (Rogers 1995:42-43). Adoption could concern an innovation or technology, ranging from the very concrete (e.g., a specific application like e-mail) to the more abstract (e.g., ICT as a set of technological applications). It is often argued that the foundations of adoption and diffusion research were laid over a 100 years ago by Gabriel Tarde (Katz 1999; Kinnunen 1996; Rogers 1995). Tarde, who was mainly interested in imitation as the explanation of social change, was the first to conduct systematic studies on

adoption. In the most famous contribution to adoption research, *Laws of Imitation* (Tarde 1903/1962:140), Tarde stated his scholarly purpose as:

Our problem is to learn why, given one hundred different innovations conceived of at the same time - innovations in the form of words, in mythical ideas, in industrial processes etc. - ten will spread abroad, while ninety will be forgotten.

As indicated in the quote above, Tarde's focus was on the system and industrial level – looking at adoption across a large group of entities, i.e., diffusion of innovations. One of Tarde's theses was that the more compatible an innovation was with ideas already accepted, the more likely it was to be adopted. Another of his theses was that diffusion of an innovation or idea generally followed an S-shaped curve.

Figure 2. Distribution of adopters over time along an S-shaped curve (e.g., Rogers 1995; Ryan 1948).



Just regarding these two ideas, and comparing them with contemporary literature on diffusion research, places Tarde far ahead of his time (Rogers 1995:40). The first edition of Tarde's laws of imitation was published in French in 1890, but it was not until the middle of the next century that the first empirical studies on diffusion were conducted. Reviewing the studies from this period, it is obvious that several different scholarly disciplines drew on the work of Tarde. Kinnunen (1996:437) notes:

From the 1940's until 1960's the popularity of diffusion research rose within different disciplines simultaneously and independently. Scholars were unaware of the fact that they were preoccupied with the same idea. Studies emerged, for instance, from the fields of anthropology, rural sociology, education, medical sociology, general sociology, communication, marketing and geography.

Regarding the period described by Kinnunen above, when the field of research on adoption and diffusion seems to have had a significant impetus, some studies that deserve mention are those by Bryce Ryan and Neal Gross (e.g., 1948; 1943) on rural sociology and the diffusion of new agricultural innovations. Their contribution, considered “*the most influential diffusion study*” (Rogers 1995:31), reported empirical studies conducted on how the usage of a new type of corn⁶ spread from farmer to farmer in the state of Iowa during a period of approximately ten years. The analysis drew on the work of Tarde (1903/1962) and showed a distribution of adopters in a similar S-shaped curve as he had identified it⁷.

In addition, other studies conducted on diffusion during the 1950s and 1960s are, for example, studies by Beal et al. (1957) on adoption processes, and by Marsh and Coleman (1954) on adoption rates, and studies aimed at creating predictive models of product diffusion (Bass 1969). Here, it can be noted that some of the most influential studies on diffusion during the 20th century were conducted in Sweden, within the field of economic geography (e.g., Hägerstrand 1967) with, for example, studies on the spread of innovations like the telephone. No matter how much they might be opposed to it, students and scholars interested in diffusion and adoption will, without doubt, run into a publication by or a reference to Everett Rogers. Rogers's book on *Diffusion of Innovations*⁸ (e.g., 1995) is without question the most cited single work within the field of adoption (Kinnunen 1996) and is at times referred to as one of the most cited publications in the social sciences (Dearing and Singhal 2006).

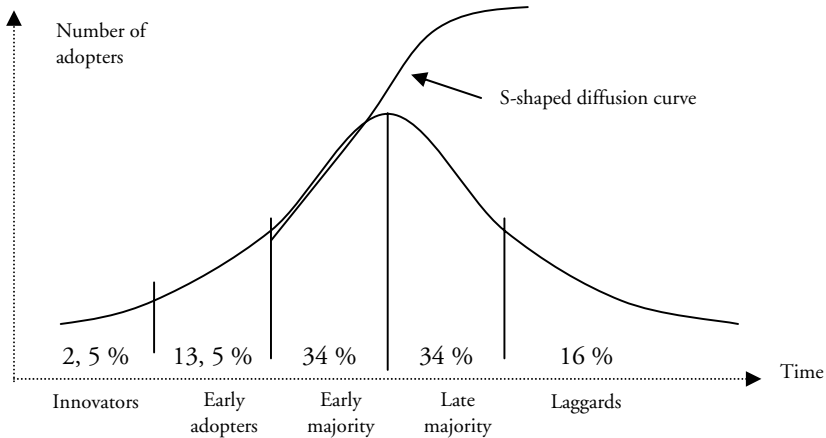
⁶ A hybrid type of corn that was more resistant and better suited for mechanical harvesting that led to a significant increase in farm productivity.

⁷ The first graphical (hand-sketched) representation of the S-shaped curve seems to be the one found in one of the seminal articles by Bryce Ryan (1948) and the first ideas on the distribution of adopters along an S-shaped curve can be found in the work of Gabriel Tarde (1903/1962).

⁸ The first edition of *Diffusion of Innovations* was published in 1962. Since then, several revised versions of the book have been published.

Three major contributions to the understanding of the diffusion of innovations can be found in the work of Rogers. Firstly, he provides the insight that the rate of diffusion is determined by the characteristics of the innovation. For example, the diffusion rate of a compatible technology with a relative advantage to the technology it is intended to replace is likely to be higher than for a technology that does not have such advantages (cf. Tarde in the paragraph above). In addition, Rogers provides a generic categorization of adopter ideal types. The idea is that, in the case of a complete and successful diffusion process, adopters and the rate of adoption among them will be distributed along an S-shaped curve (cf. again Tarde in the paragraph above).

Figure 3. Adopter categories from innovators to laggards (Rogers 1995:262)

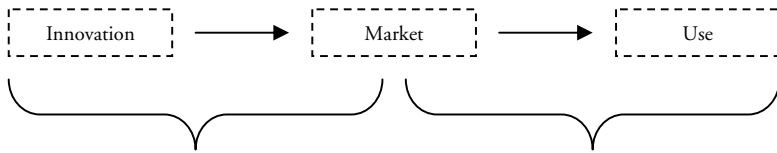


In the bell-curved figure above, Rogers (1995) provides a generic categorization of adopter ideal types. Here, the adopters are classified into types that range from early adopters to laggards. The characteristics of the different adopter types can be easily translated to fit firm characteristics. The innovators and early adopters both have a multitude of nodes (open and social) to their environment and accept a certain amount of risk, which makes them more eager than others to try new technologies. The laggards and late adopters are characterized as more isolated in their social system (few nodes to the environment) and are relatively risk-averse.

2.1.1 Defining adoption and diffusion

Two central concepts seem to be crucial to understand and disseminate within the field of technology adoption research. These concepts are the terms *diffusion* and *adoption*. The following overview will show that both concepts have an important place under the same conceptual umbrella⁹. Even though adoption and diffusion are sometimes used relatively synonymously (Brown 1981) there are, in fact, distinct differences between the two terms as they are related to two different levels of analysis. When the term diffusion is applied, the level of analysis tends to be on a macro-level, e.g., social system (e.g., Strang and Meyer J 1993). For example, Rogers (1995:5) defines diffusion as the *process by which an innovation is communicated through certain channels over time among the members of a social system*. In research where the term adoption is applied, the level of analysis tends to be on the micro-level, e.g., firm or individual (e.g., Iacovou et al. 1995). For example, Rogers (1995:21) defines adoption as *a decision to make full use of an innovation as the best course of action*. Another term used frequently in literature is *implementation*. Implementation refers to the process that takes place after the decision to adopt and when putting the technology into use within the organization. The term implementation is often used in literature with a normative nature, i.e., how to be efficient in putting the technology into use (e.g., Higgins and Hogan 1999).

Figure 4. Two aspects of the technology diffusion/adoption process



Among the several different approaches to studying diffusion and adoption of technology, or innovations, the bulk of research seems to have addressed two aspects (Figure 4) of the technology diffusion process (Brown 1981). Researchers have addressed either the phenomenon by which a technological innovation travels from the drawing table to a market and how this process is managed (e.g., Burgelman and Sayles 1986; Utterback 1994; Van de Ven et al. 2000), or the

⁹ See for example the discussion of Rogers on the rise of diffusion research (1995:38-94).

phenomenon by which an already invented technology, product or practice reaches the market and diffuses (e.g., Nasbeth and Ray 1974; Rogers 1995).

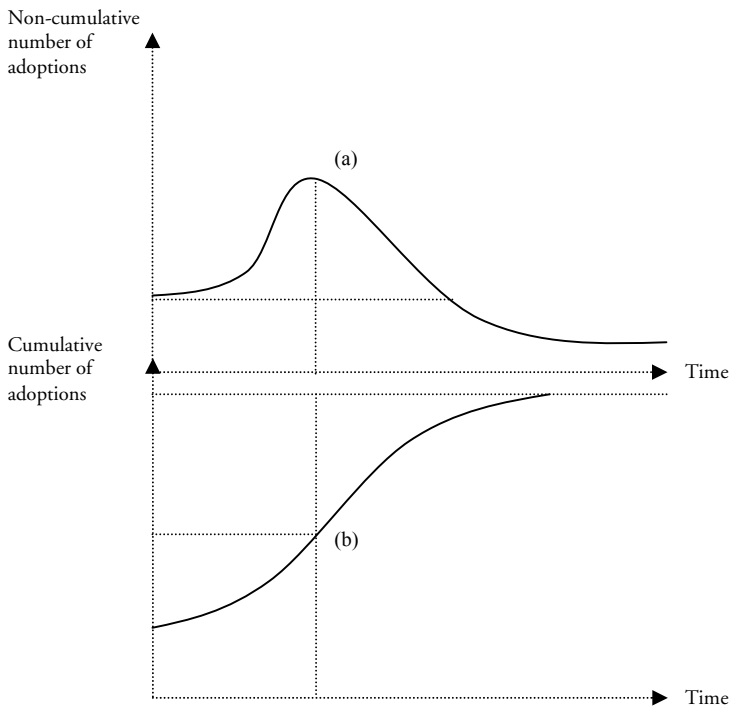
To understand how and why technologies spread and are adopted is a key interest of those who develop and market technology. It is, however, also important to others. For example, for those who wish to apply a certain means of communication in a business relationship, how to best influence and affect the adoption is important. For those who are intended as adopters, means for effective evaluation of a certain technology and, when found through evaluation to be valuable to implement, means for effective planning and execution of implementation, are of great interest. As already mentioned, the phenomenon of technology adoption can be treated in either a collective manner by which research on diffusion focuses on a group of units, i.e., industry or market (e.g., Strang and Meyer J 1993), or an individual manner by which a specific unit, i.e., firm or individual, is placed in focus (e.g., Iacovou et al. 1995). One of the commonly applied applications of the subject of diffusion is to, on an aggregate level drawing on the S-curve (see Figure 2), deal with diffusion among a group of firms or individuals. However, not all studies approach the subject of adoption on an aggregate level. Adoption on a single unit level (i.e., firm, individual) is perhaps more common, especially within business studies focusing on the actions of single firms. Another important distinction in the literature is the division and interrelatedness of the firm and individual levels of adoption (e.g., Frambach and Schillewaert 2002). Adoption research can also have a functional focus, for example using a purchasing department (Garrido Samaniego et al. 2006) or logistics department (Bush et al. 2005) as units of analysis.

In order to handle these two levels of adoption, adoption can be viewed as a two-sided phenomenon with a decision made on both an individual and organizational level (e.g., Frambach and Schillewaert 2002; Rogers 1995). The two-sided approach to adoption is generally interpreted as a firm-level decision to adopt (primary adoption), and from there on, the spread of adoption on the individual level (secondary adoption). Although the view of adoption as a multi-level phenomenon is broadly recognized and accepted, it seems as though a focus on one level of analysis is the most common approach. In the next subsection, I will continue to lay the foundation of my theoretical framework as I present two models that have been very influential on research within the field of technology adoption, the BASS model and the TAM.

2.1.2 Two contemporary models – Bass Model and TAM

Adoption is a constantly growing field of research that is still in development in terms of concepts applied. Some maturity can, however, be identified through the recurrent use or referral given to two contemporary models of technology adoption: the Bass Model and the TAM. Although neither the Bass model nor the TAM will be applied in this study, they are nevertheless too important and too broadly recognized to not be mentioned in this theoretical framework.

Figure 5. The Bass Model for forecasting the rate of adoption (Mahajan et al. 1990a)



First, the influential article by Frank Bass, which outlined the forecasting model for new products which he named the Bass Model (Bass 1969), is considered by many a key contribution to the understanding of adoption and diffusion. The article, providing scholars with a predictive mathematical model for the spread of new

products, has encouraged a stream of proceeding publications on new product marketing during the 1980s and 1990s and has been refined and extended several times (Bass et al. 1994; Mahajan et al. 1995; Mahajan et al. 1990a; Norton and Bass 1987). The model presented by Bass seemingly assumes that there are two major influences (channels of communication) that drive adoption that must be included as coefficients in a predictive model. Firstly, external influences (e.g., mass media) affect the diffusion and individual adoption and, secondly, internal influences (e.g., word of mouth) affect the adoption. In addition, the market potential for the product is considered a third parameter in the model. Even though the model initially aimed to help forecast product growth in a consumer context¹⁰, it has to a large extent been applied in an industrial context as it has grown in popularity (Bass 1986).

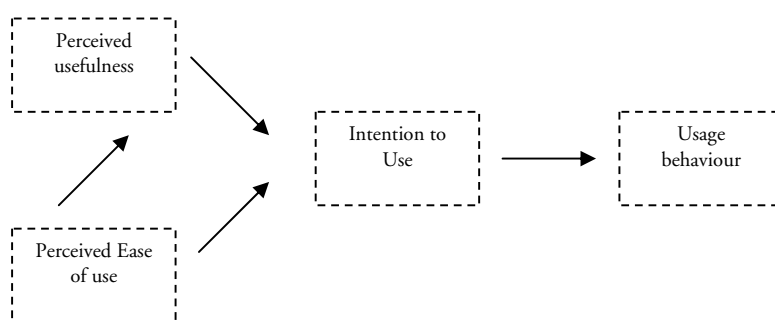
The empirical generalization (the market addressed in an aggregate way) drawn from the work of Bass and others on new product diffusion is that the diffusion (almost) always looks like a Bass curve. Through a prediction of the mean time of adoption (a), which can be found at the point of inflection on the diffusion curve, the number of adopters can then be forecasted since the S-shaped diffusion curve with cumulative number of adopters on the y-axis is symmetrical around the mean time of adoption (b). The main point in the application of the model, according to Bass's original publication (Bass 1969:226), is that the spread of a new product reaches saturation and a peak. There are several reasons for the managerial and scholarly interest in this peak and saturation. For example, it implies a turning point in pricing, advertising and distribution. This has been studied further by, for example, Robinson and Lakhani (1975) and Kalish and Sen (1986) who have made efforts to integrate marketing mix variables and adoption research.

Second, drawing on behavioral psychology and focusing on the individual technology user, acting either professionally or within an organization, is the Technology Acceptance Model (TAM) modeling individual adoption behavior, developed by Fred Davis and colleagues (e.g., Davis 1989; Davis et al. 1989). The TAM is another example of a widely accepted and applied adoption model. Although it was developed based on research examining the acceptance/adoption of personal computers, email, Internet and similar ICT applications, its generic approach makes it possible to apply to other types of technology as well. The TAM examines the mediating role of the variables perceived easy to use and the perceived

¹⁰ In the original article, the Bass Model is empirically tested against data from eleven consumer durable products (i.e., the diffusion of refrigerators and air conditioners between the years 1946-1961).

usefulness and their impact on the probability of attitude toward using and intention to use a specific technology. The overarching aim of the TAM is to predict user acceptance and guide managers in how to intervene and control or affect the determinants of individual user acceptance. The TAM has been subject to several extensions (e.g., Szanja 1996; Venkatesh and Davis 2000) and application replications (e.g., Gefen and Straub 1997; Moon and Kim 2001), as well as criticism (e.g., Taylor and Todd 1995). In later revisions of the model (TAM 2), the authors stress that context and social influence are also important determinants of user acceptance. Through longitudinal field studies with data on 200 users in four different firms, Venkatesh and Davis (2000) found support for an extension of the model including both social influence processes (e.g., image, subjective norms) and cognitive instrumental processes (e.g., job relevance, demonstrability).

Figure 6. The TAM adoption model (Davis 1989)



A related model also concerned with the rate of adoption and attributes or determinants of adoption, but focusing on the attributes of the technology instead on the behavioral aspects, is the distinction of five attributes of technology: relative advantage, compatibility, trialability, observability and complexity. These attributes will be discussed further in the coming subsection when I outline a conceptualization of adoption applied in my empirical study on ICT adoption processes.

2.1.3 A conceptualization of adoption

In this third subsection, the aim is to present a conceptualization (i.e., as a research model) that has guided my empirical study on adoption. Its structure is based on

the conceptualization of adoption research provided by Rogers and others (e.g., Rogers 1995), although the concepts are slightly modified to suit the purposes of my own research. The conceptualization builds on the idea that the computation of adoption research has some elementary building entities, following the commonly applied definitions discussed in the former subsection. The entities are: subject of adoption, object of adoption, process of adoption, outcome of adoption and context of adoption.

The first entity in the applied adoption conceptualization presented here is the subject of adoption. When discussing the fundamentals of technology adoption, I outlined that there might be varying levels of adoption in the literature and that a distinction is made between adoption on the individual unit level and adoption on the aggregate level. This discussion can be further extended by the fact that there are studies that look at a single unit of analysis in isolation (e.g., Higgins and Hogan 1999) as well as those that look at the interaction and dynamics between single units of analyses, either within or across organizational boundaries (e.g., Hart and Saunders 1997). In addition to this, the literature also includes studies that look at adoption, dynamics and interaction between the single unit and the aggregate industry level (e.g., Damsgaard and Lyytinen 1998; Damsgaard and Lyytinen 2001). For example, in their study on diffusion of EDI, Damsgaard and Lyytinen (1998) empirically explore different patterns of diffusion across three levels of adoption/diffusion; micro level, meso level and macro level.

A classic structuring and labeling of the subject of adoption is the generic categorization of adopter ideal types provided by Rogers (1995). This categorization also implies that it is the firm in isolation that decides whether or not a technology should be adopted. The idea of the categorization presented by Rogers is that, in the case of a complete and successful diffusion process, the adopters and the rate of adoption among them, the aggregate of all decisions made in a system, will be distributed along an S-shaped curve. The subject of adoption, however, needs to be described further than merely in terms of assigned labels if it is to be properly understood. Factor research has put significant effort into the exploration of organizational traits and their effects on adoption (Jeyaraj et al. 2006). The review by Jeyaraj provides a display of various factors, including those describing organizational traits. Size, centralization, capabilities, management support, formalization and integration are a few examples of organizational traits commonly applied in the literature. In their review on the ICT adoption literature, Jeyaraj et al. (2006:9) found that top management support and organization size were the best predictors of IT adoption by organizations.

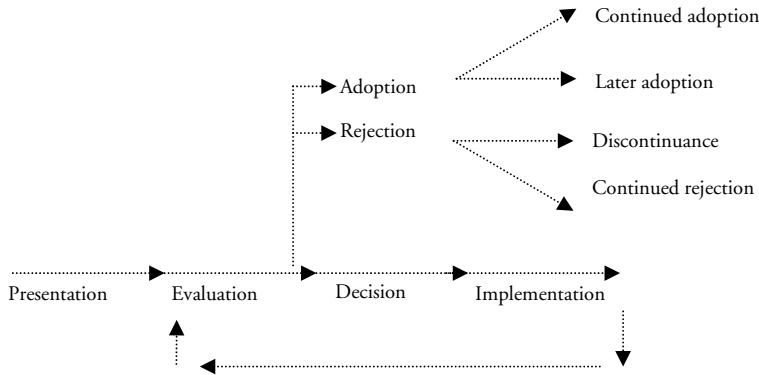
The second entity in the conceptualization of adoption presented here is the object of adoption. Looking back at the literature on technology adoption, there seems to be a tendency to focus on tangible technologies and market-ready products (e.g., Day and Herbig 1990; Fell et al. 2003; Kennedy 1983; Mahajan et al. 1990b; Webster 1969). Also within the ICT adoption literature, studies on market-ready, non-negotiable solutions are dominant. The literature includes, for example, studies that specifically address technological, often proprietary, applications like EDI (e.g., Damsgaard and Lyytinen 1998; Hausman and Stock 2003), SFA (e.g., Pullig et al. 2002; Speier and Venkatesh 2002) and ERP (e.g., Francalanci 2001; Motwani et al. 2005), or concepts like e-business (e.g., Srinivasan et al. 2002), e-procurement (e.g., Sriram et al. 1997; Zahay and Handfield 2004) and e-commerce (e.g., Chen and Dhillon 2003; Power 2005). When the character of object of technology is discussed, it is often a question of the attributes and how they are positively related to the adoption of the object under study. For an adoption to be successful, these characters should, at best, fit with an organization's goals and aims.

Characteristics of the object of technology described in the literature are often labeled technology traits. A classic structuring of traits of the object of adoption is: compatibility, trialability, observability and complexity. Rogers, for example, makes a thorough examination of these attributes as he concludes that compatibility, trialability and observability are all positively related to the rate of adoption and that complexity is negatively related to the rate of adoption (1995:224-250). Drawing on the work of Rogers, more recent studies on ICT adoption have used and replicated these traits. For example, Nijssen and Frambach (2000) studied the adoption of tools and techniques of new product development in the Netherlands. They found support for their hypothesis that former usage of tools and techniques increased the likelihood of adoption. Chen and Dhillon (2003) propose a significant positive relationship between usability, functionality and level of trust in new electronic commerce technologies. Cuncliffe and others (e.g., Cuncliffe 2000; Lu and Yeung 1998) also discuss the importance of usability of applications in Internet technology implementation. In a review of factor studies on adoption by Jeyaraj et al., (2006), the authors specifically discuss a set of variables that, based on a large set of studies, seem to be the best predictors of organizational level adoption. The study concludes that traits of the object of adoption are often used as independent variables explaining adoption in factor studies, but are not found among the best or most promising predictors of organizational level adoption (2006:9).

The third entity in the conceptualization of adoption that I have chosen to apply is the process of adoption. There are several suggestions for how to delineate the

adoption process into stages¹¹; a typical outline is presented in Figure 7. For example, Prekumar and Roberts (1999) suggest a model with five stages and Cooper and Zmud (1990) suggest six stages, with only marginal differences in what the stages include. When I have described and researched adoption, I have chosen to delineate the adoption process in four stages: presentation, evaluation, decision and implementation. If a decision to adopt is made at any time during the process, this decision is followed by implementation including adoption and usage on the individual level.

Figure 7. The adoption process - a typical outline (modified from Rogers 1995:163)



In accordance with, for example, Rogers (1995), I also extend the otherwise often assumed binary nature of adoption by adding four secondary options after an initial decision to either adopt or reject a technology. This is represented by a feedback loop and a possible re-evaluation of both decisions to adopt or reject. Instead of studying adoption as an atomistic cross-sectional phenomenon, I have therefore chosen to study the adoption process. I have defined adoption as the process by which a technology is presented to, evaluated by and decided upon by an organizational entity. In contrast to other definitions within the field of adoption

¹¹ Most process models in the literature on adoption are linear and apply the perspective of the adopting firm. For example, looking at the most cited literature in the field, the models presented by Prekumar and Roberts (1999), Cooper and Zmud (1990) as well as Rogers (1995) all apply models of the adoption process that are essentially linear.

research, this definition does not presuppose adoption as a given or sought outcome of the process. It does, however, assume a linear process including the steps outlined in Figure 7. Although time is a recurrent dimension of adoption and is an important variable within the spread of technology, the discourse in adoption studies has more recently been criticized for having a too-strong focus on factors determining adoption; it is also asserted that more attention on process is necessary for understanding adoption (e.g., Kurnia and Johnston 2000). The general argument is that research needs to move beyond the identification of determining factors and apply a more longitudinal and interpretative approach, focusing on process (Woodside and Biemans 2005a) and emphasizing cooperation and network dynamics when aiming to understand adoption and firm interactions (e.g., Hausman et al. 2005; Hausman and Stock 2003).

The fourth entity in the applied adoption conceptualization is the context of adoption. There is a plethora of publications that have focused on the environmental or contextual aspects on adoption. A typical contribution seems to be looking at external pressure (independent variable) as one determinant of adoption decision (dependent variable) (e.g., Chwelos et al. 2001; Iacovou et al. 1995). In the review by Jeyaraj (2006), looking at how adoption research over time has studied factors affecting adoption and how appropriate these variables are as measurements, external pressure as an independent variable was elevated as one of the most relevant variables and best predictors of organizational level adoption. When discussing context, however, a clear delineation can be made between internal and external context. For example, Attewell (1992) directs specific attention to the internal context, e.g., organizational and structural configurations, centralization and dynamism, relationships between departments, and existence of champions. With a single-firm perspective on adoption, external context tends to be treated as something “*out there*” in relation to the firm and its internal context.

The contributions acknowledging the context of the firm as an important player in the adoption of technology also acknowledge the criticism that too many adoption researchers have had a too atomistic and voluntaristic approach to diffusion. These studies typically argue that adoption is conditioned by contextual factors (i.e., institutions). For example, in a review of organizational level adoption, Frambach (1993:36) argues that research on adoption needs to look into factors involved in the process in a broader context. Damsgard and Lytinen strongly emphasize the importance of context in their study (1998:294):

[...] to fully comprehend the diffusion of networked and complex technologies it is necessary to approach the diffusion process using a

multiple units of analysis and multiple levels of theory [...]. each of the levels brings a new contour when painting the whole landscape of diffusion.

A few recent studies address adoption as well as acknowledge the industrial context and character, and that adoption in this context needs further investigation. Two examples can be elevated. First, Hausman (2005) conceptually addresses cooperative adoption and discusses structures and relationships as network-level determinants of adoption, outlining a set of propositions on the direction of the effects of these factors. The authors address cooperative adoption as a special type of inter-organizational cooperation. Second, in an editorial on a special issue on adoption processes and product development in a business marketing context, Woodside and Biemans (2005a) discuss how industrial adoption processes are embedded and how complex they are. The authors call for further research that goes beyond the identification of success factors and instead captures the complexity and contextuality through thick descriptions and processual approaches. Within the literature on interaction and industrial marketing, the context, in terms of relational atmosphere, is sometimes discussed as a complex pattern where both conflict, collaboration and competition co-exist within a relationship (Bengtsson and Kock 1999; Håkansson 1982). In Chapter 3 I will discuss how I have attempted to contribute to the field in terms of research approach and design and how a processual approach can capture this complexity and dualism.

The fifth and final entity of conceptualization of adoption presented here is the outcomes of the adoption process. In the overview of streams of criticism on contemporary research on ICT adoption that I will outline in Section 2.3, I will argue that alternative views on organizational level ICT adoption process outcomes are an important part of a broader understanding of technology adoption. When discussing adoption outcomes, it is important to distinguish between outcomes and effects. In this study I will use the term outcome as a reference to the results of the adoption process (i.e., adoption or non-adoption). Effects refer to the results of implementation (e.g., lower costs and efficiency improvements). Here, I specifically discuss outcomes. Previous research has perhaps looked more at how to avoid certain outcomes, i.e. non-adoption, through addressing key success factors or similar ones (Vlosky et al. 1994) than at reasons and factors leading to non-adoption. In addition, as already mentioned, most studies seem to treat the outcomes of the adoption process as binary. There are, however, examples of studies that emphasize the need to break with this binary view on adoption. Two examples of such studies are the works of Bush et al. (2005) and Philip and Booth (2001). Table 3 in Section 2.3 further shows various examples of how outcomes in the

adoption process can vary and display additional complexity, which is not seen when adoption is treated as a binary phenomenon.

Given the high failure rates of SFA adoption, Bush et al. (2005) explicitly address adoption process outcomes. Although basically factorial, the study adds an interesting perspective on the outcomes as they, by investigating SFA adoption processes spanning across several years, discuss status in the process and changing attitudes and forecasts of success. Frambach and Schillewaert (2002) call for further research on non-adoption since, they argue, the reasons for non-adoption might be found in stages of the process not captured in traditional studies. This ties in well with the proposal by, among others, Kuria and Johnston (2000) that research on adoption needs to capture the whole process of adoption in order to fully understand the dynamics of the adoption process.

2.2 Outlining the dynamics of the industrial context

In the previous section I outlined a theoretical framework on adoption and the conceptualization I will use to study adoption. As mentioned in the problematization of this thesis (Section 1.1 and specifically Subsection 1.1.3), the main focus of this thesis is on adoption in an industrial context. I argue that ICT adoption in an industrial context needs to be understood and evaluated through a processual and longitudinal approach, thereby taking into consideration the complex and embedded nature of ICT applications. In order to be able to challenge how prevalent conceptualizations of adoption in an industrial context, driven by not only an empirical investigation but also a broad theoretical exploration, I need to outline how I characterize the industrial context as a context for my investigation. As I will approach ICT adoption as an industrial marketing problem, in the coming subsections I will outline a discussion of the industrial context seen from an industrial marketing perspective. As some of the key publications within the field of adoption have been published by marketing scholars and the bonds between the adoption literature and the marketing literature (especially concerning new product development) are historically strong, this approach to adoption should make good sense (Rogers 1995:79-86).

2.2.1 Defining the market and marketing

In relation to other scientific disciplines¹², marketing could be considered rather young. In fact, the building blocks of the discipline of marketing largely build explicitly on other disciplines such as sociology, social psychology and economics (e.g., Alderson and Cox 1948). Due mostly to its close relationship to practice, the scientific status of marketing has been the subject of a vigorous and seemingly recurring discussion over the years (e.g., Bartels 1951; Hunt 1976; Levy 2002; Taylor 1965)¹³. Although it is a part of the broader scholarly field of business administration, marketing is characterized as a field of significant scope. During the

¹² That marketing is a science is taken for granted in this thesis. This has, however, been subject to recurring debate.

¹³ For an extended discussion on the matter of the status of marketing see, for example, Hunt (2002).

development of marketing as a scholarly discipline over the years¹⁴, different topics have emerged under the umbrella of *marketing research*. In Sweden, marketing research has its origins in research on distribution, which is an area concerning the industrial context (Engwall 1992). In an attempt to schematize marketing research, Hunt (2002) has proposed that the discipline could be roughly categorized by applying the dichotomies of macro/micro, normative/positive and marketing in profit/non-profit sectors. In addition, and perhaps more appropriate here, we could also pragmatically divide marketing research into scholarly work that concerns marketing on consumer markets and scholarly work that concerns marketing on industrial markets (e.g., Sheth et al. 1988). For several reasons, both these fields have their own scientific journals and associations, field-specific conferences and debates. Not surprisingly, the theoretical framework introduced in this chapter will be based on theory developed in the research stream of industrial marketing. Before delimiting the framework in such a way, however, I need to outline how I define markets and marketing.

As argued earlier in this section, marketing as a scientific discipline has borrowed its building blocks from other sciences. One such building block is, in fact, the concept of *the market*. Constituting parts of the market are of course the demand and the supply, the buyer and the seller, and the exchange that they for some reason seek to accomplish. Historically, in what has been labeled Neoclassical Economic Theory, the market has been described as an exchange system with price as the (only) coordinating mechanism. Within neoclassical economics, the main focus has been on the allocation of resources and the role of markets, seen through a lens of theory on market equilibrium. Through history, however, the neoclassical view of the market as a device or a mechanism has encountered criticism from scholars who view the market as institutions or processes. Chamberlin (1933) criticized the dichotomy of perfect competition and monopoly and the view of price as the parameter of paramount interest by asserting that parameters other than price could affect the market by introducing the concepts of monopolistic competition and product differentiation. From within the field of economics, criticism has long been voiced toward the neoclassical view of the market, through various types of arguments and approaches (e.g., Chamberlin 1933; Coase 1937; Hayek 1945; Kirzner 1973; Penrose 1959; Schumpeter 1942/1992). For example, Coase (1937) questioned the view that exchange is frictionless in his question of why firms exist. According to Coase, and what later turned out to be the transaction cost approach,

¹⁴ The American Marketing Association was established in 1937 and the first issue of the *Journal of Marketing* was published in 1936.

firms exist as an adaptation to the existence of transaction costs. Kirzner (1973) questioned the focus on the general equilibrium and price theory, suggesting instead that the main foci should be set on the process of reaching disequilibrium and the role of the entrepreneur, something he argued had been overlooked by advocates of neoclassical theorists. Hayek (1945) also criticized the neoclassical economic view of markets and proposed a view of markets as processes and, for example, through the concept of perfect information, claimed that the idea is to possess information that everyone does not have (because no one has all information, he argues) and that this capability is critical for being competitive. Hayek is thus critical of the idea of a general equilibrium and the idea of perfect information. When arguing about the adjustments/adaptations, he (1945:527) states:

[...] these adjustments are probably never 'perfect' in the sense in which the economist conceives of them in his equilibrium analysis. But I fear that our theoretical habits of approaching the problem with the assumption of more or less perfect knowledge on the part of almost everyone has made us somewhat blind to the true function of the price mechanism [...]

Critique of the market as developed by neoclassical economists has come from not only within economics but also other fields. The view of the market as an institution with a social core has been discussed by a number of sociologists (e.g., Swedberg 1994). Blau (1964) considered exchange a social process of central significance in social life, and not only in economic contexts. Homans (1958) also viewed social behavior as exchange. Here, instead of simply assuming exchange to be the exchange of good, economic exchange is stressed as also including a social dimension. Over the years, a separate view on markets and economic action has developed under the notion of economic sociology (e.g., Dobbin 2004; Swedberg 2003), with the basic argument from Weber (1922/1978) that (Swedberg 2003:15):

While economic theory can only handle economic phenomena (in their rational version), economic history and economic sociology can also deal with economically conditioned and economically relevant phenomena.

As noted in the quote above, the claim of economic sociology is that economic phenomena are socially embedded and constructed and should therefore be viewed with the help of sociological concepts. Drawing on what has been outlined above as the view on markets, this thesis will apply a view of the market as *a set of*

interconnected exchange relations (Cook and Emerson 1978:725). In doing so, this thesis adopts the view of the market as a phenomenon with a social dimension, through both direct and indirect relationships (Johanson and Mattsson 1994:325).

The concept of marketing has also been dealt with ambiguously through time. There are several reasons for this. One is the relative closeness to practice that marketing theorists have had. In fact, some of the most prominent scholars in marketing have had their background in practice or consultancy, which has led to a recurring debate on theory and the applied aspects of marketing (e.g., Levy 2002). Nevertheless, we were able to identify two streams of thought on what marketing is and how it should be theorized. Hunt (2002:31), referring to David Hume and John Neville Keynes, categorizes the streams of thought as positive or normative science, describing:

[...] a positive science as 'a body of systematized knowledge concerning what is' and a normative science as 'a body of systematized knowledge concerning what ought to be'

The idea that marketing is a function or set of tools available to the marketing manager or the producer of a good or service, and that marketing theory is the knowledge providing these managers and producers with guidance on what they ought to do in different situations facing marketing problems, is known as the managerial school of marketing (e.g., Sheth et al. 1988). The marketing-mix approach was developed during the 1950s and 1960s (e.g., Borden 1964; McCarthy 1960; Verdoorn 1956), suggesting that the prevalent price theory applied in marketing needed a broadening with several other parameters in a parameter theory (Rasmussen 1955/1972). This body of marketing theory is, as stated by Sheth et al., (1988):

[...] familiar probably to any student who has progressed past the introductory marketing course.

The managerial approach to marketing is, however, not the only contemporary view of marketing. Neither is it the view that this thesis takes. Instead, this thesis takes the view of *marketing as a process (cf. function) of exchange* (e.g., Bagozzi 1975). Through extension of this view the network approach to industrial marketing, strongly influenced by the work of Scandinavian scholars, has been developed over a period of roughly thirty years. The fundamental ideas and concepts of industrial marketing and technology in an industrial marketing context will be elaborated on in the following subsections.

2.2.2 The nature and scope of industrial marketing

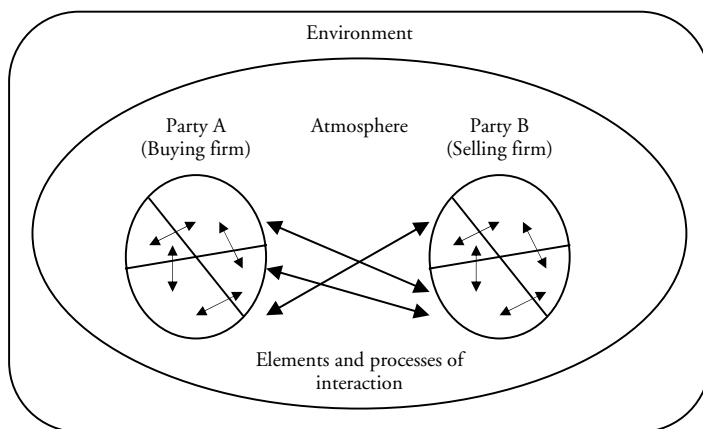
This thesis assumes that there are a few fundamental characteristics that need to be taken into consideration when studying a phenomenon embedded in an industrial context. Therefore, it draws primarily on literature found in the stream of industrial marketing. Industrial marketing involves a broad area of subtopics that are all concerned with the exchange process of products and services in an industrial marketing setting, i.e., the exchange process within a context of interconnected exchange industrial (business-to-business) relationships. From a functional point of view, industrial marketing involves not only the marketing function (e.g., sales promotion and branding) but also other functions such as purchasing and supply management as well as product development and supplier relationships.

The development of a distinct field of research within industrial marketing was initiated as a result of empirical studies and a discussion on industrial marketing and purchasing behavior (e.g., Christian 1958; Lotshaw 1970). The generalized view that the settings for interaction on business markets differ substantially from those on consumer markets and that therefore a separate set of considerations are necessary is today found in established literature on industrial marketing in both Europe (e.g., Ford 2001) and the US (e.g., Anderson and Narus 2004). In Europe, the industrial marketing domain has developed a more clear distinction from the mainstream marketing field and has its own arenas for presentation like IMP (the Industrial Marketing and Purchasing Group), which focuses on the industrial context in comparison to broader marketing conferences like EMAC (the European Marketing Association). In the US, state-of-the-art industrial marketing research is presented at broader marketing conferences like AMA (the American Marketing Association).

In Europe, a distinct tradition of industrial marketing has developed over the past 30 years. This tradition has its origins in a European research project on industrial marketing and purchasing formed in the mid-70s. The rationale of the project as outlined in the first IMP group report, edited by Håkansson (1982), is constituted by the following three arguments on the nature of the industrial market and with significant implications on how research should be conducted in an industrial context: First, the IMP project argued that studies on business markets needed to focus more on the relationship that exists between buyer and seller and not only on single purchases or business episodes as the tendency had been in the past. Second, and in contrast to the more marketing-mix oriented approach to marketing, the IMP project argued that both the seller and buyer should be considered as active

and therefore the interaction between firms must be studied. Third, as an additional argument for studying relationships instead of single transactions, the IMP project argued that since relationships often are complex and involve large investments in adaptation and encompass a long period, industrial market structures should be viewed as stable. Fourth, as a consequence of having two active parties in the exchange process, the IMP project argued for a need to break with the tendency to separate marketing and purchasing, and instead study them simultaneously as they were two sides of the same coin.

Figure 8. Main elements of the interaction model (Håkansson 1982:15)



Through a presentation and analysis of a number of case studies conducted in five European countries (France, Germany, Italy, Sweden and the UK), the IMP project developed and argued for an interaction approach to the understanding of industrial marketing and purchasing. The aim was to develop a common framework for understanding and describing buyer-seller relationships and interactions – an interaction model (Figure 8). Interaction involves four elements of exchange: product/service, information, financial and social (Håkansson 1982:15). Interaction, a constituent part of the buyer-seller exchange, is divided into four elements: process, participants, environment and atmosphere. Judging from the magnitude of citations that the interaction model has in the literature, it is an important brick in the building of the European tradition of industrial marketing research. One important area in which the interaction approach has been applied in

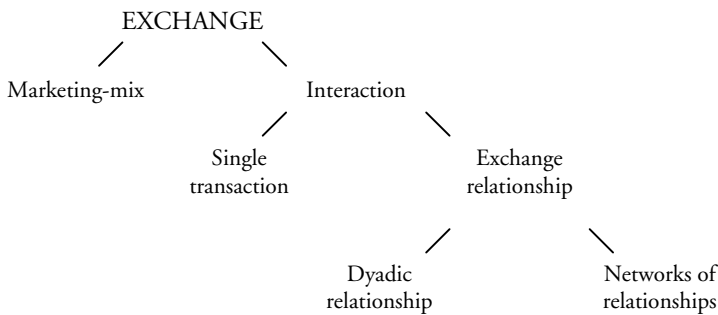
industrial marketing is product development. A key argument for this is that technological development, industrial products, are developed between actors rather than within a single actor and that product development therefore needs to be understood and studied as a process characterized by interaction (e.g., Håkansson 1987b; Laage-Hellman 1989).

The development within the IMP has, however, to some extent developed beyond the dyadic approach to the industrial setting that the interaction approach represents. A second phase of the IMP project, initiated in 1987, took a broader perspective on industrial marketing by extending the perspective from the dyad to the dyad embedded in network of other relationships (e.g., Axelsson and Easton 1992; Håkansson and Snehota 1995). A key concept in the IMP approach is the relationship, i.e. the business marketing dyad of two parties exchanging goods or services. In the IMP approach, relationships are defined as mutually oriented interaction between two reciprocally committed parties (Håkansson and Snehota 1995:25). With the extension of the perspective from the dyad to the network, the relationship was conceptualized into three dimensions, all constituting the substance of a business relationship. These entities were actor bonds, activity links and resource ties (e.g., Håkansson 1987a; Håkansson and Johanson 1992; Håkansson and Snehota 1995). The conceptual model, called the ARA model, suggested that different actors in the industrial system carry out activities and control resources. When actors perform activities, they use (change or exchange) resources. Activities are linked in activity chains and resources are tied to activities as means used by actors when performing activities.

The ARA model has been widely accepted within the IMP approach and used as a research model in a broad range of empirical studies on networks either including all three dimensions of the model or with a specific focus on actors, activities or resources. The change of perspective has also had important methodological implications. Although the primary unit of analysis still ultimately seems to be the firm, the study on a focal firm and a focal dyad needed to be studied in a network context. In an extension of the ARA model, the three entities of the model were discussed at three levels: firm, relationship and network (Håkansson and Snehota 1995). In an attempt to summarize the conceptual development of the view of the market as a set of connected exchange relationships, or as they label it, the markets-as-networks approach, Johanson and Mattsson (1994) schematized the paradigmatic orientations shown in Figure 9. The model shows the string of thought of the IMP approach, including the view of marketing as exchange relationships and markets as sets of relationships, or networks. The ARA model and literature drawing on the ARA model has seemingly been mistaken as being

synonymous with the IMP approach in general. On the contrary; the IMP approach is rather broad terms of theoretical apparatus and analytical foci (e.g., Easton 1992; Ford and Håkansson 2006). Therefore, I aim to outline what seems to be a discourse concerning the characteristics of the industrial marketing context, drawing from previous studies and conceptualizations.

Figure 9. Paradigmatic orientations for the analysis of marketing exchange (Johanson and Mattsson 1994:323)



2.2.3 The characters of the industrial marketing context

When planning and executing research within the field of industrial marketing, there is no given distinct set of theoretical concepts or models. On the contrary, the theoretical toolbox provided by the field provides a broad set of very different tools using different and analytical foci, sometimes with conflicting assertions and application of diverging perspectives. The fact that the field of industrial marketing offers an eclectic set of theories could be seen as either a major strength of the field or a major weakness, as the field of industrial marketing provides quite a few alternatives for how to approach and structure the empirical reality that one seeks to understand, some approaches clashing but most of them overlapping (e.g., Ford 2001). New perspectives and assumptions are also constantly emerging, questioning and challenging established views (e.g., Ford and Håkansson 2006; Turnbull et al. 1996). Although the field is fragmented there is, however, some discourse that can be identified – a loose set of ideas on the industrial marketing context that can be found in much of the current scholarly work on industrial marketing. This

discourse has also guided me in my work and is important since it forms bricks in my fundamental understanding of the phenomenon under study, ICT adoption processes. The characters identified below are important since they are likely to affect the nature of ICT adoption processes in an industrial context. They are also important because they have methodological implications.

The first character of the industrial context that is found in the industrial marketing discourse is that the *industrial market is constituted by a set of connected exchange relationships*. I take on this assumption since it implies that the market is much more than a mechanism balancing a specific demand and a specific supply. With the definition of markets as sets of connected relationships, I also aim to elevate the connectedness of relationships as a central concept in my thesis. This view corresponds with the argument of embeddedness, pointed out by several authors within the field of industrial marketing (e.g., Halinen and Törnroos 1998; Håkansson and Snehota 1989), ultimately drawing on the economic sociology and specifically on the work of Mark Granovetter (e.g., 1985). The embeddedness of economic actions in general and connectedness of relationships specifically has important implications for our understanding of the industrial context. Within the assumption also lies a view that relationships are both directly and indirectly connected. In line with this reasoning, Håkansson and Ford (2002:134) elaborate:

Business relationships are connected to each other. This can be illustrated by the simple example of three companies related through two business relationships. The interaction between any two of the companies, whether to buy or sell, or to co-operate in some other aspect, will depend on what happens in relation to the third party. If company A is a supplier and B and C are two customers, then any development between company A and customer B will have a negative or positive effect on its relationship with the other customer C. Similarly, if A is a customer and B and C are both suppliers then what happens between A and one of the suppliers will affect A's relationship with the other. If the three companies are in a chain, so that A supplies B, who supplies C, then interaction in either of the two relationships affects the other. When any resources or activities are shared between relationships there will be either a positive or a negative connection between them. What happens in one relationship will always affect all connected relationships, sometimes marginally, but often substantially.

The second character of the industrial context that can be identified in the industrial marketing discourse is that *industrial marketing is a process of exchange and*

interaction. This view implies that marketing is something that is ongoing and interactive rather than something atomistic and one-sided. Interaction is also central in this thesis since it entails a definition of marketing as something with two active parties – a buyer and a seller (Håkansson 1982). Marketing seen as an interaction process breaks with the functional view of marketing in which marketing takes place in a specific department of a firm, as outlined earlier in this chapter. This means that I will include other functions dealing with the establishment, development or maintenance of exchange relationships when putting boundaries around industrial marketing (e.g., logistics, purchasing and product development). As marketing in this view is a two-sided interactive process of events and actions that take place over time, we need to approach them over time when we study it. This is valid in both qualitative and quantitative research on interaction. For example, as Wilson (1996:17) elaborated:

[...] future empirical studies should strive to collect data from both sides of the dyad. While this is often logistically difficult, researchers may want to consider using smaller samples so that greater care can be taken to increase the usable response rate and so both sides of a dyad can respond.

The third character of the industrial context that is found in the industrial marketing discourse is that *industrial relationships are stable, but not static*. This view implies that the market is constituted of exchange through relationships built over time through success and failure in fulfilling needs and satisfying demands of industrial buyers. There seem to be several possible reasons for empirical observation of stability. One major argument is the basic view of heterogeneity of the industrial context (Hägg and Johanson 1982:31-33). Drawing on Alderson (1965), heterogeneity in this context means that markets are not constituted by exchange of given homogenous products, but rather that they exist to match heterogeneous resources to heterogeneous demands. Another basic argument of stability is that due to the level of complexity and degree of uncertainty in industrial markets, the propensity to engage in long-term relationships increases. For example, Hallén et al. (1991) provided empirical support for both mutual and unilateral adaptations. Along the same lines, others (e.g., Brennan and Turnbull 1999; Turnbull 1987) discuss marketing as an investment from both ends in the relationship which also affects the propensity to have a orientation toward long-term relationships. Although industrial relationships have a tendency to be stable, they are still subject to change. For example, Ford (1980) suggests that industrial relationships evolve over time through increased experience in exchange and reduced uncertainty due to the development of mutual trust.

The fourth character of the industrial context that can be identified in the industrial marketing discourse is that *industrial actors are limited in their strategic actions*. This view implies that industrial actors are considered to lack choices and, based on the constitution of markets, are also considered to be circumscribed in their ability to act independently. The assumption of limitation is closely linked to the view that industrial relationships are stable due to the heterogeneity of industrial resources and demands as discussed above, since heterogeneity also has implications on strategic options. The interdependence and dependence of industrial actors are therefore key reasons for this circumscription. The field of industrial marketing does not have a unified view on strategy or strategic option, especially on how networks are created or managed. One branch of the field of industrial marketing sees networks as a creation and sees the key managerial task as the “*management of networks*”. The other branch of the field sees networks as something that is ‘out there’ and asserts that firms need to “*manage in networks*” as the networks are unmanageable by nature (e.g., Ford et al. 2002). In a recent contribution within industrial marketing, the relationship and the network in themselves have been argued to be part of this limitations of choice (e.g., Håkansson and Ford 2002; Håkansson and Snehota 1998; Vilgon and Hertz 2003). In both the field of marketing and other related fields (e.g., strategic management), a discussion on whether the more macro-oriented approach to strategy should be supplemented with a more micro-oriented approach to strategy. An extension of this approach to strategy is sometimes referred to as strategizing. Within the stream of research discussing strategizing, the firm manager is faced by dualities and paradoxes on the micro-level and needs to negotiate strategy taking interdependencies and relational embeddedness into consideration (e.g., Ford et al. 2002; Gadde et al. 2003; Johnson et al. 2003).

For example, Håkansson and Ford (2002) argue in favor of the view of firm actions as limited through the presentation of three paradoxical aspects of networks and relationships. First, a strong relationship is a key aspect of a company’s survival and success, and functions as a basis for its growth and development. However, the problem then is that at the same time the network also ties a company into its current ways of operating and restricts its ability to change. Second, the company’s portfolio of relationships is the outcomes of its strategy and actions. But, the paradox is that the company is itself an outcome of those relationships and what has happened in them. Third, it is argued that companies try to control and manage their network and the relationships they are involved in. The paradox is that the more a company achieves in obtaining control over its network, the less effective and innovative it seems to become.

2.2.4 Technology in an industrial context

In a scientific context, defining technology can become quite difficult since there are several views and interpretations of what technology really is. Two main views can be outlined using a tangible-intangible continuum whereby technology is viewed as either a given tangible artifact (e.g., Cooper and Zmud 1990) or something as intangible as information and therefore only transferable through communication (e.g., Eveland 1986). As I do not see any point in categorically dismissing either of these two views on technology, I will accept a varying degree of tangibility of technology in my working definition of it. A technology could therefore be both proprietary applications with a high degree of tangibility and also less developed and less tangible conceptual applications or standard concepts of information or communication of data. For example, later in this thesis I will create boundaries around my cases by defining the case as the adoption process of a specific technology. In these instances, I will refer to a given technological application, either under development or already developed.

Here, a common delineation is made between process and product technologies. The delineation and relationship between the concepts of product and process technology has been dealt with by, for example, Abernathy and Utterback (e.g., 1978; 1975) in their work on industrial innovation. A key thesis in the work of Utterback and Abernathy is that innovation in product and process technologies is interconnected and occurs in a general pattern over time. As an industry develops and matures, a transition in rate of innovation from product to process occurs. One example of this pattern is the automobile industry development. Although incremental innovation is ongoing and the form and features of the product (i.e., the vehicle) as such have been rather stable and standardized in its design, the process by which vehicles are produced has changed a great deal (e.g., from craft production to mass production to lean production). In this thesis, product technology is defined as a type of technology that provides the firm an ability to produce a particular type of offering for market exchange (e.g., manufacturing designs and manufacturing practices) and a process technology is defined as the type of technology that provides the firm support to do so (e.g., manufacturing methods and fulfillment support) in the right amount of time, at an acceptable cost and with the right specifications and quality (Ford et al. 2002). In line with this reasoning, some studies suggest that product technology refers to a firm's problem-solving ability and that process technology refers to its transferability of such solutions (Ford et al. 2002).

There are quite a few examples of studies of technology in an industrial setting within the research field of industrial marketing. However, these studies have had a focus leaning more toward process and product technology than information and communications technology, and on technological development rather than technology diffusion and adoption (e.g., Håkansson 1987b; Laage-Hellman 1987; Laage-Hellman 1989; Lundgren 1991; Lundgren 1995). A more recent contribution to studies along these lines was recently published by Håkansson and Waluszewski on technological development in the paper and pulp industry, placing the firm environment in focus (2003). The view on technology within this view breaks with the view of it as a given tangible artifact. Within the field of industrial marketing, technology rather seems to take the shape of a shared asset or resource developed within a dyadic or network setting, and characterized by interaction and interdependence connectedness and change (e.g., Ford and Saren 2001:4-14; Håkansson 1987a:3-25; Håkansson and Waluszewski 2003; Lundgren 1995:29-50).

In the introductory chapter, I outlined that the scholars studying technology within an industrial context have sometimes formulated the challenges that managers face when deciding on technology as “*the problem of technology*”. Managerial choice on how to select, acquire and exploit technology has been argued to be one of the most pressing managerial concerns in current business life (e.g., Carter et al., 2000). As the distribution of power is seldom equal, choice regarding technology sometimes also entails certain aspects of force (i.e., lack of choice). In the automobile industry, it is often the automobile manufactures that dictate the demands on technology. In addition to choice, I have also outlined the problems of interdependence and change as two important aspects of information and communications technology in the industrial context. In the coming subsection, by drawing on both interdependence and change I will discuss technology as an embedded phenomenon.

2.2.5 Technology as an embedded phenomenon

Looking specifically at technology as a unit of analysis, it is quite often described as an embedded phenomenon in the literature of industrial markets. For example, Ford et al. (1998:237-241) discuss four central aspects in which technology becomes an embedded issue for managers to handle. First, knowledge is a key reason technical components are connected to a number of other components (e.g., see Figure 10). Therefore, a firm needs to develop knowledge beyond its own components and its immediate application. Second, no firm has absolute control over its own technology or the investments around it. Because technology is

In addition to the structural embeddedness previously discussed, technology can also be discussed as a temporally embedded phenomenon. This has, among other things, been brought up as *dominant design* (e.g., Suarez and Utterback 1995; Utterback 1994; Utterback and Abernathy 1975) and *path dependence* (e.g., Arthur 1989; David 1985; Rosenberg 1994; Rosenberg 1982). According to its advocates, using path dependence (e.g., Rosenberg 1994) to explain technological diffusion or non-diffusion is to study how historically early random events can lead a random walk process to lock in a specific standard. Within this stream, technological lock-in and technological lock-out are commonly used to describe the managerial problem. In one of his seminal articles, Brian Arthur elaborates (1989:116):

Modern complex technologies often display increasing returns to adoption in that the more they are adopted, the more experience is gained with them and the more they are improved. When two or more increasing-return technologies 'compete' then, for a 'market' of potential adopters, insignificant events may by chance give one of them an initial advantage in adoptions. This technology may then improve more than the others, so it may appeal to a wider proportion of potential adopters. It may therefore become further adopted and further improved. Thus a technology that by chance gains an early lead in adoption may eventually 'corner the market' of potential adopters, with the other technologies being locked out.

However, not all would agree that the technology lock-in is necessarily a result of chance-like events; some believe it is rather the result of planning, at least to some extent (Utterback 1994). The dominant design perspective, brought forward by Utterback and others (e.g., Suarez and Utterback 1995; Utterback 1994), emphasizes both the voluntaristic and deterministic sides of diffusion and non-diffusion as they suggest the term dominant design to describe the phenomenon that sets a standard that firms within a given industry follow.

2.3 Streams of criticism on prevalent research on ICT adoption

In the following section I will present an overview of some of the literature on organizational level ICT adoption. This overview constitutes an outline of streams of criticism on prevalent conceptualizations of organizational level ICT adoption. There should be no doubt that the field of research dealing with technology adoption is quite established in the sense that a great deal of work has been invested in research on the phenomenon. In the SSCI (Social Sciences Citation Index) database, a commonly used database for searches on state-of-the-art research within the social sciences, a search using the key phrase “*technology adoption*” results in almost 4,000 hits in a range of journals within the social sciences¹⁵. For several reasons, it would be superfluous to conduct a general research review on adoption research since reviews on adoption on a more general level have already been conducted by several scholars within the field (e.g., Kennedy 1983; Kwon and Zmud 1987; Mahajan et al. 1990a).

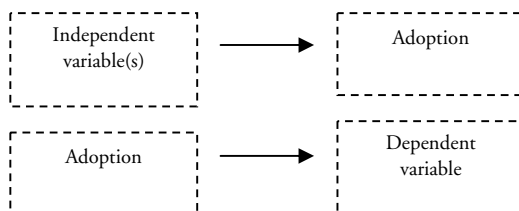
Three reviews that specifically stand out are the literature reviews conducted by Kennedy (1983), Mahajan et al. (1990a) and the review on ICT adoption by Jeyaraj et al. (2006). Although the two first deal with the adoption of new products, they are also relevant for my work. Kennedy (1983) contributes with a categorization and description of key behavioral influences on adoption, dividing these into internal (organizational traits) and external (environmental characteristics) influences. Mahajan et al. (1990a) review the literature to find developments of structural and conceptual assumptions with an aim to refine the Bass Model. The review by Jeyaraj et al. (2006) reviews literature on ICT adoption on both organizational and individual levels and distinguishes and analyzes different applied predictors of adoption. The literature I have focused on is peer-reviewed journal articles that specifically refer to ICT adoption (cf. for example, manufacturing technology or product) in an industrial marketing context (cf. consumer marketing context). In the literature on adoption within marketing domain, this distinction was developed during the 1960s and 1970s with contributions by for example Frederick E. Webster (e.g., 1971; 1969) with the basic argument that the adoption literature had a too strong focus on the consumer context. I have also limited my overview to literature that concerns organizational adoption (cf. strict individual/user level adoption micro level or strict

¹⁵ In April 2007, a search on technology adoption resulted in 3,848 hits in SSCI.

industry/macro level adoption or diffusion) and empirical studies where adoption is the dependent variable (cf. adoption as independent variable). In studies in which adoption is the independent variable, adoption is either implicitly or explicitly taken for granted. Influenced by my theoretical domicile, the journals included in my search were; Journal of Marketing, European Journal of Marketing, International Journal of Research in Marketing, Journal of Business Research, Journal of Business and Industrial Marketing, Industrial Marketing Mangement, Supply Chain Management – An International Journal, Information & Management and Journal of Information Technology. This is the case in most studies on post-adoption effects, for example (Figure 11). As most databased includes a feature to sort articles based on the times they are cited by others, I have also in addition to the set of journal that I have scanned included the most cited articles within the field if these had not previously been included.

My aim in this section is to point to a few of the general themes of criticism that to date are elevated by peers, as well as areas in which further research is needed and areas with research that remains to be conducted. Although the studies in my overview have used a broad range of theoretical frameworks and reach different conclusions regarding ICT adoption, the overview will hopefully give the reader a sense of what the studies that are empirically related and close to what I have done could look like. The point is that the prevalent conceptualizations of ICT adoption do not sufficiently consider the dynamics and complexity of the phenomenon. I summarize the criticism in four themes: 1) a need to break with factor approach and therefore, consequently, 2) a need for processual, qualitative and longitudinal research, 3) a need to open up for alternative views on organizational level ICT adoption decision outcome, and 4) a need for research focusing specifically on organizational level ICT non-adoption.

Figure 11. Adoption as dependent or independent variable



2.3.1 A need to break with factor studies

As already mentioned, there should be no doubt that the field of research dealing with technology adoption is quite established in the sense that a great deal of work has been invested in research on the phenomenon. In order to classify or structure the field based on the nature of the studies, Markus and Robey (1988) divided research into variance theory and process theory, arguing that these approaches differ in terms of their general foci and logic (i.e., variables or discrete outcomes) as well as time spent in the field (i.e., static or longitudinal). Using the same logic, Kurnia and Johnston (2000) discuss factor and process approach, arguing for research that breaks with the dominance of factor studies conducted on organizational level ICT adoption. The literature contains several examples of studies that call for further research that goes beyond the factor approach to understand adoption (e.g., Woodside and Biemans 2005a). In general, factor studies are aimed at creating a good basis for the normative theory on how to create good conditions for successful adoption and, also, how to best avoid failures in adoption. Two factor studies on ICT adoption that stand out as being frequently referred to or replicated are those of Kwon and Zmud (1987) and Iacovou, Benbasat and Dexter (1995). The conceptual paper by Kwon and Zmud (1987) has been the basis of a great deal of empirical work. The article summarizes and synthesizes the work on IS implementation and adoption conducted in the 1960s, 1970s and 1980s, and focuses heavily on determining factors: structural, technological, task-related and environmental factors. The paper by Iacovou et al. (1995) is one of the most cited studies on adoption and the subject of several extensions and replications. The model that the article proposes is typical of much factor research on adoption, presenting an examination of the three independent variables perceived benefits, organizational readiness and external pressure as factors determining the decision to adopt (see Table 1).

Table 1. Examples of empirical studies applying the factor view - a typical approach to organizational level ICT adoption

(Author, Year)	Method(s) and empirical context	Investigated factors (independent and dependent variables)
(Vlosky et al. 1994)	Study on EDI implementation based on 173 responses on a survey to of wood product retail companies in the US (response rate	Investigates intra- and inter-company factors and identifies a set of key factors

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	36%).	affecting the rate of adoption.
(King and Teo 1994)	Study on adoption of ICT based on 122 survey responses (response rate 30%) from various firms in the US.	Explores adoption as a function of external factors, internal factors and perceived benefits.
(Iacovou et al. 1995)	Study on EDI adoption among Canadian small firms through qualitative interviews with small firm managers.	Investigates perceived benefits, organizational readiness and external pressure as factors determining the decision to adopt.
(Higgins and Hogan 1999)	Study on software diffusion on a 77-firm sample from various industries in the US and Canada (response rate 53%).	Studies cross-functional team spirit, management support, user participation and technical transfer as factors determining successful adoption.
(Kuan and Chau 2001)	Study on EDI adoption based on data collected from 575 (response rate 25.7%) small firms in Hong Kong.	Explores managerial perceptions on technology benefits, organizational traits and external pressure as factors influencing the adoption decision.
(Chwelos et al. 2001)	Study on EDI adoption based on 317 survey responses from Canadian managers in various industries (response rate 36.3%).	Investigates financial resources, ICT sophistication and external pressure as factors affecting the intent to adopt.
(Pullig et al. 2002)	Study on effective implementation of sales support ICT based on quantitative and qualitative data from interviews with salespeople from various US firms.	Explores implementation climate, shared values, commitment and enabling conditions as organizational factors determining effective adoption.
(Srinivasan et al. 2002)	Study on e-business adoption based on interviews and surveys (study 1: n=183, response rate 30.6%, study 2: n=200, response rate 25.1%) in the US.	Investigates the organizational trait technological opportunism as factor determining the adoption of technology.
(Oliver and Romm 2002)	Study on ERP adoption based on qualitative document analysis from eight adopting organizations in the US and Australia.	Explores factors that justify adoption of ERP systems along four meta categories: technology, process, organization and people.
(Hausman and Stock 2003)	Study on EDI adoption in the US healthcare industry based on 281 survey responses from material managers (response rate 12%).	Investigates adoption and implementation as a function of influence, dependence and relational variables.
(Zahay and Handfield 2004)	Study on e-procurement adoption based on a sample of 96 suppliers in the aviation industry in the US (response rate 80%).	Explores learning ability, technological capabilities, and relationship priorities as determinants of likelihood of adoption.
(Martínez Sánchez and Pérez Pérez 2004a)	Study on EDI adoption in the Spanish automotive industry based on a sample of 356 automotive suppliers (response rate 32.5%).	Explores how perceived benefits, organizational traits and environment affects adoption and use of EDI and how inter-organizational cooperation is a moderating factor.

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(Power 2005)	Study on e-commerce implementation and performance based on a survey sample of 3,356 (response rate 16.5%) firms from various industries in Australia.	Investigates perceptions of benefits, strategic mindset, formal planning and capabilities as factors determining e-commerce implementation and performance.
(Bajwa et al. 2005)	Study on adoption and use of collaboration information technology based on data collected from a total of 344 firms drawn from three regions: the US, Australia and Hong Kong.	Investigates size, centralization, integration and infrastructure connectivity as factors affecting adoption and use.

In a review of factor studies by Jeyaraj et al. (2006), the authors specifically discuss a set of variables that, based on a large set of studies, seems to contain the best predictors of organizational level adoption. The authors note that the most frequently examined predictors are not necessarily the best predictors of organizational level adoption of ICT. The best predictors of organizational level adoption of ICT among the 135 independent variables among the 51 articles were found to be top management support, external pressure and organization size (Jeyaraj et al. 2006:9). The review is concluded with a number of promising aspects of future research, including environmental instability, customer support, administrative intensity, system quality and quality orientation. Table 1 presents an overview of empirical studies that apply the factor view.

Following the arguments of Kurnia and Johnston (2000), for example, the stringency often represented in factor studies could be seen as a delimitation for reaching a broader understanding of adoption processes. There are several ways in which the scope of analysis is circumscribed by cross-sectional factor research. For example, with a cross-sectional approach, it is difficult to capture what is happening over time in the adoption processes under study. If the research does not use multiple data sources covering several steps of the process, which might create a broader scope, it can hardly capture the process but instead only fragments of it. For example, factor studies look specifically at certain given independent variables in the adoption setting and their effects on a given dependent variable at a certain point in time. In addition, given the data collection procedures, the analysis becomes one-sided based on the answers from a respondent. The approach adopted by factor studies makes it difficult to capture the dynamics of the interaction between the adopting firm and its environment, i.e., a powerful buyer. This one-sided approach also implies that it is difficult, if not impossible, to use multiple levels of abstraction and analysis when interpreting the data.

2.3.2 A need for processual, qualitative and longitudinal research

If we again return to the dominance of factor studies in the ICT adoption literature, a few studies have attempted to stray from the beaten path by instead emphasizing the need for a processual, qualitative and longitudinal approach. This is emphasized either through the conduct in the study in question (e.g., Damsgaard and Lyytinen 1998; Damsgaard and Lyytinen 2001; Kurnia and Johnston 2004; Kurnia and Johnston 2000) or as a result of an analysis of the (lack of) understanding of the phenomenon in question (e.g., Min and Galle 2003; Woodside and Biemans 2005a). For example, Damsgaard and Lyytinen argue that in studies on technology diffusion *“knowing deeper is often better than knowing broader”* as the complexity of the phenomenon under study will not fully be understood if it is not fully (i.e., in depth) investigated (2001:207). This need has been emphasized in other fields of research such as that of strategic management (e.g., Hodgkinson and Johnson 1994; Johnson 1987). Looking at the literature overview in Table 2, it is obvious that there are several scholars concerned with the prevalent approach to ICT adoption, as well as a need for further research and study with an alternative focus. The compilation of studies in the table exemplifies one or several approaches but not necessarily all three approaches in studying organizational level ICT adoption.

Table 2. Examples of empirical studies emphasizing a processual, longitudinal and qualitative approach in studying organizational level ICT adoption

(Author, Year)	Method(s) and empirical context	Arguments presented for a processual, longitudinal and qualitative approach
(Cooper and Zmud 1990)	Study on MRP implementation based on 52 responses to a questionnaire survey of a random sample of US firms.	Emphasizes the appropriateness of longitudinal research since it can “thoroughly examine the dynamics” and contextuality of technology diffusion (p. 137).
(Harris 1996)	Study on the evaluation of CAD in the UK engineering industry based on four case studies during two investment periods (1977-1982 and 1983-1986).	Emphasizes that technology adoption and development is a socially negotiated process and that “the issue of CAD needs to be understood with respect to the surrounding context” (p. 54).
(Damsgaard and Lyytinen 1998)	Study on EDI diffusion in Finland based on field study with data collection through interviews with relevant actors on the industry and	Argues for more studies that orchestrate multi-level approaches and that through both “breadth and depth in the analysis” would reach a more “complete understanding” of the spread of

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	firm levels.	complex and networked technologies (p. 291).
(Volkoff et al. 1999)	Study on development and implementation of inter-organizational ICT based on single case study research conducted through interviews.	Emphasizes that the nature of the phenomenon under study and the infrequency of such projects together with the exploratory purpose calls for a single case study design (p. 67).
(Kurnia and Johnston 2000)	Study on the influences in ECR adoption through multiple case studies in Australia.	Argues that “the inter-organizational context” in which the technology in question is introduced “naturally introduces the need for the processual approach” (p. 295, 299-300).
(Philip and Booth 2001)	Study on ICT adoption based on four case studies from various industries in the UK.	Through the argument that “the adoption and diffusion of technology in organizations is a <i>non-linear process</i> ”, proposes alternative methods of understanding specific technologies’ potential in a business environment (p. 233-234).
(Damsgaard and Lyytinen 2001)	Study on diffusion of EDI in grocery sectors of Hong Kong, Denmark and Finland based on a multi-site case study approach.	Suggests that if aiming for the understanding of diffusion processes, “knowing deeper is often better than knowing broader” (p. 207).
(Speier and Venkatesh 2002)	Study on adoption of sales force automation technology based on data collected from sales personnel (Firm 1 – telecom: n=399, 100%, Firm 2 – real estate: n=251, 87%) at two firms in the US.	Argues that a better case can be made when outcomes are measured over time. Collection of pre-adoption data is argued to allow a better understanding of the implementation process (p. 103-104).
(Lancioni et al. 2003)	Study on Internet application based on two surveys sent to a sample of 1,000 US firms (response rates 18.1% and 19.3%).	Through the study of adoption patterns, the authors assert the need for follow-up surveys in order to be able to track adoption trends over time (p. 212).
(Kurnia and Johnston 2004)	Study on adoption of ECR based on a combination of quantitative (survey) and qualitative (case studies) research methods.	Discusses adoption of inter-organizational systems as less straightforward as adoption of other technologies as it involves coordination across firm borders (p. 259).
(Bush et al. 2005)	Study on sales support ICT application adoption based on interviews of key executives in three case firms from various industries in the US.	Argues that the nature of their study and the complex nature of adoption failures call for an in-depth case study (p. 372). The study explicitly focuses on process outcomes but does not look at the process itself.
(Motwani et al. 2005)	Study on factors that influence the success of ERP implementation projects based on a single case study in the automotive industry.	Argues that the complexity of technology adoption in the organizational setting calls for a case study approach (p. 379).

The call for a processual, qualitative and longitudinal approach to organizational level ICT adoption expressed by, for example, Woodside and Biemans (2005a) outlined above squares well with my previous discussion on the industrial context. If the industrial context is addressed as a process of exchange and interaction, with industrial markets as a set of connected exchange relationships, we need to address technology adoption accordingly. As pointed out by, for example, Cooper and Zmud (1990) and Damsgaard and Lyytinen (1998), these broad approaches to the phenomenon, acknowledging the connected and complex nature of technology, have the potential to contribute new insights and perspectives on ICT adoption.

2.3.3 A need to open up for alternative views on adoption process outcomes

Given the dominant role of factor studies and the nature of such studies, a tendency to treat adoption as binary (yes-no) has developed within the field of adoption studies. A typical example from the study by O'Callaghan et al. (1992:50) shows this point:

The dependent variable in the first analysis of H₁ through H₇ was the categorization of the respondents as adopters or nonadopters (from whom EDI was available). Those who had already adopted were cautioned to report on their predictions of expected costs and benefits of EDI prior to adoption. Because of the binary nature of the dependent variable, a multivariate logit model [...] was employed to test the first seven hypotheses simultaneously.

The Bass Model and the research that follows its logic also assume adoption to be binary (e.g., Mahajan et al. 1990a:13). The problem with having adoption as binary is, of course, that it tends to mislead us into believing that there are no other options. In the previous section (Section 2.2) I discussed technology in the industrial context as an embedded and complex phenomenon. This view on technology entails that technology adoption might be more complex than as described in the quote above.

Despite the presence of perhaps too simple and too atomistic views on adoption outcomes, there are studies that explicitly break with this binary view on adoption. An overview of such studies is presented in Table 3. In addition, Table 3 presents a few examples of studies in which the opened alternative is not always explicit, for example, a few factor studies that use a dependent variable (e.g., Prekumar and

Ramamurthy 1995; Sriram et al. 1997) along with a multiple item-scale, thereby discussing adoption to a certain degree or extent.

As the studies mentioned in the overview above assert, there is a need for alternative views on organizational level ICT adoption decision outcome. There are several alternatives to viewing the adoption decision as binary. For example, although they in principle still treat adoption as binary through their longitudinal and processual approach to adoption, Bush et al. (2005) discuss status as an alternative notion to outcomes, as their cases display adoption processes of SFA technologies on the organizational level, running for several years with changing status over the years. Philip and Booth (2001) break with the binary view on outcomes. In their study on ICT adoption based on four case studies from various industries in the UK, a key contribution is that they show that IT adoption is more relevant if discussed in terms of something that develops rather than assuming a sequential order.

Table 3. Examples of empirical studies that open up for alternative views on organizational level ICT adoption decision outcome

(Author, Year)	Method(s) and empirical context	Applied approach when discussing alternative views on adoption decision outcome
(Attewell 1992)	Study on diffusion of ICT among US firms based on a combination of longitudinal qualitative interviews and secondary quantitative data.	Breaks with the binary view on outcome by discussing a “third option”, namely “to purchase the fruits of a technology on a market, as a service from a mediating institution” (e.g., outsource) (p. 8).
(Prekumar and Ramamurthy 1995)	Study on decision mode for adoption on a multiple industry sample data set collected through a survey of 1,200 firms in the US (response rate 16.75%).	Breaks with the binary view on outcome by discussing adoption in terms of degree or extent, e.g., internal diffusion and external connectivity (p. 312-314).
(Sriram et al. 1997)	Study on ICT in purchasing based on survey research with a sample frame of 2,000 US firms representing multiple industry sectors and 318 responses (response rate 16%).	Breaks with the binary view on outcome by discussing adoption in terms of a three-item scale: basic hardware and software, specific purchasing systems and vendor communications interface (p. 63).
(Damsgaard and Lytinen 1998)	Study on EDI diffusion in Finland based on field study with data collection through interviews on industry and firm levels.	Emphasizes the complexity in both process and outcome by, for example, discussing adoption as something that “unfolds” (p. 276). Nevertheless, the paper at times treats outcome as binary (p. 284).
(Armstrong and	Study on ICT assimilation based on a	Discusses ICT assimilation using three distinct

Sambamurthy 1999)	sampling frame of 1,120 US firms from various industries (response rate 15%).	dimensions/functional areas: ICT business strategy, logistic activities and marketing activities (pp. 312-313).
(Volkoff et al. 1999)	Study on development and implementation of inter-organizational ICT based on single case study research conducted through interviews.	Breaks with the binary view on outcome by discussing adoption in terms of development rather than decision through the development of a stage model (p. 73).
(Philip and Booth 2001)	Study on ICT adoption based on four case studies from various industries in the UK.	Breaks with the binary view on outcome by discussing adoption in terms of something that develops rather than assuming order. This leads to a view on outcomes as something that can be difficult to isolate or define (p. 246).
(Bush et al. 2005)	Study on sales support ICT application adoption based on interviews of key executives in three case firms from various industries in the US.	Although primarily discussing outcomes as binary, the study breaks with the binary view on outcome by discussing project status (p. 372).

2.3.4 A need for research focusing specifically on non-adoption

Many studies explicitly look at successful adoption and drivers of adoption. When an adoption decision is treated as binary, non-adoption is one option, but the interest is often still on causes of adoption rather than on non-adoption specifically. Other studies look only at successful adoptions without considering non-adoption as an option at all (Beatty et al. 2001; Neo 1994). Instead, these studies take adoption for granted by, for example, grouping adopters into different adopter categories (Beatty et al. 2001). Alongside Rogers (1995), these studies seem to prefer to view non-adopters as not-yet-adopters or very-slow-adopters (i.e., laggards) and therefore non-adopters are not considered. The selection bias of adoption research has been criticized with calls for more research that empirically, either entirely or partly, focuses on organizational level ICT non-adoption (e.g., Frambach and Schillewaert 2002; Min and Galle 2003). Examples of studies that in some way empirically investigate non-adoption are outlined in Table 4. These studies either focus entirely on non-adoption as a phenomenon as in the study by Speier et al. (2002) where non-adoption projects concerning sales-force technology are examined, or factors determining non-adoption are examined through a factor study (e.g., Teo and Ranganathan 2004).

Table 4. Examples of studies that empirically, entirely or partly, focus on organizational level ICT non-adoption

(Author, Year)	Method(s) and empirical context	Description of how the study approaches non-adoption
(Attewell 1992)	Study on diffusion of ICT among US firms based on a combination of longitudinal qualitative interviews and secondary quantitative data.	Investigates different aspects of knowledge barriers as impediments to adoption. Finds that outsourcing is an option to adopting a technology "in-house".
(King and Teo 1994)	Study on adoption of ICT based on 122 survey responses (response rate 30%) from various firms in the US.	Explores facilitators and inhibitors of the strategic use of ICT based on a sample including 1/3 of non-adopters. Finds that perceived needs play a strong facilitating role for adopters and that internal need plays the strongest inhibiting role for both groups.
(Chwelos et al. 2001)	Study on EDI adoption based on 317 survey responses from Canadian managers in various industries (response rate 36.3%).	Tests a model of adoption using a factor approach to study the intent to adopt. A significant number of the firms in the study were non-adopters (259 firms of 317). Finds that external pressure and organizational readiness are important determinants of adoption intent.
(Kuan and Chau 2001)	Study on EDI adoption based on data collected from 575 small firms in Hong Kong (response rate 25.7%).	A factor study with a significant amount of non-adopters (312 firms of 575). Finds that adopters and non-adopters to a great extent had different perceptions of the technology and its benefits (?).
(Speier and Venkatesh 2002)	Study on adoption of sales force automation technology based surveys (Firm 1 – telecom: n=399, 100%, Firm 2 – real estate: n=251, 87%) at two US firms.	Explores non-adoption in a case in which a technology was first implemented but then rejected after six months. Identifies a gradual change of perceptions of and decrease in commitment to the technology.
(Min and Galle 2003)	Study on e-purchasing adoption and non-adoption based on from 656 US firms (response rate 21.89%) responding to an e-mail survey.	Factor study with aim to seek determinants of successful adoption. 44.5% of the respondents were non-adopters. Identifies a set of contextual variables that influence successful adoption.
(Lohtia et al. 2004)	Study on implementation of ECR based on data collected from a sample of 657 Japanese retailers, wholesalers and manufacturers.	Factor study that looks specifically into reasons for not adopting ECR. Finds that lack of knowledge, uncertainties and lack of capabilities and industry standards are key

		reasons for not adopting.
(Bush et al. 2005)	Study on sales support ICT application adoption based on interviews of key executives in three case firms from various industries in the US.	Examines problematic or failed adoption to find determinants that help avoid non-adoption.
(Smart 2005)	Study on adoption of e-business based on case study data from seven firms in the UK utilities (electricity and water supplies) sector.	Looks specifically at adoption impediments and outlines a list of e-business adoption barriers.

There are several reasons for the tendency to study adoption rather than non-adoption. This bias has been argued to be problematic (Schnaars 1989:59):

The problem of using research arising out of the diffusion of innovations, the product life cycle, and market growth curves is that they ignore the fact that market growth is not guaranteed, or even likely. Forecasts based on those theories have a built-in tendency to be overly optimistic. They all presuppose strong market growth. They say nothing of failure. Consequently, they set up forms to repeat the same errors. By their very nature these research traditions, when applied to growth market forecasting, results in overly optimistic projections of market growth.

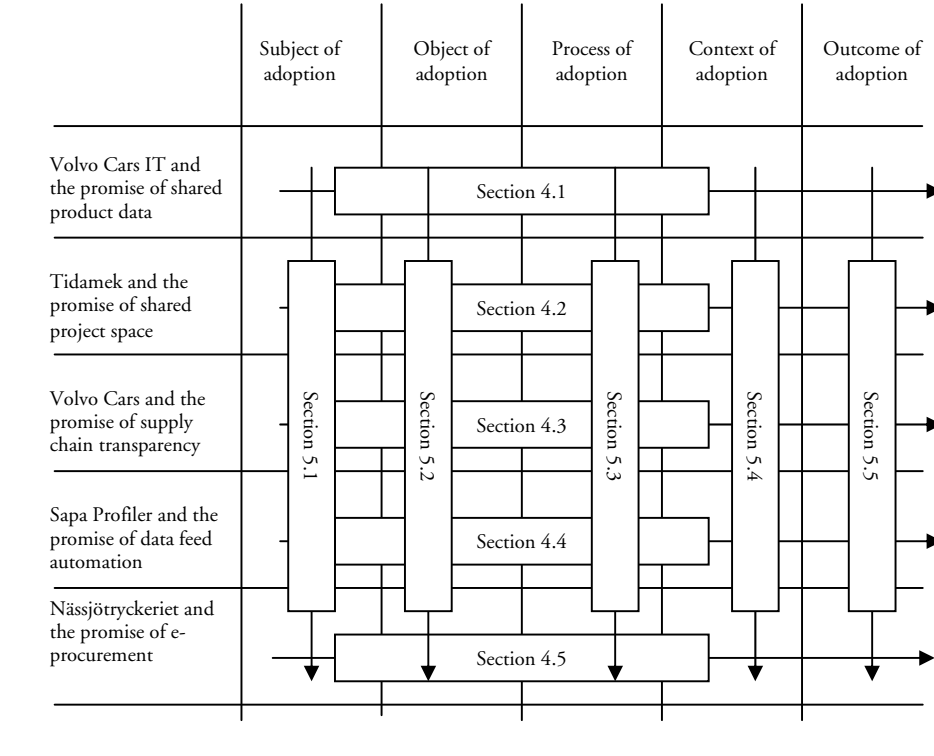
A recurring criticism of diffusion and adoption studies is the tendency to focus on successful adoption and diffusion (i.e., selection bias) (Strang and Soule 1998) and the seemingly inherent belief that the object of diffusion is something that benefits the adopter and that all actors in a system will eventually adopt (i.e., pro-innovation bias) (Abrahamson 1991:487-489; Frambach 1993:36-37).

2.4 A framework for my empirical study and analysis

In this chapter I have outlined a theoretical framework and an overview of my understanding of ICT adoption. As the thesis has its starting point in the adoption literature, I have presented the fundamentals of the field of adoption and diffusion and have also outlined a conceptualization of adoption based on the five entities subject of adoption, object of adoption, process of adoption, outcome of adoption and context of adoption. I have also outlined in detail the characters of the industrial marketing context. The industrial context is in this thesis described as complex, interdependent and connected. Therefore, building on how technology is described and studied in the industrial context, technology adoption and technological development in industrial context needs to be understood as a complex, interdependent and connected phenomena. Without a longitudinal multi-perspective and processual study, this can hardly be done. As already discussed in the introduction of this thesis, the automobile industry is the empirical setting in which I have found my five empirical cases of ICT adoption. I have in the theoretical framework also attempted to frame the Swedish automotive industry and its development and current structure and status. In the next chapter I will explain how I have planned and performed my empirical study by presenting my research approach and design. I will in detail describe my fieldwork and thereby cover both the philosophical and practical aspects of my thesis. Before doing so, however, I would like to discuss how my theoretical framework will be further applied in the coming chapters.

The conceptualization presented in Section 2.1.3, based on the prevalent literature on adoption, will be applied throughout this thesis in accordance with Figure 12. Firstly, I will structure my empirical accounts according to the suggested conceptualization. For example, in the next chapter I will explain how I have designed an interview protocol to cover all aspects of the conceptualization in order to structure the descriptions of the empirical cases in accordance with a unified structure of all five cases in my study and as outlined on the horizontal level of Figure 12. Secondly, I will focus my analysis around themes based on the conceptualization as outlined on the vertical level of Figure 12 as I reconsider and remodel the ICT adoption process in the analysis chapter. When conducting analysis and attempting to challenge the prevalent conceptualizations of adoption, I will return to the nature and dynamics of the industrial context.

Figure 12. Overview of the five cases and how the conceptualization of adoption has been applied in the empirical and analysis chapters



CHAPTER 3

Studying adoption processes - research approach and design

In this chapter, I formulate an outline of the research approach and research design applied in my study on information and communications technology (ICT) adoption in the industrial context. The chapter is divided into four sections. First, I present my general ambition in terms of research approach. Second, I discuss my thesis from a philosophical point of view, aiming to show the reader what philosophical streams I draw my reasoning from. Third, I discuss my thesis from a practical point of view, aiming to describe my conduct in my empirical investigation as detailed as possible. Fourth, I outline the methodology applied in my interpretative work, analyzing the empirical material I have collected for my thesis.

3.1 Methodology and philosophy – some point(s) of departure

As outlined in Chapter 1, the purpose of this thesis is to explore information and communications technology adoption in an industrial context in order to challenge prevalent conceptualizations of adoption. In Chapter 2, I pointed out that this thesis concerns adoption in the industrial context. The industrial context, with complexities like inter-firm dependencies and with processes taking place in interaction, calls for specific methodological attention. As the realities of the industrial context are dynamic and complex, this thesis will embrace an interpretative and qualitative position on methodology. When designing this study, conducting fieldwork and compiling my work into this thesis, I have found much of my inspiration in works labeled naturalistic inquiry or qualitative research methods (e.g., Denzin and Lincoln 2000b; Lincoln and Guba 1985) and in works that specifically, in detail, describe the craft of case study methodology (e.g., Stake 1995). My thesis provides a description and analysis of five ICT adoption processes taking place at different levels in the Swedish automobile industry. Each adoption

process is considered a case. I will outline the case study method further in the coming sections. As argued in the literature overview in the previous chapter, previous research has called for further studies that assume a processual approach, and that doing so is important for gaining a broader understanding of organizational level ICT adoption (e.g., Kurnia and Johnston 2000). When looking into case study research, I have also considered works that, despite their reputation of being positivistic, and despite not being a perfect fit with the former sources of inspiration, still have a strong influence on a great deal of contemporary case study work (e.g., Yin 1994).

My aim with this first section is to present the ambitions of my study. In doing so, I would like to start on a broad and philosophical base. Eventually, however, this chapter will hopefully also satisfy those who expect a more practical and down-to-earth description of my conduct and research design applied when conducting fieldwork. The chapter that lies ahead will present the framework of a study that has embraced a descriptive and interpretive approach in order to capture and depict the ICT adoption processes I have studied. Now, what is meant by this and why is it important to have this ambition? That this work embraces the notion of being descriptive is based on the benefits associated with a research product that literally should be “*thick*” in its description (Geertz 1973). For example, researchers who apply ethnography, an example of a core qualitative method, as their research approach, see the descriptions of social environments they produce as important and as one fundamental purpose of their research (e.g., Bryman 1995), that is, to put focus on the description of the social environment and the industrial and relational context that the ICT adoption process is embedded in. Stake (1995:42) explains the concept of thick description as detailed particular perceptions of the actors and settings under study. By descriptions of the phenomena and the setting in which the researched can be found, the aim is to come close to the phenomena. The way I have sought to accomplish this is to apply the conceptualization of adoption outlined in the previous chapter as a framework of collecting multifaceted empirical material. Some researchers apply the term naturalistic in describing this view of methodology. Denzin and Lincoln (2000a:3) elaborate:

[...] qualitative research involves an interpretative, naturalistic approach to the world. [...] qualitative researchers study things in their natural setting, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them.

When discussing the purpose of this thesis, I pointed out that it aims to empirically explore information and communications technology adoption processes. I have for

this purpose selected five cases of ICT adoption. Hence, the objective of the study is to create insights on these particular processes instead of the general. Hopefully, by having an approach that is descriptive and interpretative, I will fulfill this purpose. For this to be possible, the concept of interpretivism and understanding (Verstehen), as opposed to explaining (Enklären), become fundamental principles (Schwandt 2000) as outlined by Weber (Weber 1949/1980) in his works on methodology for the social sciences. Dilthey (1900/1976) described the process of the naturalistic study as an attempt to seek to understand the subjects better than they understand themselves. Even though I am not at all convinced about having such a pretentious and faithful research aim – this will be elaborated on in my chapter on epistemology – the point here is that the interpretative approach seeks extensive understanding of the phenomenon under study, in both broadness and depth. By naturalistic I mean that I have studied adoption processes in their natural setting, talking to people involved in the processes in their environment. Persons involved in ICT adoption processes, as either technology developers or technology deciders or users, have a perspective that will inevitably make them biased. The researcher, however, has the ability to change perspective and thereby look at the part (e.g., a firm position or a specific adoption process) and its relation to the whole (e.g., an industry or technological development in general). This does not mean that a research project can dissociate completely from the phenomenon under study. On the contrary, I see involvement and participation as key determinants of both the result and credibility of research such as the type of study I have conducted.

Qualitative research is argued to be open for a multifaceted view of a research problem. For a study on organizational level ICT adoption processes, this approach becomes essential. Here, the concept of hermeneutics, whereby the understanding of a part can only be understood if it is related to the whole (Alvesson and Sköldbberg 2000), could be brought up as related to the multifaceted approach to a research problem: That a phenomenon needs a context to be understood and that understanding is better served by concentrating on entity than on constituent parts (Stake 1995). Previous research on ICT adoption has addressed this as being important for understanding. For example, in their study on MRP implementation Cooper and Zmud (1990:137) emphasized the appropriateness of research that could “*thoroughly examine the dynamics*” and contextuality of the phenomenon under study. Another example is the works of Damsgaard and colleagues, who argue that if a multi-level approach is applied, research on technology adoption has the potential to reach a much more complete understanding of the phenomenon and that knowing deeper has more value than knowing broader (e.g., Damsgaard and Lyytinen 1998; Damsgaard and Lyytinen 2001).

It is interesting to note the somewhat aggressive position some scholars use in their argumentation in favor of their own methodological choices and against all others. Book-strict positivist statements like *“the goal of science is to be able to generalize findings to diverse populations and times”* (Schofield 2002) or *“the objective facts in the form of a systematic body of general knowledge”* (Hunt 2002), show my point more than enough. Although much research still is judged using the measurements applied in quantitative research, criticism of the orthodox view has also been raised. Despite these voices, it is no secret that the research establishment in general favors studies that deal with quantitative data and that interpretative studies are sometimes considered sloppy, subjective and undisciplined (e.g., Lincoln and Guba 1985:289). As already mentioned, the advocates of methodological bias and the proponents of the positivist view on science are not unchallenged. In a contribution sarcastically entitled *“Real men don’t collect soft data”*, Gherardi and Turner (2002) outline a counterargument and suggest that research does not and should not always follow a preordained path. There is a steadily growing stream of literature on qualitative and reflexive methodology, in which much of the inspiration and encouragement for my own research design and approach has been found. It should be made clear that my research approach reflects an ontological, epistemological and methodological position. However, some would perhaps argue that some of the labels should not be put on one’s own work. In accordance with those who say this, I will not label myself a realist, positivist, relativist or interpretivist. My view is that it is valuable to position the research at hand by describing the line of reasoning and the boundaries, as well as what novel understanding and knowledge can be generated from it. This is what I aim to do in this chapter. I will, however, try to leave the labeling to others.

3.1.1 On ontology

The terms *ontology* and *epistemology* refer to the nature of the world we live in and the ways we generate knowledge about it (Denzin and Lincoln 2000a:19). In other words, they deal with quite complicated matters. More specifically, discussing ontology means looking into questions like *“what is the nature of reality?”* and *“is there a single objective truth ‘out there’ waiting to be found and explored?”* Discussing epistemology means looking into questions like *“what is the nature of knowledge”* and *“what is the relationship between the researcher and the known?”* These are important issues and, in addition, issues that are highly related to the methodological position this chapter has proposed thus far. However, instead of announcing the kinship with a specific philosophical stance, and by this ruling out

all other stances, this chapter will discuss some ontological and epistemological stances as sources of inspiration.

On ontology, I would like to argue for and present two ontological stances that have guided me in the writing of this thesis. These stances are the pragmatist ontology and the performative view of the world as presented in organizational studies¹⁶. The pragmatist ontology is based on the pragmatist movement developed by a philosophical group championed by the Chicago School in sociology¹⁷. The pragmatist movement has been an important source of inspiration for several branches in qualitative methods, such as grounded theory and symbolic interactionism (e.g., Hammersley 1989). On ontology, the pragmatist movement assumes, first, that there is a world 'out there' that stands against human beings and, second, that this world of reality becomes known to human beings in the form in which it is perceived by them (Blumer 1980:410). Thus, this ontology is both a realist and constructivist one. This thought seems reasonable and attractive to me. Further on, the performative view of the world assumes that the world we live in is complicated. In principle, it is so complicated that it is impossible to describe all properties of a given research object, but in practice we might be able to grasp the most significant properties. In addition, what the world consists of is negotiated by, defined by, its inhabitants. Czarniawska (1993:8-11) states:

Ostensive definitions assume that social processes are basically identical with physical objects, that they have a limited number of determined properties which can be discovered and described 'from outside', and then demonstrated to an audience. We can define what a 'chair' is and then show an example of it. But can we demonstrate what 'power' is in the same way? Performative definitions, on the other hand, are creatures of language and thus always created 'on the inside', by people using the language. They 'perform' various functions: they make action possible ('now that we agreed what power is we can relocate it'), or increase subjective understanding ('aha').

¹⁶ The concept seems to have been introduced by contemporary philosopher and sociologist Bruno Latour, but this section relies on the introduction of the concept presented by Czarniawska (1993).

¹⁷ For an extensive description of the pragmatist movement and its founders, see for example Blumer (1980) or Hammersley (1989) and the original pragmatist texts by William James (1907/2000).

According to the discussions above, one could note that the pragmatist movement and the performative view of the world do not deny that there might be a 'real'. In my work I accept and presuppose, in fact, that there is a single unique physical world 'out there' that exists independently from us as observers. However, as in the case of the performative view on reality, it might be a tricky thing to capture the 'real' or to make everyone who takes part in it agree on a single view on it. As individuals - given the background we have: our experiences, individual beliefs and values - we see things differently.

3.1.2 On epistemology

Even though I have previously applied the term 'generate' when describing the emergence of knowledge, a term I consider relatively weak for defining epistemology, I would like to argue for three epistemological standpoints that have guided me and this study. The question seems to be whether knowledge, as we know it, is created or found, a difference that is linked to ontological stances on reality as constructed or as found 'out there'. My epistemological stances are logically derived from the performative and pragmatic ontological stances in which I have found inspiration. The stances presented here are the ideas that a knowledge generation is dependent on time, the researcher and the research it springs from. If we consider the statements made earlier on the performative view of the world, these seem to fit quite well with the context dependence of knowledge. This perhaps calls for further elaboration.

If we were to apply the pragmatist assumptions of the 'real' to knowledge, we would get a view of knowledge that is both realist and relativist. This makes knowledge context dependent, and one key contextual dimension is time. Truth about a phenomenon, an objective knowledge, might be out there - and it probably is - but what we see as 'known' or 'true' today might need a re-evaluation tomorrow. Just as some things might be known or true today but considered as false in the future, what is considered to be known in some context might not be considered valid in other contexts. This view on the emergence of science has, for example, been discussed by Thomas Kuhn (1970), drawing on the thought of Karl Popper (e.g., 1934/1992) as the nature of paradigm shifts in science or scientific revolutions. In the view of Kuhn, scientific progress is continuous and, thus, depending on time, we get shifts in what is known and what we believe as known.

In addition to the temporal boundedness of knowledge described above, derived knowledge also depends on us as researchers and the methods we apply. Given what we see, what theory we bring in, what perspectives we take on and what methods

we apply, we also generate different types of knowing. This view is of course a contrast to the view that there is a single objective real that is out there to acknowledge but, rather, that knowledge is a social construction. I argue that we assess what we believe as known based on our experiences and knowledge, an ontological stance. If we again return to the pragmatist assumptions, this thesis adopts a view on knowledge that is neither a strict realist nor a strict relativist view. This brings us to a view that there is, in fact, something real out there that we could know. The real is, however, hard to find and hard to fathom. Thus, in the meantime, we need to stick to knowledge that is 'as good as possible' and that this knowledge might differ depending on time and context and who the researchers are, what background we have and what lens we use to see and evaluate a phenomenon.

My view is that I believe in science and that from science there can emerge something that is beyond common sense. However, based on my epistemological view and ontological stances, knowledge is provisional or tentative and strongly influenced by perspective. As knowledge is contextually, temporally and researcher dependent, so are the perceptions of value of the certain theory built on this knowledge. Although the pragmatic ontology stipulates a tentative perspective on theory, research must strive through critical evaluation and empirical corroboration, and with all means at hand, to advance knowledge through credible, trustworthy and usable theory. Therefore, we still might need to distinguish some guidance on how to value theory. Eisenhardt, for example, argues that good theory is *parsimonious, testable and logically coherent* (1989:548) and thereby suggests that good theory explains more with less and that a theoretical contribution therefore does not need to capture all aspects of a phenomenon if this implies that the theory becomes overly complex. On the value of scientific progress, and looking back at the origins of pragmatism, William James (1907/2000:88) pointed out:

Pragmatism, on the other hand, asks its usual question. "Grant an idea or belief to be true," it says, "what concrete difference will its being true make in any one's actual life? How will the truth be realized? What experiences will be different from those which would obtain if the belief was false? What, in short, is the truth's cash value in experiential terms?" The moment pragmatism asks this question, it sees the answer: True ideas are those that we can assimilate, validate corroborate and verify. False ideas are those that we can not. That is the practical difference it makes to us to have true ideas; that, therefore, is the meaning of truth, for it is all truth is known-as. This thesis is what I have to defend. The truth of an idea is not a stagnant

property inherent in it. Truth happens to an idea. It becomes true, is made true by events.

In the quote, James makes an expression of value of knowledge is practical relevance and the power to work and the importance of the temporal and contextual boundedness of knowledge previously discussed in this section. That is, that although truth and real are potentially 'out there', truth and real are not necessarily stagnant properties of the truth and real that we conceive. I continue the discussion on how to value research in the last part of this chapter, where I discuss the credibility, confirmability and dependability of my study. I will return to the practical value and managerial implications that can be drawn from my research contributions in Chapter 6.

3.2 The research design

Leaving the more philosophical domain behind for a while, the following subsections aim at describing my fieldwork; to elaborate on my standpoints and reasons for choosing a specific research design. However, it should be pointed out that my ambition for this section is to present a research design that reflects my research approach described in the previous section.

3.2.1 Outlining arguments for a case study design

Researchers with the aim of understanding and interpreting a specific phenomenon often delimit their study to one single or a few cases. One reason for this might be that what they study is complex and needs to be understood in relation to its context, and that understanding of the particular is the only way to get a hint of the general. This thesis applies the case study approach (Stake 1995). In addition to the study of the particular, qualitative case study research in general implies that a case is tracked over time. In order to understand context and the dynamics in which the particular is embedded, the particular case needs to be studied over time. In this section I will further elaborate on the arguments for selecting a case study design.

Several scholars have used the case study design synonymously with qualitative research (e.g., Merriam 1988). However, Ragin (1992), for example, argues that the case study approach can also be found in quantitative research and that in this case it means to conduct studies by which particular cases, not particular variables, are placed in the center of a study. Regardless of whether the case study design is a research approach for quantitative or qualitative studies, the boundedness of the particular seems to be important. Stake (2000:436) defines a case in the following way:

It is one among others. In a given study, we will concentrate on the one. The time we spend on the one may be long or short, but, while we so concentrate, we are engaged in case study. Custom has it that not everything is a case. A child may be a case. A doctor may be a case – but his doctoring probably lacks the specificity, boundedness, to be called a case. An agency may be a case. But the reasons for child neglect or the policies of dealing with neglectful parents will seldom be

considered a case. We think of those topics as generalities rather than specificities. The case is a specific One.

Eisenhardt (1989:534) defines the case study approach as:

[...]a research strategy which focuses on understanding the dynamics present within single settings.

There are several ways of typifying case studies. For example, Stake (2000) suggests that a case study can have different foci by delineating between the intrinsic, instrumental and the collective case study. The intrinsic case study is described as a study in which the researcher searches for understanding of the particular – it is the case in itself that is interesting. In an instrumental case study the researcher is searching for the general through studying the particular – the case in itself is only of secondary interest. The collective case study is an instrumental case study that includes multiple cases.

Although my study design could be seen as a collective case study in which I seek in-depth understanding of the cases, I would also suggest that based on the ambition in terms of describing and understanding each particular case and its specific particularities, my study is of the intrinsic type (i.e., each particular case is interesting on its own). Although I have studied the bounded particular or, actually, five bounded particulars, I aim to use my understanding of the particular case and the separate analysis done within each case when elaborating on the set of cases and cross-case analyses conducted. Or, as put by Stake regarding cases in a collective case study (2000:437):

They may be similar or dissimilar, redundancy and variety each important. They are chosen because it is believed that understanding them will lead to better understanding, perhaps better theorizing, about a still larger collection of cases.

In addition to the study of the particular, qualitative case study research in general implies that a case is tracked over time. On the matter of time, this thesis has studied adoption longitudinally (cf. cross-sectionally). A longitudinal study implies that the researcher has been in contact with the research setting over a longer period of time, often several years (e.g., Pettigrew 1990). A key benefit in longitudinal research is that it enables the researcher to capture development and dynamics (Saunders et al. 2003). In my case, the nature of phenomenon under study is also longitudinal. Since my study is a processual study (cf. factor study), the study

design must specifically address adoption as it occurs across time. This would not have been possible if I only looked at adoption from a cross-sectional perspective. The length of time of my fieldwork has varied (measured from first to last encounter, not including follow-up interviews), from a little less than a year to several years, across the cases included in my thesis. By studying adoption longitudinally, I have been able to track changes over time and follow the adoption processes evolving over time. In addition to following through the adoption process, I have also held regular follow-up interviews to capture any changes in direction or new events.

3.2.2 Defining the case

In their book on case studies in social science, Ragin and Becker (1992) elaborate on the foundations of research. To render understanding of some of the answers related to the question of what a case is, two dichotomies in how a case is conceived are considered (Table 5): (a) whether they are seen as involving empirical units or theoretical constructs and (b) whether these, in turn, are understood as general or specific. It is stated that (Ragin 1992:8):

Realists believe that there are cases (more or less empirically verifiable as such) 'out there'. Nominalists think cases are theoretical constructs that exist primarily to serve the interests of investigators. A realist sees cases as either given or empirically discoverable. A nominalist sees cases as the consequences of theories or of conventions.

Table 5. Understanding of cases (Ragin 1992:9)

	Case Conceptions	
	<i>Specific</i>	<i>General</i>
<i>As empirical units</i>	1. Cases are found	2. Cases are objects
<i>As theoretical constructs</i>	3. Cases are made	4. Cases are conventions

Ragin continues to divide the conception of a case into either general or specific. Subsequently, it is stated that (Ragin 1992:8):

In many areas of research, generic units are conventionally treated as cases, and case categories are neither found nor derived in the course of research. They exist prior to research and scientists. Specific case categories, by contrast, emerge or are delineated in the cores of the research itself. What the research subject is a 'case of' may not be known until the empirical part of the project is completed.

Given the philosophical stances that form the basis of my research, discussed in the previous section of this chapter (Section 3.1), my view on what defines a case is context dependent. I claim to study organizational level ICT adoption processes, and it is the process as such that is defined as my case. My study concerns five cases of ICT adoption processes (see Table 6).

Table 6. Overview of the five cases and their units of analysis

	Time span	Unit of analysis
Volvo Cars IT and the promise of shared product data	2004-2006	The adoption process of a PDM data exchange standard
Tidamek and the promise of shared project space	2001-2004	The adoption process of an extranet solution
Volvo Cars and the promise of supply chain transparency	2004-2006	The adoption process of an ERP data exchange standard
Sapa Profiler and the promise of data feed automation	2002-2005	The adoption process of an ERP data translator
Nässjötryckeriet and the promise of electronic procurement	2004-2005	The adoption process of e-auctions

The cases in my study are empirical units or objects in the sense that they are intertwined real events, not least for the respondents I have met during the fieldwork: meetings that have taken place, reports that have been written,

investments that have been made and agreements that have been reached. They evolve, however, also as theoretical constructs or conventions when they are put in a scientific context.

In their study on inter-organizational ICT in the automobile industry, Howard and Holweg (2004) discuss the difficulties of studying ICT, as ICT has a degree of intangibility. In all cases except that of Nässjötryckeriet and the promise of e-procurement, the technology has been under development and only discussed conceptually and in some instances also only hypothetically. Therefore, it has been of great importance for me that the respondents and I have discussed the specific applications and their boundaries, often by first agreeing on a certain name or label (e.g., the e-auction or the extranet solution). Volvo Cars IT and the promise of shared product data was an extraordinary challenge since it involved, for example, several versions of the application.

The process, as a theoretical concept, fits the criteria of boundedness developed by Stake (2000) and other forerunners in case study research. It is the adoption process of a specific technology that creates the boundaries in my case studies, not the single organizational entity (i.e., firm). The unit of analysis that forms the center of each case is the technological application in question. This has implied that I have aimed at looking into both ends of the relationship in which the technology adoption process evolves, a research approach elaborated on by Wilson (1996), for example. For practical reasons, however, it has been convenient to label the cases based on the focal firm or the promise that they carry – this does not mean that the firm or the technology is the case itself (Table 6).

3.2.3 Selecting the cases

Due to the ambition in qualitative case study research, case selection is often argued to be made based on purposeful and emerging rather than representative case selection or sampling (e.g., Lincoln and Guba 1985). In qualitative case study research, it is even suggested that purposeful sampling is preferred. For example, Eisenhardt (1989:537) notes:

The cases can be chosen to replicate previous cases or extend emergent theory, or they may be chosen to fill theoretical categories and provide examples of polar types. While the cases may be chosen randomly, random selection is neither necessary, nor even preferable.

On case selection, Patton (1990:169) elaborates further on purposeful sampling and suggests a number of different strategies, for example selecting the unique, critical, important or typical case. Therefore, the research design is better categorized as emergent rather than preordained as it is in survey research. As do all other projects, a doctoral thesis project needs to cope with scarce resources. In my project, after concluding on research area and approach, I made the decision to study a limited number of adoption processes and follow them over time, studying how they evolved.

The selection of five individual and particular cases of ICT adoption processes was made not so much to enable comparisons as to broaden the empirical basis of the study and to obtain various and particularly illustrative examples of possible aspects and dynamics. Eisenhardt (1989:545) recommends case research to include between four and ten cases. According to Eisenhardt, unless the cases contain sub-cases, fewer than four cases will make it difficult for the researcher to generate a thorough analysis across cases. With more than ten cases, several problems occur. Firstly, the amount of material makes a qualitative case study design unsuitable. Second, it becomes difficult for any reader to grasp and form an overview across cases. Regarding the number of cases, I agree with those who argue that one case might be enough and that is not the number of cases but the quality and scope of the empirical material that is the most important factor (e.g., Easton 2003). However, I agree with Pettigrew (Pettigrew 1990:276), for example, who argues that there is a limit to the number of qualitative cases that a single researcher can manage on his or her own:

The other critical practical consideration which stands alongside the choice of sites is how many sites? Again there is no absolute answer to this question. [...] In our experience, reasonably high standards of input and output can be sustained if each experienced full time researcher conducts no more than four to six cases over a three-year period.

My selection of five cases should be seen as a way to economize on breadth and depth as well as take time and consideration to collect data. Four criteria have been the guiding principles of my case selection. Each case:

- constitutes a case of planned or recently started projects of ICT adoption.
- had the possibility to be studied through interviews and observations, and access to documentation and key respondents was established.

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- represents a case of ICT adoption that is related to the automobile industry, either directly or indirectly.
- added to the empirical investigation and to the analysis through its illustrative examples of possible aspects of the dynamics of ICT adoption to one or several of the entities in the conceptualization.

A key criterion in the case selection has been to find planned or recently started projects of ICT adoption. An additional criterion has been that these cases also needed to be accessible for research. Although I have gained access in several ways, a pattern that seems to have emerged is that access in one case has led to access to, or at least good contacts and credibility enough in order to get access to, another case. Further discussed in coming sections, the establishment of a good relationship with key respondents was critical for access in each case. For example, Pettigrew (1990) discusses access as the key criterion for case selection and states that it is more important in qualitative research to ensure quality and availability of information than other possible sampling criteria.

In 2001 I began tracking the developments in a project to develop an extranet solution at Sandvik Coromant. The project was not focused primarily on ICT adoption but the contacts in the company I had established were valuable for access. The study conducted with Sandvik Coromant at Tidamek was initially presented both at conferences (Hultman 2003) and in an anthology on networks and business renewal (Hultman 2002). The support I received for the basic approach assumed in these publications – a processual and exploratory approach to ICT adoption – convinced me that I was on to something. Parallel to the study at Tidamek, an additional case of ICT adoption had been selected: the study at Sapa Profiler was initiated in 2002. I gained access to this case due to my participation in the ETUI project with colleagues Johan Larsson and Anders Melander. After presenting my research proposal in spring 2004, I selected three additional cases: that of e-auctions at Nässjötryckeriet was initiated in spring 2004 and those describing the adoption processes of ENGDAT and SCMo were selected in summer and fall 2004.

Secondly, the automobile industry has been an important empirical boundary in my research design. This has facilitated the process of learning the language, history and structure of the empirical setting and gaining access to actors and processes relevant to my study. The firms included in the study represent organizations from different levels of the automobile industry and include OEMs, MROs, 1st and 2nd tier component suppliers, service providers and industry associations, and other various agencies. All my cases are associated with the automobile industry, which

has its heart around Gothenburg with a number of component suppliers situated in the Gothenburg region and surrounding counties, including Småland. During the two latter cases, contacts with the Swedish Automotive Suppliers Association and Odette Sweden have been useful in gaining a further understanding as well as access to empirical materials and meetings.

Finally, in the case selection I have strived to search for cases that in some way could add to the empirical investigation of the five entities that constitute the conceptualization of adoption I have used throughout the thesis. I did not select all five cases simultaneously, but added additional ones incrementally to broaden the empirical basis of the study and to obtain various and particularly illustrative examples of possible aspects of the dynamics ICT adoption. This means that I have practiced some form of principle of saturation and ended the collection of empirical materials when I judged that an additional case would not add more value to my analysis. As pointed out by Glaser and Strauss (1967:61-65, 111-113), the principle of saturation is applied in studies in which collection of empirical data is simultaneous with analysis. Although this was not intentional, I do not believe it is completely coincidental that the five cases outlined in this thesis correspond with the five entities in the conceptualization I have applied, as each entity makes up what Glaser and Strauss discuss as categories. In my case, instead of as in grounded theory where the number of categories is not *a priori* determined, the categories of my analysis were predetermined due to the nature of the conceptualization I have applied. In my study, each case adds illustrative examples of possible aspects of the dynamics ICT adoption to one or several of the entities in the conceptualization.

3.2.4 Level of analysis and respondent selection

In the design of my research, a critical decision has concerned the level of analysis with which I should approach the cases under study. In adoption research, the decision on level of analysis is a major one regarding positioning, as the adoption process can be viewed as a two-step phenomenon with a decision made on both an individual and organizational level (e.g., Frambach and Schillewaert 2002; Rogers 1995). As already discussed, due to the intrinsic complexity and intangibility of technology in the industrial context, as outlined by several scholars within the domain of industrial marketing (e.g., Ford and Saren 2001; Håkansson and Waluszewski 2003) (and discussed in Section 2.2), reaching for a level of analysis higher than the process of adoption of a few specific applications (cf. process of adoption of ICT in general) would therefore make it difficult to satisfy the boundedness criteria of what could constitute a case as outlined by, for example,

Stake (2000). Such an approach would also change the theoretical boundaries of the project, as adoption primarily concerns the organizational level.

In this study, a decision was made to look at adoption processes on an organizational level. However, as decisions on organizational level are made by individuals, the next step was to look at relevant respondents to contact. As the aim has been to study the processes of adoption and how they evolve over time, I needed to look for multiple respondents in each selected case, representing more than just the adopting firm in the adoption process. In addition, I have aimed for a broad range of respondents with different roles in the adoption process, for example:

- Technology deciders – respondents in charge of the decisions made regarding the technology in question
- Technology users – respondents intended as users of the technology in question
- Technology developers – respondents involved in the development of the technology in question
- Technology influencers – respondents who in some way were stakeholders in the technology in question and had a role in influencing the developments in the adoption process, either directly or indirectly

The division of respondents has a structure similar to the roles in a buying situation, developed by Webster and Wind (1972), showing that the organization as a whole is only a subset of the organizational actors involved. The same argument can be used in the roles actors have in the adoption process. In qualitative research, in which access through trust is a critical aspect, access to a key respondent has been very helpful. The role of the key respondent has first been to serve as the key respondent in the study, having an overview of the adoption process that others might not have. Moreover, a key respondent has had contact with users, developers, deciders and influencers and was thereby helpful in linking me to other respondents relevant in the case. I also aimed at having an arrangement with the key respondent in each case to keep regular contact and to be able to check the status of the project. In the case of Volvo Cars IT and the promise of shared product data, I had two key respondents.

A key component in my study design has been the development of a conceptualization of adoption, enabling me to disseminate and structure the empirical data I collected. The conceptualization that has guided my empirical study has its structure based on the conceptualization of adoption research based on

Rogers and others (e.g., Rogers 1995). Therefore, I designed an interview protocol¹⁸ that sought material to satisfy the following five overarching aims:

- To explore the characteristics of the firms and the firm relationships involved in the adoption processes
- To explore the specific promise that the technologies in question represented for the firms involved in the adoption processes
- To explore key activities in the adoption process and its different phases
- To explore the context in which the adoption processes were embedded
- To explore the outcome in the adoption processes studied

This enabled me to provide similar types of descriptions and a unified structure of all the five cases in my study. I will further elaborate on how I conducted my fieldwork in the next section.

¹⁸ An interview protocol outline can be found in the appendix.

3.3 My fieldwork

I have been fortunate to have a doctoral project in which my fieldwork has been a natural ingredient from the very beginning of my doctoral studies. Although very rewarding and interesting, my fieldwork has also at times been a source of frustration. When dealing with processes, often problematic or on the border to failure, it has sometimes been difficult to reach access or insight, especially when the respondents involved realize the problematic status of the project. The upcoming subsection aims at describing in detail the more practical aspects of my fieldwork: how I have conducted interviews and field visits, and what my own role has been in the project I have studied.

3.3.1 Aiming for multiple empirical sources capturing the process

There are quite a few challenges for those studying one or several processes. Through his argument that *truth is the daughter of time*, Pettigrew (1990:271) discusses the truly intriguing questions each researcher involved in processual research needs to consider:

How does the choice of time series influence the perspective of the researcher? When does the process begin and end? When is the appropriate moment to make assessments about outcome evaluation? Is time just events and chronology or is time a socially constructed phenomenon which influences behavior?

An explicit aim in the planning and execution of my fieldwork has been to search for several different empirical sources¹⁹. The main reason for this has been that I have aimed at presenting as rich an overview of the adoption processes as possible. Another explicit aim has been to follow the process through. For ICT adoption processes, this aim has shown to be difficult to achieve. As pointed out by Pettigrew (1990) above, identification of when a process begins and ends might be tricky. I will address the question of outcome further in my analysis. I have, however, followed the adoption processes for a significant amount of time. By addressing multiple sources and returning to the different cases over time, I claim to have understood the boundaries and dynamics of the process and gained a neutral perspective that exceeds the perspective of a single respondent involved in the case.

¹⁹ A detailed list of my empirical sources can be found in the appendix.

An outline of my empirical sources is shown in Table 7. In order to generate rich descriptions of the adoption processes I set out to study, I needed to obtain rich and longitudinal empirical material.

Table 7. Outline of my fieldwork across the five cases

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Transcribed interviews	11	8	8	11	10
Field visits at firm site or headquarters	2	4	1	3	4
Attended meetings ²⁰ or seminars	1	5	7	5	2

The core of my empirical material is the interviews conducted, the observations I have made during the project I have participated in and the documentation I have been able to collect from my respondents. Interviews, direct observations and documentation are three types of empirical sources that complement each other very well. Pettigrew argues similarly (Pettigrew 1990:277):

Interviews can provide depth, subtlety, and personal feeling. Interviews may also be staged occasions where feeling and evocation is high and factual detail low. Documents can provide facts but are subjected to dangers of selective deposit and survival. Direct observation provides access to group processes and can confront the researcher with discrepancies between what people have said in their interviews and casual conversations, and what they actually do. Crucially, data

²⁰ Since some of the cases entail projects that covered more than the adoption processes in this thesis, I have only included meetings relevant to the empirical study in this table and have excluded all other meetings I attended during the projects.

collection is concerned with observation and verification, and in longitudinal field studies these are iterative processes. One observes, follows themes and trails, identifies patterns, have those patterns disconfirmed or verified by further data, and the process moves on.

In Table 7, observational records are divided into field visits and attended meetings, since meetings and seminars were important ingredients in some of my cases. Access to the adoption processes has varied across the five cases and is shown in the frequency of interviews, field visits, meetings and documents. There are several reasons for this variation. As already mentioned, when dealing with processes, often problematic or on the border to failure, it has sometimes been difficult to reach access or insight, especially when the respondents involved realize the problematic status of the project. This has been especially apparent in the latter part of each process. Also, each adoption process setting is unequally embedded in unique and sometimes delicate relationships and backgrounds.

3.3.2 Conducting semi-structured interviews

There are several different types of interviews a researcher can use, each with different format and suitable for different purposes. A significant part of the empirical material in this thesis has been gathered through semi-structured interviews (e.g., Fontana and Frey 2000) conducted in a field setting, i.e., at the production site of the firms involved in the organizational level ICT adoption processes in question. In this thesis, semi-structured is an interview style by which questions can be categorized using a continuum from completely structured to completely unstructured. Other typologies exist; for example, Healey and Rawlinson (1994) distinguish between standardized and non-standardized interviews and Saunders et al. (2003) distinguish between individual and group interviews.

A major advantage of the interview as a source in the collection of empirical material is the closeness to the respondent, which enables you to observe the reactions and body language that follow answers. During my fieldwork, I have conducted a total of 48 transcribed interviews (Table 7). The purpose of my interviews have primarily been to become familiar with the cases and be able to ask direct questions to relevant respondents, at different levels and with different roles, involved in the adoption processes under study in order to collect material on their perceptions and views about events and actions occurring in the process and the outcomes of these actions. Some of the respondents were interviewed on several occasions, often with different purposes at the two or more times they have been

interviewed. For example, the first interviews conducted in a case study have focused on getting familiar with the technology in question. Other interviews have focused on collecting information during an ongoing process or were follow-ups on possible changes in a process outcome.

A typical interview lasted around 60-120 minutes and was conducted either at the office of the respondent or in a conference room²¹. As a majority of my respondents were Swedes, a majority of the interviews were conducted in the Swedish language. After approval from the respondent, all interviews were recorded either with a mini-disc recorder or a digital recorder. Each interview has been thoroughly prepared. Since the respondents were often pressured in their daily activities at work, the interviews were often scheduled a few weeks in advance. When I scheduled an interview, I explained to the respondent the purpose of my study and my general interest in the adoption process in question. For each case, I used an interview protocol containing both a fixed set of questions about the firm and project description, and a set of open-ended questions regarding the pursuit and effects of transparency by exploitation of specific applications. The interview protocol was developed based on the applied conceptualization of adoption developed in the theoretical framework²². In accordance with the developed conceptualization, the interview protocol sought to enable the collection of empirical material describing the object, subject, process, context and outcomes of the adoption process. Open-ended questions in a semi-structured interview situation present one way to avoid introducing bias into the interview situation, as this allows the interviewer to pursue answers without imposing any predetermined categorization (e.g., Fontana and Frey 1994). As some authors note, the semi-structured interview allows the researcher to follow up with interaction like: *That's very interesting, can you tell me a little more about that?* or *I see. Would you explain exactly what you have in mind there? Can you explain?* or *What do you mean?* (e.g., Kahn and Canell 1965). After the interviews the recordings were transcribed, labeled and filed.

At some instances, more often in some cases than in others, I was accompanied by a fellow researcher during the interviews. The reason for this is that I have been involved in the research projects with colleagues. Professor Helén Anderson was a fellow researcher and participated in several of the interviews in the case of Volvo Cars IT and the promise of shared product data. Professor Björn Axelsson was a fellow researcher and participated in parts of the work in the case of Tidamek and

²¹ The appendix outlines with whom, where, with what purpose and for how long the interviews took place.

²² The interview protocol guide outline can be found in the appendix.

the promise of shared project space. Professor Susanne Hertz was a fellow researcher and participated in most of the interviews conducted in the case of Nässjötryckeriet and the promise of electronic procurement. Colleague Johan Larsson and I collaborated closely in the ETUI project and he was therefore also a fellow researcher in what developed into the case of Sapa Profiler and the promise of data feed automation. In the case of Volvo Cars and the promise of supply chain transparency, Professor Susanne Hertz and colleague Benedikte Borgström acted as my fellow researchers and were involved in both interviews and project meetings. In cases in which there was more than one researcher present during an interview, a discussion on aims and roles between us researchers in the interview situation was agreed upon before the interviews took place. For reasons of convenience, i.e., to avoid long distance travel, a few interviews were conducted over the telephone. These interviews were to the greatest possible extent preceded by face-to-face interviews, since an establishment of trust is even more critical when later conducting interviews over the telephone (e.g., Saunders et al. 2003).

3.3.3 The use of observations and documents as empirical materials

Observational research has still been described as the primary foundation of all research methods in social science (Angrosino and Mays de Pérez 2000). In this thesis, observations are used since the interview method as a method of collecting empirical materials has its limitations (e.g., Silverman 1997; Silverman 1998). Silverman's point is that the interview in qualitative research is often used as a means to determine how the respondent answers a specific question, but interview outcomes say little about how respondents really act in certain situations. Although observations do not necessarily make the empirical account more 'true', they are important complementary sources of empirical materials. The central role of observation in the social sciences has its background in its concern with both the activity that takes place and the social setting in which that activity takes place. In the most extreme form of observation, the researcher takes on a role as one of the subjects of his/her research and becomes a participant observer, a form of research method with its roots among sociologists.

In my fieldwork, field visits have had several purposes. First, visiting the premises of the firms involved in the ICT adoption processes has given me a sense of the environment where the specific application the case evolves around was intended to be used. What activities were the application going to support and how were these activities performed? Who were the persons who were to use the application? Second, the field visits were important in establishing a good relationship with key

respondents, to make them feel that I could be trusted and that the work that I was conducting was also in their interest.

The types of observations that have been important in enabling me to depict the adoption process differ across the five cases. In three of the cases I have been fortunate to have an active role in the projects I was studying and thereby had access to follow meetings that were held and that were related to some of the adoption processes (see Table 8 in next subsection). In the Tidamek case, I was able to have access to meetings held in Tidaholm regarding the introduction and trial of the extranet that Sandvik Coromant had made in 2002. In the Sapa case, I was able to have access to meetings that took place within the ETUI project that were related to the adoption process of the application developed within that project during 2002 and 2003. In the Volvo Cars case, I was able to have access to meetings that took place in the Swedish project group aiming to launch a pilot implementation of SCMo during 2004 and 2005. In the Nässjötryckeriet case, I was not granted access to meetings regarding the adoption of the e-auction application presented to them, and I was also not granted access in the Volvo Cars IT case.

When meeting and interacting with the respondents in my study, I have also collected secondary data in the form of documentation for each case. Even though the documentation only played a supporting role in my study, it were often helpful in either verifying dates, persons present or decisions made during a meeting, or emphasizing points when writing and presenting my cases. In the case of Volvo Cars IT and the promise of shared product data, the description of the adoption process of ENGDAT is built on both interviews and documentation ranging from 1989 onward. The following list shows the main types of documentation used as support and complement to the observations and interview this thesis builds on²³:

- Formal project material as plans, reports evaluations, agendas and meeting minutes
- Presentation material from seminars or conferences
- Newspaper articles, press releases and newsletters with either internally or externally produced articles
- Technical specifications and implementation recommendations
- Training material and user guidelines and studies or white papers created by the firms involved in the case

²³ A list of the documentation used in each case can be found in the appendix.

3.3.4 My role as researcher in my fieldwork

As already mentioned in the previous subsection, I have had a varying role in the five case studies I have conducted. Although I would not go as far as to say that I have conducted action research in the sense that I had a specific aim to change something in the field, driven by an agenda of my own (e.g., Greenwood and Levin 2000). Still, I have been very active as a project participant, project evaluator and project interpreter. The primary reason for this is that access has to some extent been conditioned activity of some sort. Through activity in the project, I have gained the trust necessary to gain access to a more extensive picture of the adoption process than I otherwise would have had. At several times during my study, I have met some degree of resistance among respondents to continue participation. The fact that I have been part of the process to some extent has helped me in such situations.

Table 8. My different roles in the five case studies

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Interpretative	Yes	Yes	Yes	Yes	Yes
Participative	No	Yes	Yes	Yes	No
Evaluative/ Consultative	To some extent	Yes	Yes	To some extent	No

I have had basically three roles in my fieldwork (Table 8). First, in all cases, I have had the role of interpretative researcher. In all my contacts with respondents this has been explicit, as I have never concealed my presence there as a researcher conducting research. Second, in three of the five cases, I have had an active participatory role in the ICT adoption processes in question. Third, in four of the

cases, I have had an evaluative or consultative role to some extent in the sense that I have explicitly been present and active in order to evaluate, comment and give feedback on the efficiency and effectiveness of the adoption process.

3.4 Analyzing, reporting and evaluating the outcomes of my fieldwork

In the coming subsections, I will describe as thoroughly as possible the interpretative work I have performed with the empirical material collected. Just as each case in my study was unique in its own way, so was the fieldwork. However, across the five cases in my study, the process by which each case has developed can be divided into a number of phases when my process is viewed in retrospect:

1. Getting familiar with the case
2. Arranging a meeting with a key respondent
3. Gaining access and starting to collect material
4. Creating an interim case description and overview
5. Making an inventory of the empirical material
6. Returning to the case to conduct follow-up interviews
7. Performing within-case analysis
8. Writing up the case description
9. Collecting feedback from the key respondent(s)
10. Finalizing the case description
11. Requesting formal permission²⁴ to print case descriptions

Again, I would like to emphasize that gaining access to and finding a key respondent for each case has been crucial to my success in conducting fieldwork. The role of the key respondent has primarily been to serve as a key respondent in the study, having an overview of the adoption process that others might not have.

3.4.1 Analysis as part of an interconnected research process

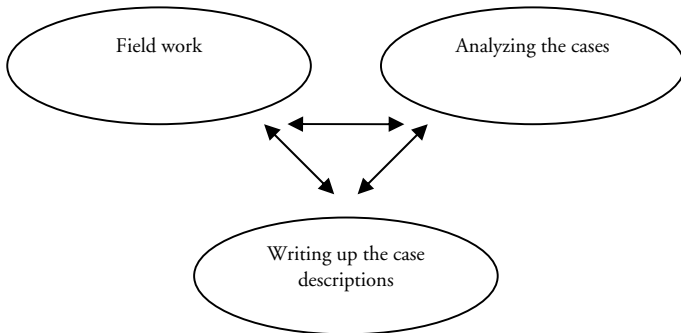
All five case studies were conducted parallel or with overlapping processes. Structuring, discussing and writing about the empirical material has been an important part of my interpretative process. During my time as a doctoral candidate, a process that on this very general level is probably similar in most qualitative work, there has been no clear point in time when I moved from collection of empirical material to analysis of the same. Rather, my fieldwork, the process of analyzing the cases and the process of writing up the case descriptions

²⁴ An example of how formal permission was sought is found in the appendix.

were all interconnected. Similarly, the development of my theoretical framework has been developed simultaneously with my understanding of the phenomenon under study, characterized by an overlap between literature studies and fieldwork. Seen in the light of my research and the conclusions I draw on the adoption process, I agree with Pettigrew (1985:222) in his view that it would be naïve of us as researchers to think of our own research activities as exercises of technical rationality, when we think of the practitioners and the practice we study as non-rational, incremental and organic. Although I see a certain direction in my process, with intention and structure, the process has a resemblance with what Alvesson and Sköldbreg (2000:17) describe as an abductive approach (cf. inductive or deductive), by which you develop an explanation based on an observation with a critical eye on past theories and perspectives. Dubois and Gadde (2002:554) suggest a similar approach when outlining their ideas on systematic combination:

[...] a continuous movement between an empirical world and a model world. During this process, the research issues and the analytical framework are successively reoriented when they are confronted with the empirical world.

Figure 13. Interconnectedness of my fieldwork, analysis and writing of the cases



My analytical work has indeed been intentional and structured. Although I do not believe I can control the moments of insight that are necessary to move forward in my interpretations (i.e., my insights are not the results of pushing a button on a keyboard and waiting for a given result to appear), I have purposely tried to create a good platform for such insights. Partly, the insights in the cases have emerged as I

have gotten to know the cases better and, also, gotten to know other cases. Also, the insights have been the fruit of structuring, evaluating and writing the cases. The insights into each case seldom occurred during deskwork, but rather during the final steps of my fieldwork in each case and in the interaction between myself and my supervisors as well as with colleagues, and while presenting my own work for students or listening to others presenting their work during seminars or conferences. In order to be prepared for these sudden “*A-ha moments*”, I always tried to keep a notebook with me. The notebooks are my records of sketches, comments and ideas developed, whenever they occurred. Interestingly, I have noted that these moments often occurred when I was the least concentrated on my own work – during a seminar, meeting or lecture, or even in my spare time. Therefore, I feel it has been important that I distance myself from the cases for a while, either to let things ‘happen’ in the case or to create a distance between myself and the events happening in the case in order to generate new energy and enthusiasm, and to make room for new creative insights and perspectives.

When writing up the case descriptions, I have tried to work with multiple descriptive levels, mixing the description with interview excerpts, document excerpts, figures, photos, timelines and presentation material used by the respondents I have met. The writing of case descriptions has been argued to be central in case research as this process in itself can be a key to generation of insight (Eisenhardt 1989). In my writing of case descriptions, my inspiration has been found in exemplary work on technology development descriptions by Bruno Latour (e.g., Latour 1996) and James Utterback (e.g., Utterback 1994) and in descriptions of technological development in an industrial context (e.g., Anderson 1994; Håkansson and Waluszewski 2003). Although different in many other ways, these studies researchers are all examples of how extensive longitudinal studies on technological development can be reported, using both primary and secondary data. Unlike myself, Latour (1996) takes the description of the development of the technology named Aramis several steps further than I would ever dare or find useful, as he heterodoxically distributes the authorship with a play of different voices. Although there are several significant differences in research approach, the point has been to make the text more vivid by using material that has been important in the cases. When I have structured and written the case descriptions, I have used materials that have been helpful in my process of understanding. The general ambition when writing up the case descriptions has been to develop five cases that are independent from each other in the sense that they all can be used and viewed separately, for example as teaching cases.

3.4.2 Conducting within- and cross-case analysis

In the thesis, I have structured the analysis through a separation between within- and cross-case analysis (e.g., Miles and Huberman 1994). Although the actual interpretation is critical in qualitative research, the analytical process as part of the research process suffers from too little codification and format (Eisenhardt 1989:539). Except for the case descriptions as displayed in this thesis, the within-case analysis in my process included the development and updating of interim case summaries (e.g., Miles and Huberman 1994). My interim case summaries included a brief description of the case, relevant respondents and events that had occurred during the process. I also developed timelines in order to keep track of and sort out events, actors and unique challenges in each case. For each case, a specific analysis of drivers and barriers was also developed. Eisenhardt (1989:540) develops an argument for within-case analysis:

[...] the overall idea is to become intimately familiar with each case as a stand-alone entity. This process allows the unique patterns of each case emerge before investigators push to generalize patterns across cases.

In my interpretations of the empirical material, cross-case analysis was conducted. According to Eisenhardt, certain procedures can be applied in cross-case analyses (1989:541):

[...] to force investigators to go beyond initial impressions, especially through the use of structured and diverse lenses on the data. These tactics improve the likelihood of accurate and reliable theory, that is, a theory with a close fit with the data. Also, cross-case searching tactics enhance the probability that the investigators will capture novel findings which may exist in the data.

An important starting point in my interpretative process has been to develop cross-case displays as one tactic (Miles and Huberman 1994). Through the creation of a cross-case display, I was able to start seeing across the cases basically through the reduction of material. Two other strategies in cross-case analysis are searching for categories and sorting case findings through pairing (Eisenhardt 1989) and matching of the separate case entities. The creation of pairs was important when I looked at the different aspects on which I could explore the empirical material, especially early in the analytical process. Through the creation of displays, themes emerged that later were developed and investigated as structures for my findings.

Dubois and Gadde describe this process as systematic combining (2002:555), or matching between theory and empirical data on both single- and cross-case levels.

3.4.3 An assessment of the credibility and trustworthiness of the study

When assessing (and self-assessing) the trustworthiness of research within most sciences, the two most commonly applied measurements are the terms validity and reliability. In interpretative research, in which the focus is on the particular rather than the general, as in case studies, these measurements become somewhat awkward. Therefore, it is often argued that other criteria or interpretations of the original measurements are needed when assessing the trustworthiness of qualitative and interpretative research (e.g., LeCompte and Goetz 1982; Lincoln and Guba 1985; Maxwell 1992). Some of these researchers suggest that the terminology used in evaluating interpretative research is adaptations of the traditional measurements. For example, Maxwell (1992) suggests that validity should be adapted to judge descriptive and interpretative validity. Others suggest replacement. Perhaps the most commonly applied trustworthiness criteria used in the interpretative paradigm are the concepts developed by Lincoln and Guba (1985): credibility, transferability, dependability and confirmability.

Since I find the criteria presented by Lincoln and Guba (1985) appealing, they have been considered. I believe it is up to others to assess and comment on trustworthiness. I would, however, like to make a few points showing how I have reasoned when planning my work. First, however, let us review what these 'alternative' criteria include. It is perhaps also important to point out that the measurements discussed in this study are relative in nature; this is also true for the concepts of validity and reliability. First, credibility is the level of confidence that the material has from the respondent's perspective. According to Lincoln and Guba (1985:301-315), the credibility of a study can be improved by, for example, prolonged engagement, persistent observation, triangulation, referential adequacy materials, peer debriefing and member checks. Second, transferability is the extent of applicability of the findings and how they can be translated or transferred to other settings or cases. Compared to generalizability, transferability relates to how findings from one study can be applied in other (related) contexts. Stake (1995:85-88), discussing the relevance of generalizability in qualitative case study research, discusses naturalistic generalizability as the process of taking findings from one study and applying them in order to understand similar circumstances and situations in other cases. Third, dependability is the extent of trustworthiness the material can demonstrate in terms of minimizing researcher idiosyncrasies. In qualitative research, this becomes important since both the interpretation of

individual respondent accounts of a setting and the interpretation of a setting in its totality are essentially subjective operations. Lincoln and Guba (1985:316-318) discuss the relationship between dependability and credibility as the relationship between validity and reliability (i.e., that there can be no validity in a study without an acceptable degree of reliability). As a way to reach dependability, Lincoln and Guba (1985) suggest, for example, that the researcher use an external auditor to authenticate both the progress and process of a research project. Fourth, confirmability refers to the findings of a study and states that their trustworthiness can be discussed in terms of level of confirmation and corroboration by others.

I will now make a few points showing how I have reasoned when planning my work in order to satisfy the trustworthiness criteria described above. Firstly, in all my cases, I have conducted research accompanied by a fellow researcher. There have been varied purposes for this collaborative approach. In some cases, it has been the collection of empirical data that we have had a mutual interest in, but with different angles of approach in terms of research question and theoretical framework (e.g., joint interview on a specific topic that touches more than one research project). In these cases, it has been a doctoral student who was involved. In other cases, the mutual interest has been in the overarching phenomenon (e.g., interest in how and why firms use e-procurement) with a professor taking part in either the fieldwork or the analysis (or both). Adding an additional pair of eyes in analysis has been interesting and rewarding. Adding an additional pair of ears and eyes in the fieldwork has eased some of the burdens of transcribing interviews and keeping track of events in the field. In both cases, the fact that I have not been totally alone in my work should increase the credibility, confirmability and dependability of my study.

In the collection of my empirical material, I have aimed at using multiple empirical sources and multiple rounds of interviews in all cases reported. Through this prolonged engagement in the cases, I have been able to see developments through, and enable multiple observations over, time. In addition, I have also had the ambition to select respondents representing different views within the focal firm, thereby extending the perspective to more than 'just' the manager view. The main reason for this is that I have aimed at being able to present as broad an overview as possible of the adoption processes. In addition, using documentation excerpts and respondents' quotes gave the individuals in the cases a voice. The additional perspectives, alongside documentation, have supported my study as referential adequacy materials. Patton (1990) describes this as a strategy to increase the face validity of the study. The events and circumstances presented in the cases have been checked for accuracy by the key respondents of each case. This procedure was seen

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as very positive by the key respondents. Several emphasized the value of being provided with an inside-out perspective description of a process they had been a part of. This follow-up session was conducted after the data collection and was one of the last steps in the writing process, just before the case descriptions were finalized. This procedure is called member checking (Stake 1995) or informant verification (Goetz and LeCompte 1984). These measurements have hopefully also strengthened the sense of credibility, confirmability and dependability in my study. In addition to being asked to read the document and comment on its accuracy, the respondents were also asked to sign a document allowing me to publish the case descriptions without disclosing firm names.

CHAPTER 4

Five cases of information and communications technology adoption processes

In this chapter, I outline the five cases of information and communications technology (ICT) adoption that constitute the empirical base of my thesis. The five case studies on ICT adoption, with the organizational level as the level of description, were conducted between the years 2001 and 2006. The five case descriptions are all structured to present 1) a general description of the focal firm and the context in which the adoption took place, 2) a description of the object of adoption, the technology, and 3) a description of the adoption process that took place. Each case is concluded with a within-case analysis on drivers and barriers identified.

4.1 Volvo Cars IT and the promise of shared product data

The first case in this thesis describes the promise of shared product data in the automobile industry, with a focus on Volvo Cars IT, a business unit serving detained the Volvo Cars Corporation (Volvo Cars) with ICT solutions and support. The acquisition by the Ford Motor Company in 1999 led to large changes within Volvo Cars, not least for the conditions of product development. Although it was important news in the Swedish industry context, the acquisition of Volvo Cars was just one of many mergers and acquisitions that took place during the late 1990s and onward. A key driver behind consolidation of the industry into a few key actors is scale advantages, long considered a “*holy grail*” in automobile production (see e.g., Holweg and Pil 2004), created through production of large volumes of automobiles and commonality across models. One trend in automobile production has been to develop scale advantages in innovation, sourcing, assembly, manufacturing and logistics and so on, to create efficiency through what is called cross-brand product platforms (Lundbäck 2002). For example, both the Ford sedan

model Five Hundred and station wagon model Freestyle are built on the same platform as Volvo models V70, S80, XC90, XC70, and so on²⁵.

Table 9. Volvo Car Corporation: Firm data (Sources: Affärsdata, www.ad.se; Volvo Cars Corporation Media Services, www.volvocars.se)

	2002	2003	2004	2005
Turnover (in MSEK)	103102	111900	116011	115448
Employees	27,990	28,159	27,575	27,339
Net result ²⁶ (in MSEK)	286	9016	4444	7507

Important elements in the creation of efficient vehicle production and thereby exploiting the potential in mergers and acquisitions are communication, collaboration and coordination across firm borders. When dealing with these challenges, information and communications technology has become a key ingredient (e.g., Sánchez Martínez and Pérez Pérez 2004). Therefore, research has shown that how to exploit ICT is one of the most important current concerns among managers and executives in purchasing and supply. For example, due to the significant costs in the development of new car models, coordination, communication and collaboration become essential. The prerequisites for product development in the automobile industry have changed dramatically during the latest decade. Not long ago, product development was much more down-to-earth than it is today. When interviewed, an associate working with product data management at Volvo Cars IT explained how things had been done in the past:

In those days all production was in-house, we had ten years to develop a new car model. All tools were produced in our own workshops. Nothing needed to go to someone outside... [...] Then the need to

²⁵ The platform is called Ford D3 and is a platform for full-size cars. The platform was adopted by Ford after the acquisition of Volvo Cars. At Volvo Cars, the platform is called P2.

²⁶ The net result is an estimation made by an external source since the Volvo Cars Corporation policy is to never comment on net results.

decrease lead times came. Production of tools is a lead time-critical activity for us. We needed to start buying tools. During the 70s we had a project where we started to use tapes instead of sending out models carved in wood. It was easier to produce and reproduce a tape with data on it than to copy a wooden model. Still, if we had production in Spain and needed to transfer product data to them it took at least a week for a tape to get there by mail.

Of course, the situation in 2006 was very different from the days described above. In product development, the use of CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) technology is considered state-of-the-art practice for engineers in the automotive and automotive component suppliers industry. When one walks the corridors of the offices and production sites at Volvo Cars, it becomes evident how automobile production has moved toward automation and digitalization. Prototypes carved in wood are long gone. Product development is only one area in which ICT has gained ground as a tool that can enable improvements. ICTs have also become a strategic issue in process technology, vehicle production, machining, logistics and procurement. The subsequent cases in this chapter will further illustrate this development.

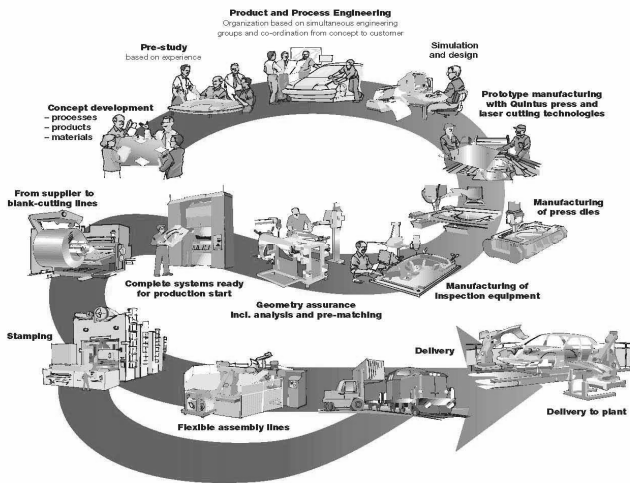
4.1.1 The promise of shared product data

As shown in the quote above, the prerequisites for product development in the automobile industry have changed dramatically during the latest decades. The development of a new car is done with the help of product data management tools that enable engineers to communicate product data across firm and country borders and to undertake changes in components at a cost much lower than if the change were to be done in a physical car prototype. The use of digital prototypes has truly created new opportunities for product developers and others in the industry. As it seems, a current major problem in the automobile industry is decreasing profitability. Among several cost-saving strategies that the industry seems to apply have been alternatives for cutting costs in product development. One way to do this has been to increase the digitalization of product development.

The principle of digitalization in the case of product development follows the logic that the more changes that can be made when the car is still on the drawing table, the lower the total costs of development will be. As already mentioned, ICT is a key ingredient in modern product development. At Volvo Cars, the product development process has been described as the process that goes “*from concept to component*” (Figure 14). In this process, a great deal of data is produced and

communicated. In addition, several parties are involved in the process. At Volvo Cars, common practice is to gather component suppliers and groups at Volvo Cars at physical meetings and phone meetings, but also at e-meetings, to discuss product development and product specifications. The reason behind this is the coordination challenge due to the complexity of systems sourcing (Gadde and Jellbo 2002). In the product development process, Volvo Cars has to take numerous interdependencies into consideration on both component and systems level from a technical, functional and physical point of view. During the ramp-up phase of a new car model the frequency of these meetings is significantly higher than during the production phase, although meetings are held on a regular basis throughout the lifetime of the specific component or system.

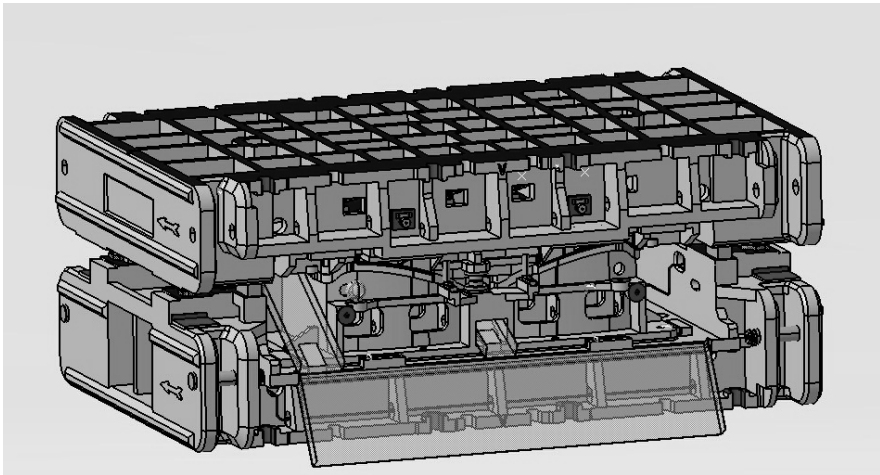
Figure 14. From concept to component – an overview of the different phases of the development process at Volvo Cars (Source: Volvo Cars Body Components, 2006-03-09)



In product development, there are different types of ICT systems to support the process and a common delineation is made between the content dimension and the exchange infrastructure dimension of CAD-files (Computer Aided Design). In the content dimension we find systems that deal with creation and modification of CAD data (e.g., systems that enable the creation of a digital 3D blueprint of a

future automobile component, see Figure 15) and in the exchange infrastructure dimension we find systems that deal with the transmission of CAD data (e.g., systems that enable secure exchange of CAD files from one user to another). The same delineation is used among practitioners in, for example, work on industry standards in the field. At a product data management conference in Sweden in 2004, Volvo Cars showed that they transmitted approximately 40 gigabytes of data every month. At the same conference, the Swedish truck manufacturer Scania reported an almost quadrupled need to transfer CAD data between its thousand CAD users during the years 1999-2003.

Figure 15. A CATIA CAD-image representing a die tool design of an automobile body component (Source: Volvo Cars Body Components, 2006-03-09)



Since the products dealt with are very complex, the volumes of data files are huge. When looking at the content of CAD data in a complete integrated CAD model of a vehicle, this complexity becomes strikingly clear. An integrated CAD model of a modern vehicle contains thousands of separate CAD files. For the constructors at the different component departments at Volvo Cars, each responsible for a set of components, a change in a CAD file for one component will inevitably lead to a

need for changes in other components. Since the development of a new car model is indeed costly, a split of the development costs of one car with another car model can make quite a difference on the returns of the investment. An engineer at the Industrial Research and Development Corporation commented:

Automotive suppliers more and more are part of the product development process [...] Also, the demands for shorter lead times for product development and the products themselves have become more complex – the volumes of data are huge. The amount of data that is sent during product development has created a need to find new solutions instead of sending tapes and discs. The volumes are breathtaking. We don't see any decline in this. Rather, the opposite. When we started this we had a recommendation on what should be written on the label when a disc or something similar was sent via mail...

As stressed in the quote above, the development of new technology also creates new types of challenges. The current industry trends imply that there is a need to enable coordination of activities both within firm boundaries across continents and across firm borders and continents. The sheer amount of data transmitted and the number of transmissions needed have created a need to manage not only product data in themselves, but also other types of documents that are exchanged during product development:

Document Excerpt 2. SASIG/XMTD – Exchange and management of technical data guidelines (Source: SASIG, December 2003)

The use of CAD/CAM technology is a state-of-the-art practice in the automotive and automotive component supplier industry. Many other types of technical data files, including Bills of Material (BOMs), Requirements lists, Finite Element Analysis (FEA) documents, spreadsheets, and text documents often accompany this data. Such groups of technical data, often called technical data packages, must be exchanged over considerable distances between partners.

In order to enable a smooth transmission of product data, both within and across firms, the technology to manage product data communication has developed. Finding ways to standardize external product data communication carries a promise of significant savings and has therefore been a priority.

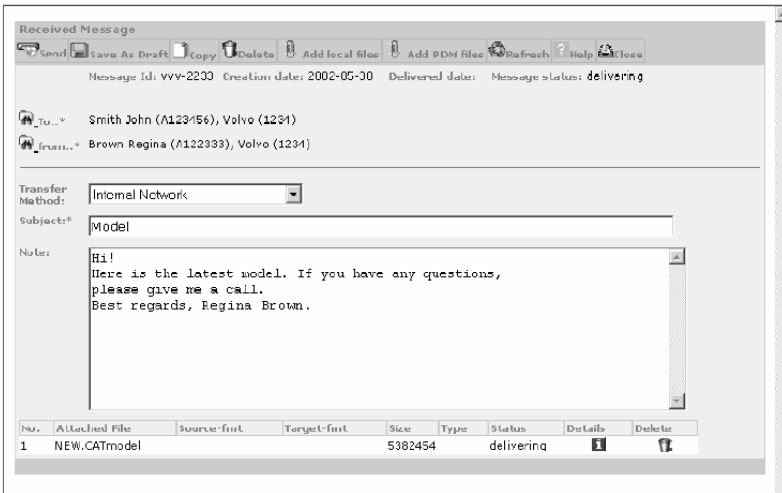
4.1.2 The relationship between Volvo Cars IT and Volvo Cars

Before the Ford buyout of Volvo Cars, the firm Volvo IT (during the 80s named Volvo Data) served the whole Volvo group, including the car manufacturing operations, with ICT. The management of ICT at Volvo Cars is handled through a department within Volvo Cars called Volvo Cars IT. Until 1999, Volvo Cars IT was a part of Volvo IT. The geographic position of Volvo Cars IT is that of its mother: The head operations for Volvo Cars IT are situated at the Torslanda plant grounds just outside Gothenburg in Sweden. However, ICT support would not work if the Volvo Cars IT division was not also closely connected to the users served, who are also found at the Volvo Cars plants in Uddevalla (Assembly plant), Olofström (body components), Flöby (connecting rods and brake discs) and Gent (Assembly plant) in Belgium. In 2005, Volvo Cars IT had 270 employees. The relationship between Volvo Cars IT and Volvo Cars includes the demand and supply of ICT infrastructure and systems development and support. Volvo Cars IT bills Volvo Cars like any ICT consultant would bill its customer. The hierarchical order of Volvo Cars IT and its operations is that it serves Volvo Cars as a division (not as a separate legal entity) and reports to the IT division of the Ford Motor Company called Ford IT.

There are in principle two different types of CAD users at Volvo Cars. Firstly, CAD is used by product developers to develop digital drawings and models of automobile components. Secondly, it is used by tool developers to create the tooling that will be used in the production of components shown in a CAD file. From a software point of view, there are also two different types of applications to run CAD files in: user and viewer. User applications enable the creation and change of CAD models, while viewer applications are used only to view CAD models. At Volvo, CAD developers use a CAD/CAM solution named Catia provided by the French firm Dassault Systèmes. In the exchange dimension Volvo Cars use Exter (Figure 16), an EDI-based file exchange application and that allows users in different locations to exchange files. Exter is a system developed internally by Volvo Data that was released in 1991 (Johansson 2001). After the separation of Volvo Cars and Volvo AB, Volvo Cars IT source Exter licenses from Volvo IT. A second, updated version of Exter was released in 2002. In addition, Volvo Cars use an

application named Teamcenter, provided by US IT-systems provider UGS, as their communication platform in product development projects.

Figure 16. Screen dump of the file exchange application Exter used at Volvo Cars Corporation (Source: Volvo Cars IT, 2006-03-09)



4.1.3 Introducing the application - ENGDAT

As already noted, there are two dimensions delineating information technologies that support the product development process: the content and the exchange dimensions. In the case of Volvo Cars IT, the exchange dimension included an exchange application called Exter. In Europe, a solution for product data communication in the automotive industry is a concept called ENGDAT (ENGINEERING DATA). Compared to Catia or Exter, both examples of software used at Volvo Cars, ENGDAT is not tangible software but rather a standard message for communication of product data. ENGDAT is a type of file, or message, rather than a specific software file. The principle is that every time a package of product data files is sent between two users, it is accompanied by an additional ENGDAT file describing the content, receiver and sender. A common metaphorical description of ENGDAT is that it functions for file transfer like an

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envelope to a letter. When interviewed, a former consultant at the Swedish engineering industry's research institute, who was very active in the development of the first version of an ENGDAT message, stated:

The basic idea with ENGDAT was to find a structured and secure way to transfer product data (mainly CAD models) over the telecommunications network. This was arranged by the fact that the ENGDAT message works like an envelope and delivery note for one or many documents. The intention was that the receiving party would be able to choose different degrees of automation for translation, local distribution and administration of received documents based on the information in the ENGDAT message.

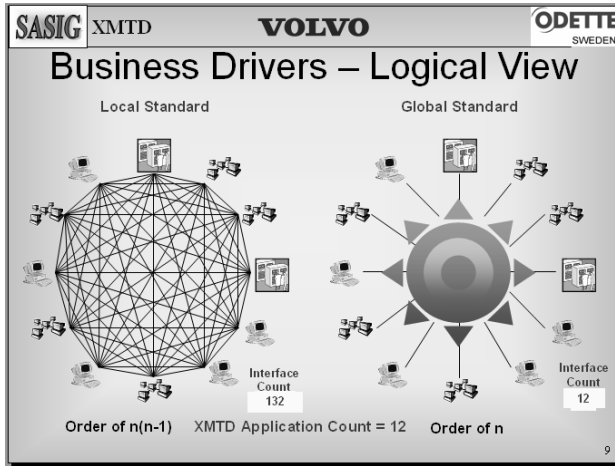
An employee at Volvo Cars IT in Olofström with long-time experience of PDM, presently working specifically with ENGDAT at Volvo Cars, commented on the early development of ENGDAT:

A fundamental thing was that one needed a simple standard that worked all the way down to supplier n. The different actors in the industry had different methodologies and instead of changing these methodologies across the whole industry, one started to search for a lowest sufficient level of coordination that made file exchange possible.

ENGDAT was the result of a European cooperation project driven by Odette International and its Swedish branch, Odette Sweden. The basic driver behind the development of standardization for product data exchange is the number of interfaces many firms in the industry have had to deal with and that exchange could be facilitated by including a message that revealed a description of the content in a batch of files being sent. The logic is that the stronger acceptance a standard way to communicate receives, the less complex the exchange infrastructure becomes (Figure 17). The first industry recommendation of what the ENGDAT message should look like was published in 1994. Since then, two updated versions have been developed. The development of ENGDAT was simultaneous with its adoption, and the firms involved in the development were also potential users. In 2005, with the publication of ENGDAT version 3 (ENGDAT V3), ENGDAT had gone from being a region-specific, i.e. European, standard to a being a global application built on more sophisticated technology and therefore incomparable to the first version

published in 1994. Then again, from an ICT point of view, much has happened during the past ten years.

Figure 17. Logic behind a standardized way to communicate product data (Source: Volvo Cars IT, 2004-05-12)



4.1.4 An overview of the development process toward ENGDAT V3

The point of departure for the development of ENGDAT was a series of investigations of how firms in the automotive industry were dealing with product data that stakeholders had issued during the 80s. One actor that had been essential to the development of ENGDAT was Odette. Odette is an industry-owned organization with the purpose of setting up standards for e-business communications and product data communication. It was Odette Sweden that initiated the development of a single European standard for product data, later labeled ENGDAT. Detailed planning for the launch of a standard was initiated in 1992 and the first version of ENGDAT (ENGDAT V1) was launched in 1994. The manager of Odette Sweden explained how ENGDAT was received by the industry:

[...] the speed of implementation was quite high when this was done [the development] and published in 1994. Seen as an EDI message,

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ENGDAT is quite simple. The thing that was difficult was to get everyone to agree on the mechanisms. When this was done it was a relatively small task for a software firm to make it ready for use. There were a lot of IT firms in Europe at the time that considered this an easy task to complete if asked. Software solutions were available more or less immediately after the specifications were ready. OFTP was the transfer mechanism and OFTP was something one [the OEMs] already had. This was common for most producing units in the industry. The only ones who were new to this were a couple of consultants.

Even though the development of ENGDAT was a Swedish initiative, the target was not only the four Swedish automotive OEMs and their suppliers. Rather, the focus was on Europe. Odette had been an active part of the development of the EDI message standard for the automotive industry and the EDI message transfer mechanism OFTP (Odette File Transfer Protocol). Since the ENGDAT development project had Odette Sweden as project champion, it can be said that the development was driven at an OEM level. The development of ENGDAT was financed by the Swedish OEMs through their control of Odette Sweden. Although the automotive component suppliers had much to gain from a standardization of product data communication, they were not part of the development. The manager of Odette Sweden clarified:

The more complex products become, the more complex the chains of actors that are working in product development projects become. The more complex the exchange of information becomes, the more pressing the need for standards becomes. It is the customers who drive this development. [...] In Sweden, the suppliers were not in the picture at all from the beginning. They were not part of this. However, during implementation, they became important. [...] When the ENGDAT concept was developed, they were not part of the development, especially not in Sweden where most suppliers are quite small. The situation in Germany is different where some are very big.

Parallel with the development of ENGDAT, Odette Sweden also cooperated with other European industry actors in other related projects. For example, since 2000 a number of European automobile OEMs and suppliers have been working with the development of a secure communication network for the European automotive industry. Odette Sweden was an important actor in the aim to reach acceptance for ENX in Sweden.

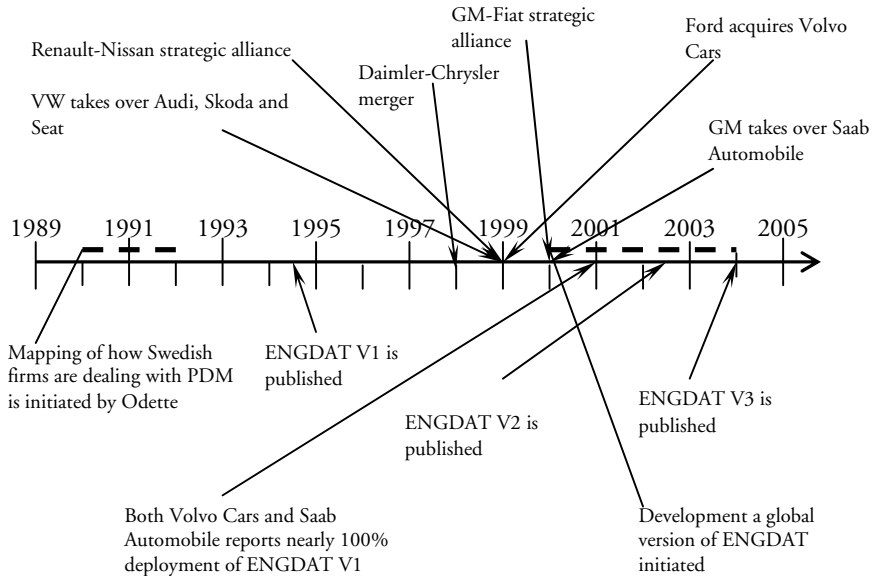
After the publication of ENGDAT in 1994, the standard acquired acceptance quite quickly. Strongest acceptance was found in Germany, but French and Swedish OEMs also found the technology useful. A problem in Sweden was that a national adaptation made it impossible to exchange files with business partners in other countries. This problem became very obvious when Volvo and Renault started to cooperate during the 1990s through a joint venture established in 1990 (Olsson and Moberger 2002). At a Swedish industry summit in 2001, figures on the deployment of ENGDAT were presented. Among the Swedish OEMs, Volvo Cars and Saab Automobile reported nearly 100% deployment of ENGDAT. While Volvo Trucks also showed strong support for ENGDAT, Scania lagged behind in deployment. In Germany, DaimlerChrysler was the lead user among the OEMs and Wilhelm Karmann GmbH was the lead user among suppliers. In France, Renault and Peugeot also reported nearly 100% deployment.

One important reason for the spread of the use of ENGDAT was that it utilized the same infrastructure of data interchange as did other types of electronic messages provided by Odette - OFTP, at this time already to a great extent adopted in the automotive industry. Through intense use among most of the European OEMs, a couple of weaknesses in the system were found. Also, new technologies became available (e.g., network structures like the Internet or intranet and information formats and protocols like HTTP and FTP) and created new opportunities for secure and smooth data transmission. For example, the increase of bandwidth made it possible to send larger data files with short transmission times. Therefore, work to create an updated version of the ENGDAT standard was launched and the second version of ENGDAT (ENGDAT V2) was published in 2002.

The development of ENGDAT in general took a new turn in 2000. At this time, a joint decision was made by several important actors in the automotive industry to initiate the development of a global standard for product data communication. The background for this new turn was an increased worldwide consolidation of the industry. A milestone in this development was the merger between Daimler and Chrysler in 1998. All these new ownership and collaboration linkages worked across the US, Japanese and European markets. Since all three markets had their own standard for product data with a low degree of (or no) compatibility across markets, a global standard was needed when product developers from different markets needed to cooperate. The product data communication standards in the US and Japanese markets were not products of EDI standardization but of ISO standardization. The organizational structure for the development work toward a global version of ENGDAT brought about a transfer of responsibility from Odette

to an international task force for product data communication standardization called SASIG (the Strategic Automotive product data Standards Industry Group). The members of SASIG are interest organizations from automobile producing countries all over the world like AIAG (the Automotive Industry Action Group) from North America, GALIA (Groupement pour l'Amélioration des Liasons dans l'Industrie Automobile) from France, JAMA (the Japan Automobile Manufacturers Association), VDA (Verband Der Automobilindustrie) from Germany and Odette from Sweden.

Figure 18. Milestones in the development of ENGDAT (adapted from Anderson and Hultman 2005)



Within SASIG, a special interest group working with exchange and management of technical data (SASIG XMTD - Exchange & Management of Technical Data) had the mission to develop a global solution based on the ENGDAT message. The group was formed by six representatives from all interest groups in SASIG. Most representatives were associates from different OEMs, appointed by their respective interest organization, and the Swedish representative in SASIG XMTD, appointed by Odette Sweden, was a Volvo Cars associate working with EDI and technical data for Volvo Cars IT. The third version of ENGDAT (ENGDAT V3) was

published in 2003 and implementation work began immediately. The difference between the present third version and the former versions of ENGDAT is substantial. In technical data guidelines issued by SASIG in December 2003 it was stated:

Document Excerpt 3. SASIG/XMTD – Exchange and management of technical data guidelines (Source: SASIG, December 2003)

The changes in ENGDAT between this version (3) and the previous version are extensive. This new version accommodates business processes in additional regions of the world and incorporates many new requirements and updates. It also drops many outdated and little-used components, and accommodates a new implementation method: XML. It is therefore not practical to require compatibility with previous versions of ENGDAT.

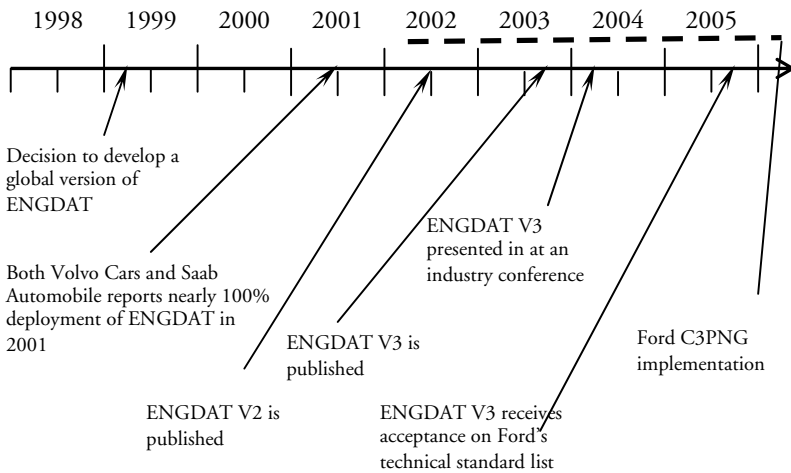
4.1.5 An overview of the adoption process

As the need for shared product data was a problem in the whole industry, including not only OEMs but also suppliers and sub-suppliers, the development of solutions had been driven by industry interest organizations. In Sweden, the OEMs had been interested in the development of a standard for product data exchange, and a project champion was Odette Sweden. Odette Sweden had a strong position through their role in the industry as a Scandinavian industry cooperation arena and their prior and successful work on EDI. Although Odette is owned by the OEMs through BilSweden, there are established relationships between Odette Sweden and the automobile supplier network through the development and involvement in standardization of EDI technology in the industry. For Odette, both in Sweden and elsewhere, it was essential to preserve the investments in data exchange so that a global standard would be compatible with the infrastructures built in Europe.

Through its representation in the SASIG task force on XMTD, Volvo Cars was an important part of the development of ENGDAT V3. The Volvo Group and Volvo Cars had been a stakeholder in the development of ENGDAT since the very beginning and had also at times been regarded as the leading user in Sweden. The background of the fact that Volvo Cars IT had an appointment in the group was

that ENGDAT was actually an infrastructural issue, mostly recognized and appreciated by systems specialists. The different versions of ENGDAT are not actually something that the user (e.g., Volvo Cars) sees or experiences, since users exchange documents through applications like Exter and Teamcenter. Volvo Cars IT applies the ENGDAT technology when it provides Volvo Cars with the appropriate infrastructure for smooth product data exchange. After the work in the SASIG XMTD had been finalized in December 2003, the work to prepare the publication of the V3 recommendations was initiated. However, the recommendations continued to be discussed between the different interest organizations – a number of practical aspects needed to be solved. For example, the North American organizations involved in the development of ENGDAT needed to make sure that the access to the ENGDAT message recommendations was kept through them, since they aimed at licensing out the recommendations on their respective markets. This was not an issue in Europe since Odette Sweden, like the other European representatives, had no economic interest in the development of industry recommendations.

Figure 19. Milestones in the Volvo Cars IT case



In Sweden, the first presentation of the XMTD results was done at a PDM conference in Gothenburg during the spring of 2004, arranged jointly by Odette Sweden and the Scandinavian Automotive Suppliers. The presentation of the

concept of ENGDAT V3 was backed up by Odette Sweden and Scandinavian Automotive Suppliers, who jointly hosted the conference. During the conference, all Swedish OEMs and several key suppliers were present. Representatives from both suppliers and OEMs were active participants with presentations on the theme “Tools and techniques for collaborative product development – state of the art in the automotive industry”. The Volvo Cars representative in SASIG XMTD commented on the interest and attitude among the conference participants:

All this coincided with a more general development of the transfer process in Europe, a development in which ENX had gained a lot of ground. Due to the changes of ownership structures in the Swedish industry, ENX had never been adopted in Sweden. Another aspect was that the costs had been considered too high not only for OEMs but also for suppliers [...] To handle this in Sweden, the firm Strålfors suggested that one could create a file transfer protocol for ENGDAT over the Internet, which would lower the costs and increase the transfer speed. This became possible with ENGDAT V3 since it had XML syntax, which is globally accepted. For the participants at the conference, this was good news.

Although the general view in the Swedish industry was that ENGDAT V3 carried a new promise of efficient product data transfer, the Volvo Cars representative had some problems presenting ENGDAT V3 within his own organization. Although they had accepted participation and representation in the task force, ENGDAT V3 faced a number of challenges internally at Volvo Cars IT. On several levels, the evaluation of ENGDAT V3 from a Volvo Cars point of view needed to take other projects in the industry into consideration. One such project was the work within the Ford Motor Company to develop commonality regarding product development platforms under the name C3PNG; (CAD-CAE-CAM and PDM, Next Generation). Another project was the industry development of a meta-standard for communication driven not by those involved in product development but by those involved in logistics – the meta-standard was developed under the name Joint Automotive Data Model.

C3PNG covered all possible aspects of product data management, including exchange of data. At the Ford Motor Company, C3PNG was initiated in 2002 (see Figure 19). Within C3PNG, when making a decision on software provider for both the content and exchange dimension, the Ford Motor Company decided to source the CAD environment from Dassault (Catia) and the communication platform from UGS PLM Solutions (Teamcenter). In a newsletter describing the progress of

C3PNG, the process manager for PDM at Volvo Cars made the following comment:

Document Excerpt 4. Volvo Cars on PDM in newsletter (Source: Verkstadsforum, #3, 2004)

There is no room for sentimentality in this context. This is all about creating a solid foundation for exchange of knowledge and documenting everything in order to enable access for the future. The experiences we have made us choose Dassault and Catia for the CAD environment and UGS PLM Solutions and Teamcenter regarding the PDM solution.

Regarding data exchange, the C3PNG project ultimately meant that OEMs in the FMC Group and suppliers serving the Ford Motor Company at one or several levels regarding product development would be directly linked and were therefore not in need of a standard for CAD data file exchange. Within firms that had migrated to C3PNG, regardless of role, CAD data exchange would be kept within one system instead of being handled in two systems and transferred between them, as was done in the past. The background of the development of a group-specific solution can be traced to the relative position of the Ford Motor Company in relation to their business partners. An associate at Volvo Cars commented on the view on standardization present at the Ford Motor Company:

In the Ford world, there is only one perspective that needs to be considered and that is the Ford perspective... one does not need to have a message that enables data to be transferred from one system to another if the one system used is the same system as Ford uses...

When evaluating the options for future CAD data exchange at Volvo Cars, the view on business partners seems somewhat different than that at the Ford Motor Company. Here, Volvo Cars rather looks at how all involved can agree on a solution that is sustainable and cost efficient:

The current solution is cost efficient for the suppliers... this is also important for Volvo... we want to create a win-win situation where we don't just push costs upstream. Exter is a solution that is free of

charge to our suppliers... Of course, they need to take care of their own costs but the reason for our hesitation is that these costs tend to return to us sooner or later...

An alternative solution to the direct connectivity enabled by migration to C3PNG was to keep accepting file-based transfer in some way. At the Ford Motor Company, although the commitments to C3PNG seemed very strong, alternative channels for data exchange were also planned for. The development of file-based CAD data exchange in North America had taken a completely different path compared to Europe. In the North American market, a third-party system called FDX (Ford Data Exchange) is widespread. FDX is a third-party platform hosted by a firm called AutoWeb Communications. FDX offers a web-based CAD data exchange platform that resembles a web-based e-mail service (cf. Hotmail or Yahoo) but with a much more developed capacity to manage significant data volumes. Volvo Cars, on the other hand, had used the ENGDAT standard and the Exter application to enable file-based exchange. For many years, Volvo Cars has striven to make Exter their common supplier communication system.

Parallel to the ENGDAT project, a project to develop a unified model for communication in the automotive industry had developed under the name Joint Automotive Data Model. The project aimed for a standardized EDI message across Europe, North America and Japan. Odette had long offered this in Europe, but the rest of the automobile world lagged. This project had almost identical initiators as the ENGDAT project. The difference was that it was initiated from a logistic perspective rather than from a product development perspective. Nevertheless, it involved communication and the infrastructure ENGDAT was built for. A problem for the global team working with ENGDAT V3 was that they created the standard on an XML base, while the Joint Automotive Data Model was created on a more generic syntax, UML. From a meta-standard point of view, the XML base of ENGDAT V3 implies a significant impediment. From a UML base, however, one can generate an XML message or an EDIFACT message. Until 2005, when the Joint Automotive Data Model project was launched, the ENGDAT task force had worked blindfolded as they did not know about the attempts to develop a meta-standard for communication.

In order to promote ENGDAT V3 and its benefits, the supporters of the ENGDAT standard message needed to present a business case to management regarding the potential savings inherent in a migration to ENGDAT V3. Since no one at the time had implemented ENGDAT V3, a business case was of great interest to the industry. In May 2004, such a business case was presented at a seminar in Gothenburg (Figure 20). Seemingly, it had over the years become

increasingly important to develop a business case in order to justify IT investments at Volvo Cars and the Ford Motor Company. The business case had been developed over a couple of years and had been presented not only in Sweden but also within the FMC group and elsewhere. The business case showed that a firm with the volumes of data transmission that Volvo Cars had would have positive returns on the investment after less than one year – something that was a requirement at the Ford Motor Company.

Figure 20. Savings involved in ENGDAT V3 adoption for Volvo Cars, presented at a conference in Gothenburg in May 2004 (Source: Volvo Cars IT, 2004-05-12)

ESTIMATED Saving cost components ENGDAT V3 SEK	
Annual Savings:	
1 % of Global Supplier Choice Savings	2 184 000 SEK/Year
1 h/transfer Leadtime savings "From Concept to Component"	1 680 000 SEK/Year
Changing from 80% of ENGDAT ISDN and 80% of Physical Media to https	900 000 SEK/Year
	TOTAL: 4 764 000 SEK/Year
Changeover (One-time) Costs:	
Rewriting from ISDN to https (shared 50% by Volvo Truck)	470 400 SEK
	TOTAL CHANGEOVER COST: 470 400 SEK

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By showing the potential to cut costs through estimations made in the business case, ENGDAT V3 had been given approval to be put on the Ford Motor Company's list of technical standards. This meant that Volvo Cars had a green light to change their view on ENGDAT in the future and adopt ENGDAT V3. The business case was never presented internally at Volvo Cars. After having received the final recommendations for ENGDAT V3, the firm team working with process and technology at Volvo Cars IT with a focus on product development needed to evaluate and decide what to do. Their hesitation was due not only to the possible conflicts with the development toward C3PNG, but also to the fact that the current infrastructure was working quite well. An associate at Volvo Cars IT, working with strategic analysis on PDM close to Volvo Cars, commented on the situation:

We have a good solution that is working well... cost efficient... built on a standard that has been applied for 20 years. It works and it is cheap and as we see it today, we would like to await the development ... the new connect-solution definitely has teething troubles that it needs to get over first...

The wait-and-see approach included not only C3PNG but also ENGDAT V3. The analyst continued:

I mean, if you put ENGDAT in the latest version against the version we have now, then of course there is an interest in improvements. However, this is then based on the assumption that we will continue with file-based exchange.

The associate working in the SASIG XMTD task force made the following comment on the wait-and see approach:

What this is all about is that a number of investments have been made in ENGDAT V2. If changes are made to ENGDAT V3, it implies that a lot of these prior investments are abandoned. However, it will become difficult to stay with ENGDAT V2 if things start to move in the industry. This is not the case yet, which means that one awaits further developments.

During spring 2006, more than a year after the publication of ENGDAT V3 and well into the process of implementing C3PNG at the Ford Motor Company, there had been no immediate decision to implement ENGDAT V3 at Volvo Cars. Rather, the options in data exchange systems had grown from the alternative of having one European standard to including several additional options from directions other than Europe. First, suppliers and business partners could migrate to C3PNG and thereby erase the need for 'external' CAD data exchange. An additional option was to use a third-party solution. Also, regarding file-based exchange, there was the option of using the FDX-hosted solution for data exchange, which was common in the US. With several different options for business partners, Volvo Cars kept all doors open for product data file transfer.

4.1.6 Within-case analysis: drivers and barriers in the Volvo Cars IT case

Looking back at the development of the different versions of ENGDAT, it is notable that both the character of the technology as well as the drivers to use it have changed. What then have been the drivers and barriers in the development of ENGDAT? When dealing with this question, one needs to remember that the first and third versions of ENGDAT, as well as the context in which they are used and needed, are quite different. For the first version of ENGDAT, the driver was more a need merely to come up with a solution for transferring data. New technology for product data management emerged and, therefore, technology that enabled firms to transmit such data became necessary. In the publication describing the recommendations for ENGDAT, the terms globalization and internationalization are not mentioned. In the case of ENGDAT, the drivers on industry and group level became stronger at a later stage. Table 10 outlines the drivers and barriers identified in the empirical material. For all versions of ENGDAT, however, as the use of ENGDAT occurs through firm interaction, it should be clear that the adoption of the system is dependent on several users adopting the system. Therefore, the role of Odette as an organization bringing together actors across markets (mainly in Europe) has been very important during the entire development process.

In the case of ENGDAT, the barriers can also be discussed on several levels. An important aspect of the development of ENGDAT is the industry's fragmentation into a few big industry groups (i.e., US, Japan and Europe) and that the work to solve the same perceived problem led to the development of parallel competing systems and standards. As with many other items in the automobile industry network and other industry networks as well, a clear delineation can be drawn between the US, Europe and Japan. As it was in the case of the development of EDI technology, this parallel development of standards has also been the case in the development of a standard for product data communication. In addition, although mergers and acquisitions in the automobile industry have worked as a strong driving force toward standardization, they have sometimes also hindered development. For example, the interest among OEMs seems to have shifted during the process due to changes in ownership. At the same time as some actors have stepped back, others have stepped forward. For Volvo Cars, the situation seemed to change after its acquisition by the Ford Motor Company. An associate working with product data management at Volvo Cars IT explained:

Early in the process, a lot of people from Volvo Car Corporation were part of the work that was done within Odette Sweden. Today, there are considerably fewer people involved. Nowadays it is Volvo Trucks and Scania that feel they need to deal with this and that this is useful. The reason for Volvo Car Corporation stepping down is the Ford acquisition.

Since there are conflicting systems on global level, this leads to a conflict of systems at group level when Volvo Cars was acquired by the Ford Motor Company. In this case, the Ford Motor Company represents a different tradition in terms of both supplier interaction in general and product data transfer in particular. With more than one option and a risk of technological lock-in, the situation for the management involved in the decision on ENGDAT at Volvo Cars became difficult. The Ford C3PNG project seems to have functioned as both a driver and a barrier for ENGDAT. C3PNG suggests that interoperability is important but also emphasizes that there are options to ENGDAT. The multiple options seem to have created an inertia to decide.

Table 10. Organizational levels and drivers and barriers in the case of shared product data at Volvo Cars IT

	Drivers	Barriers
Industry network level	<ul style="list-style-type: none"> - Globalization of the industry through both mergers and moving production to low salary regions like China and South America. - Mergers and acquisitions create new needs to cooperate across firm borders and an increase in product data transmission. 	<ul style="list-style-type: none"> - Competing systems and standards that are used within industry groups.
Buyer level (Volvo Cars)	<ul style="list-style-type: none"> - Increase in product data transmission due to increase of complexity in product. - Increase in need to cut costs and lead times in product development. - Platform production creates need to share product data across firm borders. 	<ul style="list-style-type: none"> - Clashes between separate ways of working with product data between firms in cooperation. - Mergers and acquisitions change the priorities for the acquired firm of new group formations.
System supplier level (Volvo Cars IT)	<ul style="list-style-type: none"> - Need for a smooth and secure way to operate product data transmission across and within firm borders. 	<ul style="list-style-type: none"> - Difficulties in obtaining support from Volvo Cars to implement.
Supplier level	<ul style="list-style-type: none"> - Need for a solution to the problem of working in several different systems with several different customers. 	<ul style="list-style-type: none"> - Lack of the required upstream infrastructure to carry product data.

Five cases of information and communications technology adoption processes

On the supplier level, the suppliers had not played a large role in the development of ENGDAT. However, from a supplier perspective, the benefits of having an industry standard in product data communication seem to be reasonable. Having many ways to deal with data as a customer is not an economically sound way of working. However, for suppliers, the communication of data is not mainly one-directional, as it is for OEMs. Instead, receiving product data from customers and processing might also require a need to transmit product data upstream in the supply chain. Traditionally in the automobile industry, the problems with IT-enabled inter-firm interaction are not between the OEM and 1st tier but are rather further upstream. An associate at Autoliv, a systems supplier to Volvo Cars, expressed:

A typical problem for 1st tiers is that 2nd tiers don't have ENGDAT or access to the required technology and one therefore needs to use CD or tape anyway.

For a supplier like Autoliv, this would mean that the company is back to square one again, having to use physical distribution of product data to suppliers lagging behind in IT development. This finding implies that the industry needs to consider how to enable 2nd tier and downward to work with ENGDAT since they often do not have access to the infrastructural prerequisites. One way to do this would be to develop viewer and/or user-applications that are web-based since this would increase the technology's availability and compatibility.

4.2 Tidamek and the promise of shared project space

The second case outlined here describes the adoption process following the introduction of an application enabling shared project space in the relationship between Sandvik Coromant and Tidamek AB. Situated in Tidaholm, at the plains of Västergötland in southwest Sweden, the production of Tidamek AB (Tidamek) is strategically positioned close to Skövde and not far from Gothenburg. Although one could think that the reason for the geographic position of Tidamek is due to its close relationship with the automotive industry, this is not the case. Instead, Tidamek has its antecedents in the conglomerate that is today called Swedish Match. In 1868, the mechanical shop named Tidamek today had its core business in machines for the match industry. Even today, Swedish Match has its production in Tidaholm, not far from Tidamek. In total, Tidamek has somewhat less than 100 employees (see Table 11). Since 1996, Tidamek has been a subsidiary of Hexagon, a Swedish technology group. Although Hexagon is a well known brand in automation and engineering, Tidamek acts seemingly independently of its mother. Entering the production site in Tidaholm, the customers of Tidamek seem more present than the owners. For example, almost all walls have posters with vehicles containing Tidamek components.

Table 11. Tidamek AB: Firm data (Source: Affärsdata, www.ad.se)

	2001	2002	2003	2004
Turnover (in MSEK)	120	119	116	157
Employees	89	84	86	111
Net result (in MSEK)	2.4	2.5	2.9	2.3

As opposed to when Tidamek was founded in the 1860s, the company's major customers today are found in the automotive industry. With a segment turnover of approximately € 6.5 million, the automotive industry in general accounts for one-third of the firm's total business. The operations at Tidamek are mainly machining components in metal, i.e. drilling, molding, cutting and milling details later used in

cars and trucks. Apart from the machining of other firms' components, Tidamek has also worked with product development. They have, for example, developed their own solution for an adjustable steering wheel system, which they are marketing to the heavy truck industry and Scania. Given that changes in the supply base, even in less important components, entail high costs for a vehicle manufacturer, the automotive supplier aims at having as few changes as possible during the production of a specific vehicle. This means that if the average lifecycle of a car is around seven years, the production at Tidamek follows that cycle quite closely. This also means that the operations at Tidamek are rather stable. Tidamek machines relatively long series of components in long-term relationships with their customers.

Figure 21. The Tidamek adjustable steering wheel system (Source: Tidamek AB, www.tidamek.com, 2005-05-18)



An interesting characteristic of the business Tidamek runs is that it is involved in close business relationships with much larger firms like Volvo Powertrain, ABB Ltd and Scania AB, each responsible for approximately one-third of Tidamek's business. According to the management at Tidamek, the automotive segment is a very important and constantly growing part of their business. Being in business with a few large customers means a great deal of dependency on the perseverance of these relationships. It also means that Tidamek has to produce state-of-the-art and that quality and reliance is necessary to stay in business. For Tidamek, getting close and

involved with customers has been a way to create a competitive advantage over other suppliers, not least from developing European countries like the Baltic countries. For handling the progress toward closer relationships with their customers, as well as with their suppliers for that matter, Tidamek has considered the exploitation of ICTs the enabler of closer integration and cooperation. For the production management team at Tidamek, to stay competitive, the lead-time from a request from a customer to production and delivery needs to be shortened.

4.2.1 The relationship between Tidamek and Sandvik Coromant

In order to keep up with the demands that customers, especially those in the automotive industry, place on quality and performance, for some years Tidamek has been developing a close cooperation with Sandvik Coromant (Sandvik). Sandvik, considered the world's leading tooling equipment provider, was an important partner and preferred supplier in Tidamek's various productivity projects. In 2001, Tidamek's ambition was to reach a steady annual 5% productivity improvement rate. An effect of the partnership the two firms had developed over the years was that Sandvik had a 95% share of all metal cutting tools purchased by Tidamek. In 2000, the close relationship between Sandvik and Tidamek was formalized in a partnership agreement. The partnership was a formal agreement signed by the two firms. The account manager at Sandvik explained:

This agreement that we have made is a gentlemen's agreement. It describes that they have chosen us to be their supplier and that we are going to supply them with something more than 'just our tools'. It is teamwork between buyer and supplier. For example, they have demands from ABB to reach lower costs. [...] The salesperson's job is then to collect information and to support... we have all the specialists and constructors who are experts... if we work closely with a customer they will get more support and we will get more market shares... it's win-win...

The account manager at Sandvik responsible for the Tidamek account had been working with Sandvik for many years and had around twenty customers that he served, including Tidamek. All his clients could be found within and around Skövde. According to those who worked closely with him, he was very knowledgeable in metal cutting and similar production procedures. What he did not know about the cutting business was not worth knowing. Formally, the account manager did not work directly under the Sandvik headquarters in Sandviken but under Sandvik's Nordic sales organization, which had its headquarters in Kista just

outside Stockholm. The account manager was a familiar face at the Tidamek shop in Tidaholm. According to himself, he visited Tidamek at least every other week and usually more often. In addition to the explicit ambition of maintaining a close business relationship through a formal partnership agreement between Tidamek and Sandvik beginning in 2000, the two firms had been working on the implementation of different and separate ICT supported systems, thereby knitting structural and technical bonds. The system was mainly for automation of purchasing processes and supply management. Sandvik had been working with Tidamek for some time to implement a tooling supply system called AutoTas. This implementation project had been somewhat problematic and perhaps not as smooth as one could have expected. Nevertheless, Tidamek was one of the customers of Sandvik that had been targeted in the implementation of AutoTas.

The main contact between the two firms had been channeled through the production manager at Tidamek and the account manager at Sandvik. The account manager also visited customers of Tidamek at times, since they also had some machining operations in-house for which they needed tools. The production manager at Tidamek was the person with the immediate responsibility to see to it that operations on the shop floor were running smoothly. The production manager seemed quite energetic and keen on developing the operations at Tidamek, trying new things to make the production run more smoothly. At his side he had a staff of production engineers and machine operators and a few people performing administrative duties. The account manager at Sandvik did not work alone either. He had a number of highly qualified product specialists and engineers, both in-house and field-based, who could support him in his duties. In addition to staff, Sandvik had also a number of ICT applications that supported its business. Since 1996, Sandvik had been developing its Internet business activities using different ICT applications. At first, the development at Sandvik was toward electronic commerce with the purpose of automating transactions and creating an efficient order process.

Beginning around 1998, when new Internet-based applications were available, Sandvik started developing capabilities to offer extended electronic business as an opportunity for customers and partners, by providing e-services on an extranet in addition to its ordinary services and electronic transactions, like project platforms and tool engineering (e.g., tailor-made) applications. In addition to developing its own e-business solutions, Sandvik had also been approached by various businesses in the automobile industry to engage in e-marketplaces. As this was during the peak of the "dot.com" hype, there was significant pressure on Sandvik to deliver e-business solutions to the market. Sandvik had decided to focus on e-business solutions that supported a relational orientation. The director of e-Business

Development at Sandvik Coromant stated the following when interviewed in a newsletter called Metalworking World:

Document Excerpt 5., Sandvik on e-business in newsletter (Source: Metalworking World Business Newsletter, #1, 2000)

One of the core values throughout the years for Sandvik Coromant has been to offer superior products and services based on strong and lasting personal relations with customers. [...] Electronic commerce and Electronic Business will reinforce the customer relation by improved reach, richness and more personalized business.

Clearly, it was important for Sandvik to show that they had something to offer within the field of e-business. An associate in the e-business department commented in retrospect:

One wanted to do something... what that 'something' was had less significance... At this time one wanted something to report and for the newspapers to write about. This was the time... you know... year 2000... dot.com...

4.2.2 The promise of electronic collaboration

Although the relationship in general terms was functioning well, both the production manager at Tidamek and the account manager at Sandvik sensed that the relationship between the two companies had problems to overcome. Many actors from each firm were involved although the two key figures remained: the production manager on Tidamek's side and the account manager on Sandvik's side. In 2001, the bulk of the activities within the business relationship between Tidamek and Sandvik were connected to different projects. A typical joint project was an OTS (original tool setup) project.

An OTS project has the objective to create an original tool setup for a specific machine. In such projects, several participants work at a spatial distance. Key participants were representatives from the machine supplier and the account manager from Sandvik. In addition, in-house sales or tool constructors from

Sandvik headquarters were also involved at some stages. The communication within these projects was conducted over a plethora of communication channels, for example mail, e-mail, telephone, fax and separate and fully or partly web-based systems. Many of these means of communication were relatively new and, to some extent, threatened the function of controlling information and communication flows that a key account manager usually has. At the time of this study, the present communication processes at Tidamek, where several channels of communication were used (and sometimes misused), there had on several occasions been misunderstandings that had inevitably led to loss of time and lack of overview by actors not directly involved in the project team. The production manager described some of the problems that had occurred in the relationship as time consuming, costly and sometimes bad for the relational atmosphere:

I wanted better projects and better project handling. We would blame Sandvik and they would blame us... this meant that projects caused large scale problems...we thought we should do something... they thought something else... it was pure communicational mishaps... no minutes were available... no kidding that we had problems... nothing was done in writing... when are we supposed to be finished?... No, this was something that you should have taken care of..No, this was something that you should have done... we threw pies at each other... I just said: let's halt this... we need a solution to these problems...

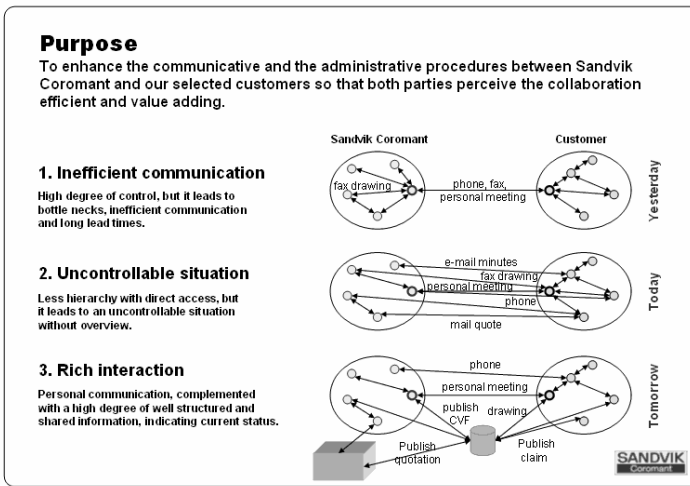
The manager of the special tool construction department at Sandvik's Nordic subsidiary had this reflection:

Yeah, well, communication's the big problem here, that's what takes so long. That's what I think, anyway. [...] ...the seller and the buyer have been communicating – on the phone, face-to-face or via email – and we don't know about it. Finally, when we get to make the design, its [different solutions] have been tossed back and forth and we have to untangle it all over again and start hunting down people [to clear matters up]. We wouldn't have to deal with that if everybody had the same information, the same accurate information.

At Sandvik, the person responsible for the development of an extranet accessible to customers was hired in 1999. He was immediately appointed project leader of a project run by a subsection of the marketing division at the headquarters in Sandviken with the purpose to develop an extranet and to look at a future e-service offer. All in all, a handful of people in Sandviken and Copenhagen worked with

Sandvik's e-service. The organization of the group was basically the project leader, heading the project from Sandviken, and the staff at Sandvik's subsidiary in Copenhagen working parallel with pilot studies at Danish firms with system support and development. The e-service project leader presented the purpose of the extranet at an internal meeting in Sandviken in July 2002 as shown in Figure 22.

Figure 22. Purpose of the extranet solution (Source: Sandvik Coromant, 2002-07-05)



Before his employment at Sandvik, the e-service project leader had worked as a consultant in both Sweden and the US. From 1999 to 2002, the group had a direct link to top management, as the subsection manager was part of the firm's top management team. Due to changes in prioritization, the group was organized under the marketing division in 2002 and thereby lost part of its autonomy. The complexity of the tooling project run by Sandvik and Tidamek could be quite complex in nature. When describing the promise of electronic collaboration in the case of Tidamek, a starting point could be to look at the typical tooling project (see Figure 23). When looking at a purchasing project for tools and all the information gathered in this process, it was seen that there were quite a few activities that generated documents that could be digitalized and potentially shared on an extranet. In the figure, either at the request of Tidamek or by suggestion from

Five cases of information and communications technology adoption processes

Sandvik, a tooling project was initiated. According to the account manager at Sandvik, the initiation of a tooling project is often based on suspected or known inefficiency of a currently used tool or method. Finding and evaluate such inefficiencies was a part of his tactics for creating new business opportunities for Sandvik.

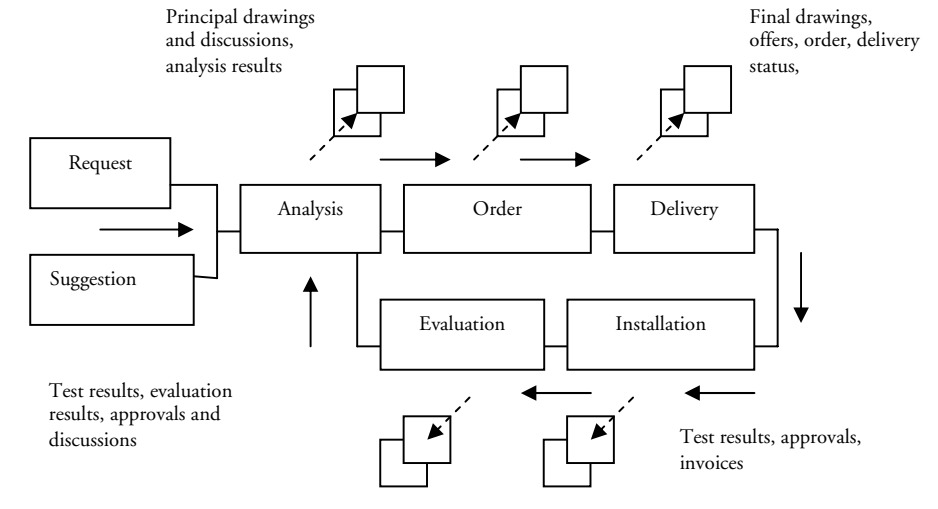
The formation of a project is done by the sales organization at Sandvik and the management of Tidamek and, after discussion, consideration of alternatives and a basic analysis of feasible solutions, a principal drawing of the tool is usually sent to a constructor at Sandvik either through one of the field specialists or to in-house sales support. Before the buyer places the actual order, several additional steps that create further documentation are made. CAD drawings are produced and are sometimes re-sent to the in-house construction department with corrections and comments from the buyer. Construction approvals are made and the final offer is approved before tools are ordered and the production of the tool starts. If the buyer approves of the drawings and offer from Sandvik, the production site in Sandviken initiates the construction of the new tool. During production, the information of estimated delivery might be crucial for Tidamek, due to the planning of usage of the specific machine the tool is tailored for. In addition, Tidamek has to answer its customer's questions on how the project of a new product is progressing. Hence, order status information is communicated in one way or the other between Sandvik's in-house sales support and Tidamek. A senior project leader at Sandvik's Nordic subsidiary made the following comment:

If you put all the information on a platform that's available to everyone, you've got a better chance of making it right. There's less risk of failure. But that won't solve all the problems, if the designer doesn't understand how the customer is going to use the tool it doesn't matter if everybody's got the same information. That's the thing with technical products, sometimes it's obvious how something should be used, but the guy who's only seen the designs and not the customer's production line might see things differently.

When new tools are delivered and are about to be put in use at the Tidamek site in Tidaholm, the installation process is supported by either the field agent or the field specialist from Sandvik (or both). To evaluate the results of changing one tool to another, test results are collected from test drives. In many cases a customer value (e.g., savings in time or improvements in quality compared to the usage of other tools) file is produced. This is not least important for Sandvik, since they need the

knowledge of how their special tools function in production since it is rare that special tools are tested elsewhere than in the customer's own production.

Figure 23. Chain of activities in tooling project (Hultman 2002)



Within the process of developing an e-business offer at Sandvik, a project to develop a collaborative platform that could be offered as support in specific customer relationships was launched in 2001. The collaboration platform developed by Sandvik had the characteristics of an extranet. In general, its main function is to extend the access to former internally used systems to customers, suppliers and other collaborators (e.g., Vlosky et al. 2000). When the project manager at Sandvik responsible for the launch of this collaborative platform heard of the Tidamek account and the problems therein, he realized immediately that this was a relationship that could fit his need to pilot an extranet application that was central to the collaboration platform. Many voices called for a solution and his prototype seemed to be the answer (see Figure 25). The trend at Tidamek was that more and more tools were being tailor-made for their production. A main issue was to cut current time lags in the development of new tools since the lead time for tailor-made tools was considerably longer than that of standard tools. One of the production engineers at Tidamek commented:

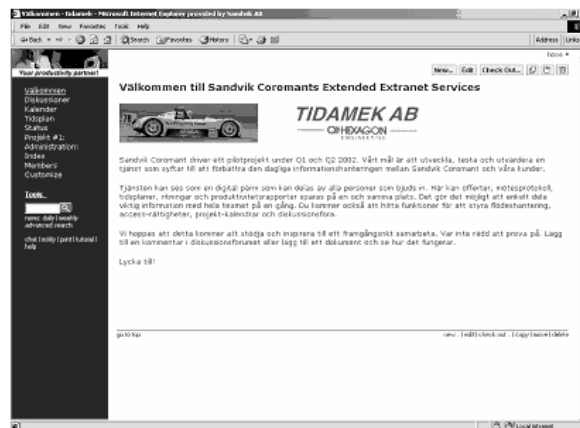
Five cases of information and communications technology adoption processes

If you could have a forum where the designer uploads his tools in 3D format you could easily log on and download them, then you don't have to spend time drawing them. Sure, it takes 5 or 10 minutes for each tool, but six tools and you've got an hour.

4.2.3 Introducing the application – an extranet solution

Within the project to develop a collaborative platform at Sandvik, when searching for appropriate applications, the supplier of the corporate communication system used by Sandvik had built-in application that was suitable for the purpose Sandvik selected to use. The system's supplier, IBM, provided a solution that had many advantages, and this attracted the project manager at Sandvik. The application Lotus Notes Quickplace (in 2003 renamed by IBM to Lotus Team Workplace) was a web-based solution for creating team workspaces for collaboration. In general, the communication conducted on a shared workplace like Quickplace is asynchronous, i.e., two users communicating do not necessarily need to be online in the system at the same time (e.g., Strauss et al. 2005).

Figure 24. Screen dump of the Tidamek extranet solution (Source: Sandvik Coromant, 2002-04-22)



The main purpose of the application, besides keeping track of discussion threads, is to offer a shared space where documents can be placed for all participants to view. For each project, the workspace administrator, often a project leader or someone

with similar responsibilities, can customize the workspace to suit the specific purposes of a project. If necessary, integration can be made with other applications like web conferencing to support synchronous communication. For some years, Sandvik's effort had been to establish partnership agreements with selected (profitable) customers. A few years earlier Sandvik had launched a broad venture to find suitable IT support for the firm's interaction with customers. Here, exploitation of the Internet was in focus. In the case of Tidamek, Sandvik made a simple configuration of the standard Quickplace solution (see Figure 24). The main features of the application included: calendar, discussion board, time plan connected to projects, project overviews with current state of each project (e.g., completed or incomplete). The major advantage of this specific extranet application was that non-technical professionals could, after just a few hours of training, create an electronically shared workspace to support a project. To enter and modify or make an entry in a discussion, access to the web and authorization with password was needed. The system was generally considered user-friendly and required a minimal amount of support if only those using the system had some experience of using computers. For Sandvik, this was an opportunity to give non-technical professionals a chance to track and support customer projects without having to physically visit the customer site. This was seen as superior to the traditional way of working. Further on, the solution had the advantage of being accessible through the Internet. Authorized project members could thus easily access the workspace to communicate, maintain a project calendar and organize project information.

4.2.4 An overview of the adoption process

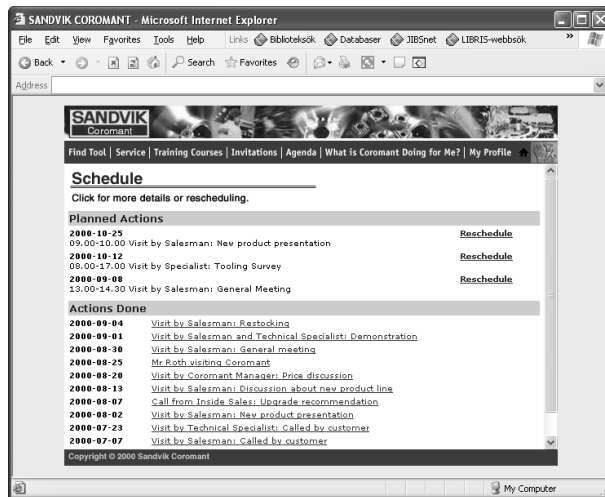
When the account manager at Sandvik who was responsible for the Tidamek account invited the production manager at Tidamek and his staff to participate in the project, the response was immediate and positive. Tidamek was one of three proposed pilots for the collaboration platform. All three pilots were established business partners of Sandvik's. They were, however, different in terms of size and type of business. Tidamek was the smallest of the three pilots and, also, the other two firms were OEMs whereas Tidamek was a 1st tier supplier. The presentation of the platform was made during a meeting between the production manager of Tidamek, the account manager at Sandvik and the e-service project manager from Sandvik's headquarters. The meeting was held in Tidaholm in September 2001.

Since the application was not ready to be demonstrated at the time of the meeting in September the e-service project manager, who was in charge of the presentation, had to use a dummy version created as an internal demo to show what the future e-service package could look like (Figure 25). The sales pitch was that the

Five cases of information and communications technology adoption processes

collaboration platform could solve a few of the communication problems in the relationship between Sandvik and Tidamek. Through trialing the pilot, Tidamek could better support the way they worked in projects with Sandvik and other firms, without any cost other than the time spent to learn how to use the application. This was an offer the production manager could hardly refuse. From his point of view, applications like these were something he believed constituted the future, and he truly wanted Tidamek to be on the front-line of technology adoption. For Tidamek's production manager, who was Tidamek's representative at the meeting, there was considerable potential in the project. From his point of view, every way to cope with an ever-increasing pressure from customers was interesting to evaluate. Increasing pressure and a clear intention of Tidamek's customers to concentrate the supply base and migrate toward more collaborative relationships made it important for Tidamek to achieve a higher level of productivity in their production processes. Tidamek needed to stay competitive and find new ways to better cope with customer and supplier collaboration.

Figure 25. Screen dump of the demo version of the Sandvik extranet (Source: Sandvik Coromant)



The fact that Sandvik created a new project on ICT did not come as a surprise to the production manager. Among the suppliers he worked with, Sandvik was by far the most active and energetic. Sandvik seemed to always have a few projects running at Tidamek. Project topics ranged from reducing material waste to trying

new production methods, and were often initiated by Sandvik. Although initially positive, the production manager had a few former implementations of IT systems in mind when evaluating the proposition from Sandvik. He had been quite critical of the commitment of those involved in former implementation projects and of the way the implementation projects had been handled. One disappointment had been the implementation of a tooling supply system called AutoTas. In January 2002, the production manager commented on the fact that although AutoTas had been technically implemented, it was not yet ready to use in full scale:

I know that this to some extent is my fault and that I need to push things... [...] but, I mean, if I'm going to invest in this I need to get something back... there is a screen and a computer over there [pointing toward the corner of the room] packed with information... that's what I call half-hearted

AutoTas and other technical solutions offered by Sandvik were part of the business partnership agreement the two firms had signed. Another application was an e-commerce application called ShopOnline. This application had also been implemented at Tidamek, without success. The production manager commented on the implementation of ShopOnline:

We did not have much use for this... the way we run things here is that people go to see Johnny [the purchasing manager at Tidamek] and order tools... like the old days... and then they had to write down what they ordered anyway... an order was created gradually... one day it was fifty pieces and another day it was nothing.

Parallel to the less successful projects like AutoTas and ShopOnline, Tidamek had also had some successful implementations during prior years. One of these was a supply management system called PipeChain, introduced to Tidamek by Volvo Powertrain. When being introduced to the project platform, the production manager at Tidamek constantly referred to PipeChain as a positive experience regarding ICT support in business relationships. The implementation of PipeChain was done at the same time Sandvik introduced their extranet solution to Tidamek. The implementation of PipeChain was, however, a few steps ahead of the implementation of Sandvik's extranet solution. In addition, Tidamek had worked with internal implementation of an ERP system for some years and had just initiated an implementation of a quality system in their relationship with Scania AB. Along with these implementations, Tidamek had started to work with team-based production. All these implementations took a great deal of energy from the

small group of employees at Tidamek they were intended for. The same target group of employers had to use and feed the different systems with information: the production manager, the purchaser, the production engineers.

Despite the Tidamek production manager's concerns about the success of the implementation project, an initial decision to join the project and therefore to adopt the idea of an application supporting shared project space was made during the meeting in September. Although they had many things to do at the time, this was an important step in the relationship with Sandvik. In order to secure the commitment of Sandvik, one condition the production manager made was that, although it was a pilot, the application should be made permanent for Tidamek to use if the implementation and trial period were successful. The project manager at Sandvik accepted this demand and left Tidaholm for Sandviken to start to finalize the pilot version of the project platform solution. A new meeting was set for late April 2002. During this meeting, training and implementation at Tidamek was scheduled. At this time, more people than the production manager were to be initiated and trained in using the extranet solution. Immediately after the April meeting at Tidamek, since Tidamek was the first of the three pilot firms to implement the project platform, a process to obtain internal funding for the pilot project was started at Sandvik. The project manager at Sandvik had held off with the formal decision of a project until he had received initial agreements to participate from a few potential pilot firms. At this point, however, it was full speed ahead to build the solution and run a few tests internally in Sandviken. In October 2001, the project manager at Sandvik filed a pre-study and a request for funding for a pilot study to his superiors (Document Excerpt 6). The report reads:

Document Excerpt 6. Pre-study report and requirement specification (Source: Sandvik Coromant: 2001-10-15)

The overall objectives of this marketing-focused pilot are:

- *To run a field test at a maximum of 10 selected customers in the Danish and Swedish market during Q1-Q2 2002.*
- *To develop and launch a centralized prototype system that supports an IT-based collaborative environment. The subsidiaries and the customers will be offered a virtual project workspace where the actors can share project-related information. The service will be based on our Global Web*

Standard design and functionality, and function together with ShopOnline.

- *To experience the development process, the implementation, the usage and the adoption process of the system, and to evaluate the customers' expectations, reactions and needs.*

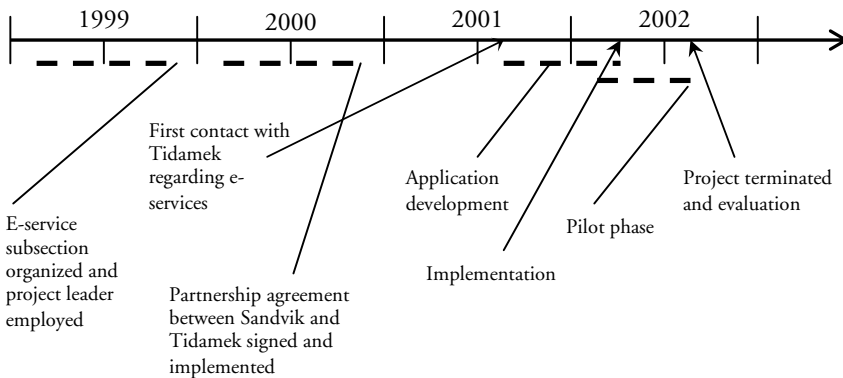
From September to April 2002 the task force at Sandvik, consisting of one project manager and a few technical employees, worked with the project platform project, focusing on finalizing the pilot version of the project platform solution. Work was put into establishing the system environment and performing software adaptations, and creating content structure and aggregation. From the first meeting at Tidamek in September, a great deal of new input had been collected in order to create content that met the user requirements. The main features of the platform included a calendar, a discussion board, a time plan connected to the current projects at Tidamek and a project overview displaying the current state of each project (e.g., complete or incomplete). These features were functions the production manager at Tidamek had stressed during the meeting at Tidaholm in September 2002, and it was feasible to provide them through the IMB Quickplace project platform. The idea at Sandvik was to give a handful of people at Tidaholm access to the shared platform, together with a handful of relevant people at Sandvik.

A few days before the scheduled meeting at Tidamek in late April, the implementation team at Sandvik sent out training material and passwords to the intended users of the platform. At this time, significant investments had been made in the project: new hardware, new software and quite a few man hours to set up the platform. Before visiting Tidamek to present the solution and meet with the intended users of the platform, the e-service project manager had scheduled a meeting with the team at Sandvik that was going to work with the platform, as this was new for them as well. The e-service project manager wanted to know whether the users on the Sandvik side of the relationship (e.g., field sales, specialists and tool construction) felt that the application was acceptable. The e-service project manager also wanted to discuss suitable projects that the project platform could support. The presentation at Tidamek in April 2002 was very positive. Sandvik had scheduled a full day of presentation, implementation and training. The day started with a presentation of the platform and how it could be used. During the day, a meeting was held during which the team from Sandvik met with a team from Tidamek to discuss possible projects the platform could support. For example, for several months Tidamek had been trying to deal with quality problems in deliveries from a

casting firm in Switzerland. Through the project platform, an opportunity opened up for Tidamek to invite different actors to discuss and deal with the problem, despite the spatial distance between them. Alongside the project manager, the training sessions were attended by production engineers and the purchasing officer at Tidamek. Immediately after the meeting at Tidamek in April, although the project platform had already been launched before the meeting in Tidaholm, the e-service project manager at Sandviken went back for final adjustments of the platform in accordance with the feedback received during the meeting. To his surprise, the meeting had generated more interest than expected from the employees at Tidamek and the project manager had issued more passwords and usernames than he had anticipated. The project manager made the following comment after the meeting:

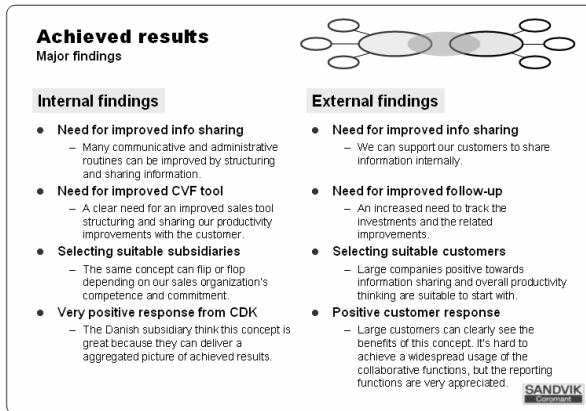
The afternoon was intense. It ended with all persons working in the production engineering department hanging over my shoulder and wanting to try out the solution, commenting on what kind of projects we should put in there and saying that they wanted passwords of their own and so on... There was a positive spirit in the room. I'm very happy with the outcome of the meeting.

Figure 26. Milestones in the Tidamek Case



Paradoxically, although the interest among the employees at Tidamek had been initially high and although all those who had wanted to had received password and username, the usage of the application was quite low. To all involved and especially to the e-service project manager, the low interest and degree of activity on the project platform came as a surprise. It seemed that the Tidamek relationship had had all the best prerequisites to succeed. Still, the implementation project of the project platform failed as a result of the initial decision to adopt. An internal evaluation of the extranet project was initiated by Sandvik in August 2002. During the summer, after an internal discussion the project manager at Sandvik again talked to both the key account manager and the product manager at Tidamek. It seemed that the more time that passed, the colder the project became.

Figure 27. Major findings from the evaluation of the extranet project (Source: Sandvik Coromant, 2002-07-05)



The failure of the implementation left a somewhat bitter taste in the mouth of the project manager. Although the people close to operations at Tidamek had been fully aware of the importance of their participation and championing of the project, they simply had no energy left to engage in supporting the system and feeding it with information. In the evaluation (Figure 27), it was stated that there was clearly a need for improved customer communication and that this system, despite the

failure in the Tidamek case, was an important piece of the firm's future marketing efforts. Sandvik terminated the project on the Swedish part of the system during fall 2002. In the evaluation performed in 2002, in addition to concluding that customer selection is vital, the project manager also drew the conclusion that Sandvik should probably have had more internal preparation before introducing the application to a customer:

One important thing that we have learnt in all this is that we need to start with our own marketing organization... the salesman... if we get the marketing organization to use this by providing them with better decision support. That's how he can provide his customers with better service... The next step can be for him to say: why not give access to the customer. Our sales organization in the field basically looks like one-man enterprises. What I mean is that our sales organization is pretty much on their own when they are in the field and we need to better use the thrust we have as a large organization in giving our own sales organization better support.

4.2.5 Within-case analysis: drivers and barriers in the Tidamek case

In the case of Tidamek, the prerequisites and setting this case represents could be considered ideal for an adoption of a platform for collaboration. For Tidamek and Sandvik, the extranet solution was a way to increase the level of commitment and create a better ground for collaboration. Both firms saw a clear potential in the technology provided by Sandvik. The relationship between the two firms was, although functioning, in need of a platform to communicate. To proceed with the pilot project was something that both firms agreed on. ICT development was an explicit part of the partnership agreement the two firms had signed a few years previously. Although the prerequisites were promising, this case presents a case with several business-related barriers to overcome. An important empirical observation in this case is how the approach of Tidamek changed during the course of the process and that an initial decision to adopt was turned into a decision not to adopt at a later stage. An interesting question that follows this observation is what the drivers and barriers were in the adoption process.

Also in the case of Tidamek and the promise of shared project space, the drivers and barriers can be discussed on multiple levels. On the supplier level, the Sandvik Coromant staff involved in the Tidamek account had organized the relationship to

fit a project-based work approach. To some extent, this was a driving force toward the initiation of the extranet project. Over the years, increased use of different communication applications disrupted traditional channels of information and the activities carried out. This, in turn, led to costs and complications. Being able to gather all information related to a specific project in one single database accessible to all actors involved was expected to solve some of the problems. A closer look, however, at the activity structures as a whole showed, in retrospect, that the production of Tidamek was relatively stable at the time of the pilot project. During the time of the pilot project, only minor change projects were being carried out. Such smaller projects did not seem to have the same intrinsic need for coordination as did larger projects and communication was therefore handled without using the collaboration platform.

Table 12. Organizational levels and drivers and barriers in the case of shared project space at Tidamek AB

	Drivers	Barriers
Relationship level	<ul style="list-style-type: none"> - Increasing problems in communicating in the relationship. - The development and signing of a partnership agreement. 	<ul style="list-style-type: none"> - Negative experiences from previous implementation projects. - Activity structure in the relationship between the two firms.
Buyer level (Tidamek)	<ul style="list-style-type: none"> - Pressure from competition and customers to cut lead times and increase flexibility in production. - Interest in closer collaboration with Sandvik Coromant. 	<ul style="list-style-type: none"> - Commitments to other system implementations, e.g. PipeChain in a customer relationship and ERP for internal purposes. - Internal activity structure, i.e., no development projects initiated during the pilot study.
Supplier level (Sandvik Coromant)	<ul style="list-style-type: none"> - Organizational transparency and systematic bypassing in conventional channeling of communication. - Willingness to develop the relationship further. 	<ul style="list-style-type: none"> - Commitment among field sales force. - The need to adapt information across several systems and make the information visible in one system.

Another important factor in the case of Tidamek was that in their relative smallness they were quite dependent on their counterparts in terms of development of new technical applications, enabling them to achieve efficiency in the supply chain. A year before Sandvik initiated their project to exploit information and communications technology in customer relationships, some of the customers of Tidamek launched similar projects. In the case of Tidamek and the developments in the extranet project, Volvo Powertrain was particularly active in using its relative

power to pressure small suppliers to adopt their applications for electronic procurement. The implementation of Pipechain had the advantage of coming from a customer, and this implementation also preceded that of the extranet solution. According to the Tidamek, the message from Volvo Powertrain and similar firms was quite clear: Either a supplier goes by the demands of the large firm or they are out of the running as a supplier. Large actors, of course, have the resources to develop their own procurement applications. Tidamek, however, had no such resources. Further on, Tidamek was not in a position to oppose their customers. In addition, Tidamek had one single purchasing officer who was in charge of procurement. The production manager expressed:

We set about adopting things... sometimes I think things happen a bit too fast... the pressure is not from the firm itself... I mean... in today's world it is sometimes hard to keep up with things on your own... there is a pressure from the world around us and there are updates coming all the time... we all want to do so much... the updates are faster and faster and the guys working here have just about learnt how to use something when things suddenly change [...]. For example, I just got a new computer... it took me 14 days to get the right software in there... people don't feel comfortable with that...

At the time, the commitment to adopt the extranet solution Sandvik Coromant had offered became a burden too difficult to handle. In this light, assuming that the production engineers and purchasing officers at Tidamek needed to prioritize among the systems they were to adopt due to limited resources for educating the purchasing officer and others authorized to deal with inter-firm relations, the question of which systems were the most important to them had a simple answer.

4.3 Volvo Cars and the promise of supply chain visibility

The third case outlined in this thesis is a case describing the failed adoption of a concept enabling supply transparency for Volvo Cars and its suppliers. This case has its starting point in the changes of the production philosophy that have largely influenced the production of automobiles around the world during the past decades – build-to-order. As already mentioned, during the past couple of years, from 1999 onward, some substantial changes have occurred in the ownership structures of the automobile industry in Sweden as well. The remaining automotive production the Volvo Group had after the sale of Volvo Cars to Ford (i.e., buses, trucks and construction), together with aerospace and other operations, was kept within the Volvo Group. The car manufacturing operations were named Volvo Cars Corporation (Volvo Cars) and the firm immediately became an important part of the Ford PAG (Premier Automotive Group) segment including the brands Aston Martin, Jaguar and Land Rover.

During the first five years after the acquisition, Volvo Cars spent a great deal of resources on product development, leading to very successful launches of new car models such as the S60 (2000), XC90 (2002) and V50 (2004) and updated versions of present car models like the C70 (2006) and S80 (2006). However, in 2005, after reports showing negative trends in sales and a cost structure that was higher than those of competitors, demands to start cutting costs grew within Volvo Cars. During the fall of 2005, a savings package with an aim set to a billion SEK in cost cuts resulted in, among other things, significant cuts in administrative personnel and consultancy service sourcing (Sandström 2005). The pressure to cut costs is not a new issue in the automobile industry, and neither is it new to Volvo Cars. For many years, Volvo Cars has systematically worked with supply base reduction and supply management in order to cut costs in supply and to make supply more cost efficient. Common practice in the industry is also to demand an annual decrease in sourcing costs upstream, putting a significant amount of pressure on suppliers and sub-suppliers to cut costs.

4.3.1 The relationship between Volvo and its suppliers

In 2005, roughly 800 newly assembled Volvo Cars left the Volvo Cars plant at Torslanda on a daily basis²⁷. According to the department for material planning and logistics, the supply needed to assemble the daily production levels of approximately 800 cars entails 16,500m³ of materials arriving in either batches or sequences that are coordinated with the production. The production facilities at Torslanda show the general trend in automobile assembly toward efficiency, and efficiency through automation and organization. For example, Figure 28 shows the assembly line at Torslanda with more than six separate robots working simultaneously on the welding of an XC90 chassis.

Figure 28. Efficiency through automation at the Volvo Cars Torslanda Plant
(Source: Volvo Cars Corporation Media Services, www.volvocars.se, 2005-01-14)



Over the years, Volvo Cars has worked with supply base reduction. Today, Volvo Cars Torslanda is served by approximately 300 suppliers, of which 21 are so-called

²⁷ In 2005, Volvo produced a total of 446,588 cars, of which 183,518 were produced at the Volvo Cars plant in Torslanda and 257,978 were produced at the Volvo Cars plant in Gent. A long-term goal for Volvo Cars is to produce 600,000 cars annually (Volvo Cars Corporation Media Services, www.volvocars.se).

sequence suppliers. A sequence supplier is defined by JIT (Just-In-Time) deliveries, supplying components tagged for a specific car on the assembly line. In addition to the distinction between batch and sequence, a supplier can supply modules instead of single components. A module is a product that includes components defined by the specific characteristics of a car. For example, an instrument panel is a module consisting of a number of different components and the type of instrument panel necessary for a specific car is dependent on whether the car is, for example, right-hand or left-hand driven. The development of supplier relationships and flows of material to fit JIT has its foundation in that the production at Volvo Cars since the mid-90s has been adapted to follow the principles of build-to-order. Over the years the idea has been to go from a production system based on forecasts to one based on actual demand (Holweg and Pil 2004).

The rationale that drives build-to-order production is that the key to efficiency is not necessarily in scale but in minimizing inventory and maximizing flexibility by producing on demand with significant cuts in lead times. For example, to manage production without any obstructions or complete stops on the assembly line, close interaction with 1st tier suppliers is a key factor. As an order is placed on a certain car with certain features concerning the interior and exterior, engine and instrumentation, e.g., an XC90 with automatic transmission, four-wheel drive and right-hand drive, a number of impulses leave Volvo Cars and are passed on to the suppliers that supply components for the XC90. These impulses result in the development of customized components responding exactly to the demands for a specific car, so that they are ready for delivery in a sequence that is coordinated with the production sequence along the assembly line at the Torslanda plant. Although zero disturbances are the goal, disturbances still occur. A complete stop along the assembly line is very costly.

Quality and efficiency seem to be two key metrics in the automotive industry. At least, these two concepts have gained the most attention among manufacturers (Holweg and Pil 2004). The problem is, however, that both efficiency and quality are moving targets since all manufacturers are working with such improvements. The system of build-to-order is certainly one example of the efforts to develop efficiency in automobile production. In order to sustain a smooth supply, Volvo Cars demand that all communication of, for example, delivery schedules and production plans is handled via EDI. Volvo Cars works with both long-term production with a horizon of approximately sixty days, and short-term production

plans, so-called call-offs, with a horizon of approximately twelve days²⁸. Planning is carried out by the logistics department. From a supplier perspective, the production plans made by Volvo Cars form the basis for their respective planning – the production plans are regularly communicated to the suppliers and the actual orders may deviate from the plan, but only to a limited extent as a certain number of days in the call-off are fixed.

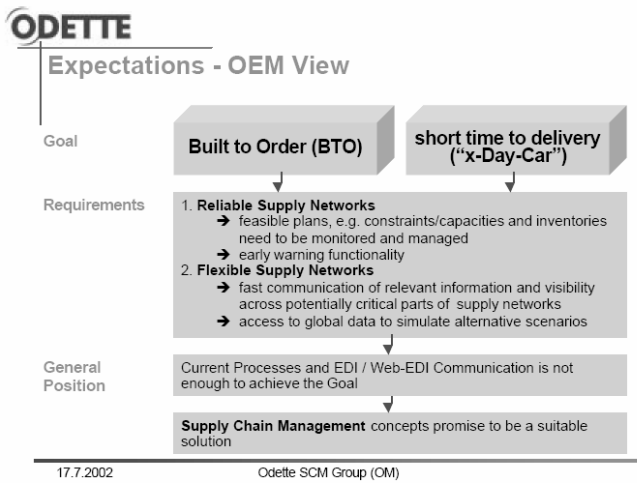
4.3.2 The promise of supply chain transparency

The build-to-order production system implies a number of things for the supplier network serving the automobile manufacturer that has implemented it. Looking at production at, for example, the Volvo Cars plant at Torslanda, all vehicle assembly is organized along a single assembly line. Although minor disturbances are manageable, a complete stop in production can be very damaging. In addition to the direct costs a production stop generates, other problems also emerge. Re-active actions in order to control the damage caused by a stop in production can be significant, including costs in the development of safety stock. In addition to direct and indirect costs, friction in supplier relationships needs to be managed and ways to avoid similar problems in the future need to be developed. In a study on the problems of a production system based on forecasts, Holweg and Pihl (2004) found that problems in the information flow constituted the cause of 85% of the delays in the order cycles in automobile production. According to an industry task force on supply chain management organized by Odette International when presenting their work at VDA in Germany in October 2002, build-to-order and short lead times require a flexible and reliable supply network (Figure 29).

Consequently, from an OEM perspective, smooth supply is critical and a means to reach efficiency. Taking into consideration that a significant proportion of the production of components is outsourced, and that the build-to-order system is applied, accurate and frequently updated information about supply is a necessity for making production as smooth as possible. In addition, the perspective in information flows needs to be elevated to chain level. That is, in order to uphold production smoothly, it is in the OEM's interest to get information from not only the immediate upstream supplier but also suppliers further up in the supply network. As lead times need to be shortened in order to produce on demand within acceptable time frames, it is in the supplier's interest to receive accurate information in order to plan production accordingly.

²⁸ For an extensive description of the planning systems at Volvo Cars Corporation, see for example Fredriksson and Gadde (2005).

Figure 29. Background and general approach of the Odette Supply Chain Management Group (Source: Odette Sweden, 2004-08-23)



4.3.3 Introducing the concept of SCMo

The transparency necessary for enabling information flows in both directions – propagated demand and stock levels – is a challenge that the automobile industry addressed during a seminar in Gothenburg in October 2004. The vice president of MP/L at Volvo Cars presented the following view on transparency at a seminar in 2004 (outlined in Figure 30). The idea of creating a standard concept for supply chain information visibility in the automobile industry that all industry stakeholders can adapt to was initiated within the Odette work group on supply chain management (SCM) during the late 1990s. The work force had been formed to work with SCM as a project within one of the four committees of Odette International. In the project, representatives from a number of European automobile manufacturers (e.g., Ford, DaimlerChrysler, Audi, Renault), 1st tier suppliers (e.g., Faurecia, Siemens VDO, Trèves) and industry organizations (e.g., VDA, Galia) had come together.

Five cases of information and communications technology adoption processes

The ultimate goal of the Odette Supply Chain Monitoring (SCMo) project was to publish recommendations that were accepted by a majority of the key OEMs in the European industry, and thereby create enough power to make the recommendations a standard. The background to the formation of the project was the problems the industry saw in the slow development of web-based systems that worked across firm borders, although a few such pilot projects had been successful. The recommendations were published in May 2003 and formally presented in detail at the annual Odette Conference in October 2003. Odette made the following statement when the recommendations were published:

The Automotive Industry is facing the challenge that a comprehensive flow of information must be made transparent between supply chain partners [...]. This transparency cannot be fulfilled just by exchanging EDI messages, but there has to be real-time exchange, synchronization, aggregation etc. to be shown in a separate VMI level.

Figure 30. Volvo Cars view on future supply chain management (Source: Volvo Cars, 2004-10-07)



The idea of the work group managing the project and developing the concept was: the information flow in the supply chains should be handled the same way as

ordinary telecommunication between any users over a common telecommunication net, i.e. the user calls and the receiving party answers. Using the telecommunications metaphor, the system would work with standardized data transmission (e.g., voice). To access the information flow (e.g., to hear what the other party/parties are saying), you need a system (e.g., a telephone that is connected to a widely diffused telecommunication net) to handle incoming and outgoing data. The concept, called SCMo was explained as:

Document Excerpt 7. Supply Chain Monitoring V1.0 recommendations (Source: Odette, 2003-05-28)

Supply Chain Monitoring (SCMo) is a multi-level SCM concept supporting the fulfillment/execution process. Basically SCMo automatically generates automatically alerts (e.g. by sending emails) if the actual inventory levels in the supply network are too high or too low regarding the demand of the next days/weeks. The multi-level approach allows taking into account the cumulated inventory across the supply chain and enables a fast and transparent demand calculation. Every company will get early and clear signals whether to speed up or to slow down production. This visibility will bring great benefit, especially for suppliers on lower tier levels suffering most from the so-called "bull-whip effect".

According to the recommendations document, the general principles of the concept were:

Document Excerpt 8. Supply Chain Monitoring V1.0 recommendations (Source: Odette, 2003-05-28)

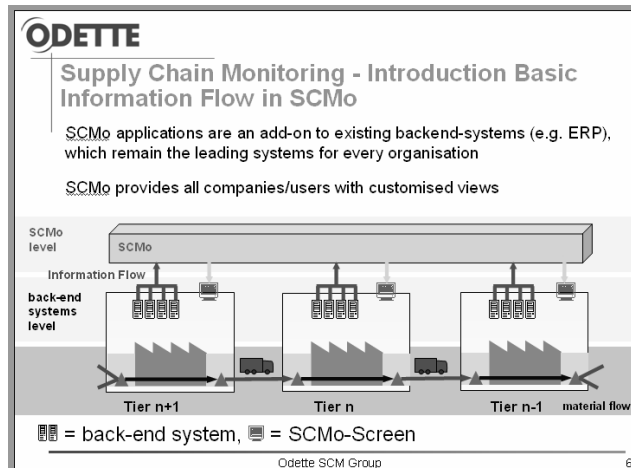
- *Integration of supply chain participants with the aim to exchange demand and inventory information.*
- *Information (demand) transparency and inventory visibility for multi-level supply chains.*
- *Elimination of time lags in the information flow.*

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- *Synchronization of demand information along the critical paths of selected supply network to achieve fast demand calculation and eliminate a root cause for the bullwhip effect.*

One of the key advantages of the SCMo concept was that it was anticipated to open up an information flow structure across different partners without customer-specific investments. The concept was not a technology in itself that was necessary for stakeholders to adopt. Instead, it worked as a recommendation on data exchange to and from current existing back-end systems (e.g., ERP), working as a low complexity complement. The transparent view, customized and showing different information for different users, was created through a separate SCMo level, available to every participating user. Although there are evident advantages involved in the sharing of information, there are also problems associated with the creation of transparency. In order to make the concept of SCMo work, each tier would feed the system with data, leading to a propagated demand shown in the system on the elevated SCMo level (Figure 31).

Figure 31. General description of the information flow in the SCMo concept (Source: Odette Sweden, 2004-08-23)



When implementing a concept like SCMo, which has the purpose of propagating end-customer demand upstream to enable smooth supply, the fact that different actors in the supply chain have different perspectives and are still autonomous actors needs to be taken into consideration. Each relationship in a supply chain is built on agreements regarding supply and demand that on the one hand are built on forecasts coming from the OEM but on the other hand depend on production facilities and so on; these forecasts are dealt with individually by each firm on its own. When demand is automatically propagated through add-on technology, this leads to the problem of two demands for each actor in the middle of the supply chain. One of the persons actively working in the Odette work group on supply chain management, who also had the role of project leader for a specific SCMo implementation project in Germany, commented on the situation and his experiences with the concept:

[The] point is that there are two demands. One is coming from SCMo which is the computed, propagated demand, and the other is the contractual demand from their direct customers. This is the very basic problem behind SCMo. [We have to manage] two flows of demands, one official and contractual sent via EDI or fax, and one that comes from the SMC software. [...]

4.3.4 An overview of the adoption process

The concept of SCMo was introduced in Sweden and at Volvo Cars through the collaboration between Volvo Cars and Odette Sweden. As with many other projects on new IT solutions in the automobile industry, especially within the field of logistics, the size of the network of actors in the industry demands that discussions on demands and possible solutions be held on an industry level. Although much is decided at the top of the food chain, i.e. among the OEMs, they have shown a need to coordinate technology development horizontally. One example is the implementation of EDI technology during the 1980s, when top executives from all four Swedish automotive OEMs came together to sign a letter addressed to the automotive supplier network in Sweden, demanding cooperation in the implementation of EDI. Odette has a tradition of organizing its development into committees containing representatives from both OEMs and the supplier network. In 2001, the working committee under Odette International concerning B2B exchange received SCM as a concept on their table. The managing director of Odette Sweden explained how SCMo became an issue within Odette:

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[...] in the late 90s, during the internet hype period, we had a task force called B2B. At that time, a loose network that discussed Internet communication in a business-to-business context had developed, especially on a German supplier industry level. This network was squeezed in under the Odette umbrella and got the name B2B committee. Within this committee SCMo was developed. The initiative came from Bosch. They were pushing the development. The representative from Bosch became chair of the group that developed the SCMo recommendations.

In 2001, the work of finding a solution on supply chain management that took the chain into consideration was initiated within the B2B committee. The Swedish representative in the group was chosen from Volvo Cars. The general purpose of the task force was to find a standard solution for supply chain management for the automotive industry. In the project, representatives from a number of European automobile manufacturers (e.g., Ford, DaimlerChrysler, Audi, Renault), 1st tier suppliers (e.g., Faurecia, Siemens VDO, Trèves) and industry organizations (e.g., VDA, Galia) had come together. In 2001, Odette was not interested in a stand-alone solution. However, time told another story, according to the Swedish manager of Odette:

One wanted to run this with connections to Covisint... my view on this was that if it did not work in Moscow in the 60s, it would certainly not work today... [...] Covisint's view was that all they needed was the demand from the factories at Ford... this was then going to be distributed and presented to all parties in the supply chain... I did not believe in this... I felt it was important to take the commercial reality and conditions that all parties are working with... the tendency was to not see all the investments that had been made in transfer mechanisms and structure that was already there. This was the general attitude at the time.

The group met on a regular basis and for every meeting, some or all participants could have assignments to report or gain approval in their own organization regarding certain steps in the process. According to the Volvo Cars representative, the spirit in the meetings was positive and all involved seemed devoted to finding a solution. Volvo Cars was the only Swedish automotive actor that had shown interest in the concept. An additional Swedish automotive firm had been part of the

project at its initial stage but withdrew after a short time. The project manager at Volvo Cars explained:

In a project like this, it is not necessary to have all Swedish automotive manufacturers represented in a group. In some cases, one could be enough under the circumstances that this person in his turn develops a Swedish sub-group that discuss the implications and demands from a Swedish perspective. This is the way it works at Odette... However, this was not the case for us. There did not seem to be any broader interest among the other Swedish organizations at the initial stage... they were skeptical... one reason was that this was seen as a threat to the investments made in EDI... replacement of EDI was not something one was interested in.

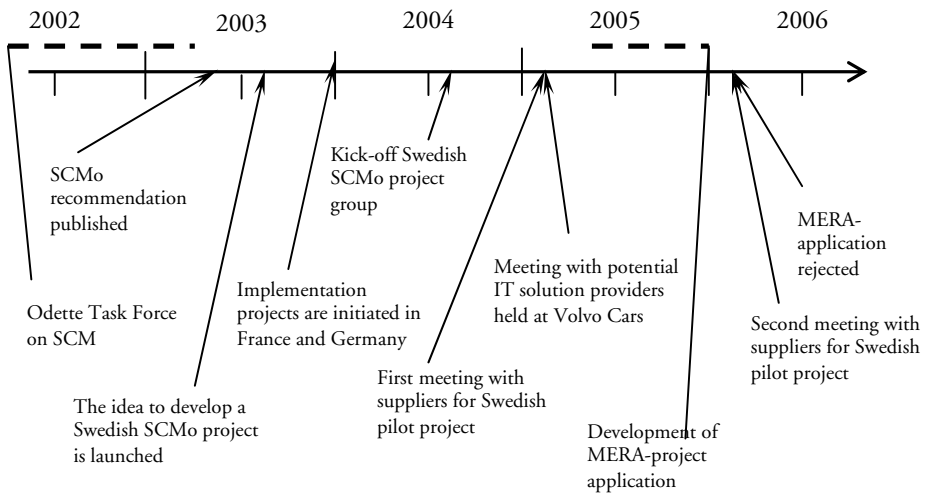
The outcome of the work in the group was a set of recommendations regarding SCMo divided into two parts: Firstly, a general description of how to obtain visibility in supply chains and its implications and the functionality of the concept of SCMo, and secondly, two separate technical specifications on business processes and a detailed data description. The group presented its finished work in 2003. The first presentation of the SCMo recommendations was given at an automotive conference in Germany in 2003 and a similar presentation was held in Sweden at a conference in Linköping in September 2003. The idea to launch a Swedish pilot project on SCMo was brought up at this seminar. When interviewed, the manager of Odette Sweden commented when interviewed:

It was in Linköping in September 2003. We ran the conference since we saw that SCM was an area that was interesting and that it was time to do something... an important part of the conference was to present the SCMo concept [...] During the seminar, the idea to perhaps test this in Sweden was brought up for the first time.

Since Volvo Cars had met initial positive reactions, the person who had represented Sweden in the SCMo group continued to work as project manager in close cooperation with Odette Sweden in planning a Swedish pilot of SCMo. During spring and summer 2004, these plans became more and more concrete. At this time, SCMo was beginning to be implemented or tried in automobile supply chains across Europe. The implementations had been especially successful in Germany, where the initiative of SCMo had originated. After the publication of the recommendations in 2003, the concept was presented at various conferences and meetings. The vice president with responsibility for logistics and material planning

at Volvo Cars was at the time a member of the board at Odette International. During a presentation on Supply Chain Management made to the board, she became interested in the concept of SCMo. According to the Swedish project manager, the managerial support for SCMo was strong within Volvo Cars.

Figure 32. Milestones in the Volvo Cars case



During the summer of 2004, together with the manager of Odette Sweden, the project manager of SCMo at Volvo decided that they needed additional perspectives in planning a Swedish pilot project. Contact was made with Jönköping International Business School (JIBS) and a research team on supply chain management. Representatives from the three organizations Odette Sweden, Volvo Cars and JIBS formed a project group aimed at launching a pilot implementation of the SCMo concept in Sweden. In addition, a representative from an organization that represents the interest of automobile component suppliers in Scandinavia, Scandinavian Automotive Suppliers, was affiliated with the project group and occasionally participated in the group meetings. The group met on a monthly basis between August 2004 and February 2006. The role of JIBS was to study implementation as well as function as a consultative party in the group. The studies that JIBS planned to conduct in the project had four directions. First, an interview study on former implementation projects in Germany and France was conducted during the fall of 2004. Second, a survey with the purpose of investigating the

willingness and capability to share supply data among Swedish suppliers was conducted during the fall of 2004 and reported during the spring of 2005. Two other studies were dependent on a launch of the implementation project. These studies involved the mapping of a number of supply chains selected by the project as potential candidates for a pilot of the SCMo concept and a study of the implementation process.

During the spring of 2005, two important meetings concerning the SCMo project were held. On March 9, a meeting was held with a number of suppliers and persons within Volvo Cars involved in materials supply. The purpose of the meeting was to check the reactions among key suppliers and also, if the reactions were positive, to check their willingness to participate in a pilot study. During the meeting, the applicability of the SCMo concept in the case of Volvo Cars and its supplier relationships in certain types of situations was discussed. The outcome of the meeting was a positive response from the suppliers present, although hesitancy on a number of points was shown. No commitment to participate in a future project was made, and the suppliers present clearly signaled that they could not finance this, or even their own parts, in a future project. The manager of Odette Sweden commented on the situation:

Among the suppliers we found inability rather than lack of willingness...they did not seem to have any room for this. Taking the general atmosphere in the OEM supplier interface, I can imagine that they already had limited resources and enough problems as it was... the curiosity and the ability to test new things is limited depending on the conditions that suppliers are in today. Clearly, money matters.

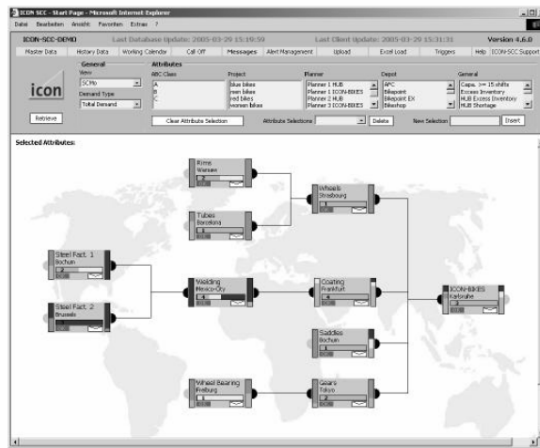
The outcome of the meeting with the suppliers at Volvo Cars was that the project manager did not want to force any suppliers into the project. Instead, it was important that they, together with the department at Volvo Cars, responsible for the relationship, had a common view on the urgency and criticality of shared information and smooth supply. Therefore, the question of which pilot firms to include was left for a later stage and the project group continued to set up the pilot in terms of looking at possible IT solution providers who could support the SCMo concept. If necessary, at a later stage, the project manager planned take the issue to a senior executive level at Volvo Cars and force the suppliers into participation through the purchasing organization.

A few weeks after the meeting with the potential suppliers, a meeting with potential IT solution providers was set up at the Volvo Cars headquarters in Gothenburg.

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Three solution providers were invited, having been selected by Volvo Cars from an initial list of eight. The initial screening was based on the criteria: 1) experience with SCMo, 2) experience on automobile logistics, 3) type of solution, 4) type of firm, and 5) firm location(s). Although different in character, all three firms had a solution that could support the SCMo concept. All participant firms were given the opportunity to present their view on the project and their solution for creating supply transparency. After the meeting and a subsequent evaluation, two firms were kept in the race. The idea was to run both in two separate pilot studies and afterward evaluate which supplier was most suitable for a large-scale implementation at Volvo Cars. The two firms were PipeChain AB, a Swedish solution provider, and Icon Supply Chain Management (Icon), a German solution provider. Icon was the only solution provider with real experience from previous development of SCMo projects.

Figure 33. Screen dump of demo view of the SCMo solution provided by Icon Supply Chain Management (Source: Icon Supply Chain Management, 2005-03-31)



In the fall of 2005, the project group working with SCMo in Sweden started to prepare an application to the research program on automotive engineering called MERA, administered by Vinnova (the Swedish Governmental Agency for Innovation Systems). The opportunity to apply for funding from MERA had been initiated during the spring of 2005. The background of the MERA project was the announcement by General Motors that they were considering moving the

production of Saab Automobiles from Trollhättan, Sweden. During the fall of 2004, the Swedish government presented a plan to save the employment opportunities that automobile production in Trollhättan meant. The plan had two legs. First, a number of infrastructural investments in the area around Trollhättan were promised. Second, the government promised a strengthened bid on research within the automotive area. The governmental agency for research that integrates research and development on innovative systems was given the assignment to administrate the research program.

During the preparations to apply for funding for a pilot study on SCMo in Sweden, the situation within Volvo Cars changed and affected the project and its opportunities to seek internal funding within Volvo Cars. During 2005, the Ford Motor Company had financial problems that affected Volvo Cars in the sense that a demand was made that they cut one billion SEK in costs. For the department in which SCMo was run, a few of the employees were offered early retirement. No employee directly involved in the SCMo project was affected by the cut in employee base, but the project was affected in the sense that one could not count on finding financial support internally at Volvo Cars and therefore had to rely on the possibility of finding external funding for a pilot implementation. The project manager expressed:

Senior management involved in logistics at Volvo Cars spoke very positively about the project and followed the development closely. [...] however, we have had a very tough situation here... I won't say toughest ever but... even though business has been good, we have really been forced to tighten our belt here. [...] I remember that a rough number that was discussed was 10 or 15% in general savings across all fields.

The savings that Volvo Cars announced during the fall of 2005 changed the situation for the project in the sense that one could not rely on finding financial support internally. The project manager continued explaining the effects on the SCMo project:

The project became dependent on external funding via MERA [...] we were very much into the idea that MERA would solve this financially... I know that we had SCMo in our budget proposition during the summer of 2005... it was a couple of hundred thousand [SEK] that would cover implementation. This pot was cut out... the

savings and directives came in waves during the fall and it was swept away somewhere at that time... we had talked about it but SCMo never made it into the final budget.

The application for funding for SCMo was finalized and submitted to MERA on January 18, 2006. In late January the application was presented and discussed in a quality assessment workshop. The manager of Odette Sweden was responsible for the project. His view of the meeting was very positive; He was confident that it went well and that the project had a fair chance of getting funding. The project was summarized as follows:

Document Excerpt 9. Project summary in the MERA application (Source: MERA application, 2006-01-18)

Lack of information in the supply chain is a large problem for the automotive industry since it entails high costs of freight, frequent stock-outs and high administrative costs. Information about demand takes too long to reach upstream suppliers. Within Odette, suppliers and car manufacturers have developed a solution, 'supply chain monitoring, SCMo', which this pilot project is based on. The conceptual idea is to increase capital efficiency through increased information instead of increased stock in the supply chain. The concept is to connect parties in the supply chain's information flow.

The IT solution sends an alert when there is a divergence in demand and supply, thereby the actual demand is synchronized with supply levels. The pilot covers two supply chains and within these the primary step is to map actual supply flows. To take part in the study, the demands should be critical and the participant firms need to have an expressed will and capacity to participate in the project. Similar projects have been started in Europe and our project is built on experiences from these.

A few weeks after the submission to MERA, in February 2006, a second meeting with potential suppliers interested in a pilot study on SCMo was held at Volvo Cars. The purpose of this meeting was to increase preparedness for the initiating of a pilot study in the case of acceptance of the application at MERA. At this meeting, representatives from four key suppliers of Volvo Cars were present. The atmosphere at the meeting was again very positive, with both the supplier representatives and

the project group discussing the pilot study under the assumption that the MERA application would be accepted. Acceptance from MERA was crucial at this stage. Clearly, all suppliers saw the potential of SCMo and were interested in participating under the condition that their part of the funding was their own time spent in implementing and testing the application. One of the suppliers at the meeting commented on the actuality of the concept:

This type of technology clearly becomes important as we have more and more production outside Sweden. A big problem for us is the time for transport between our production sites and between us and our customers. It becomes even more important when the material is highly graded, as a lot of things we handle are.

On February 9, 2006, the decision that the evaluation board of MERA had decided to reject the SCMo application reached the project manager and the project group. Although the decision was a disappointment, it was not a complete surprise. After the application had been sent in, both Odette Sweden and representatives from Volvo Cars were notified that it was seen as an application that did not fit the call from Vinnova. Although this view did not correlate with that of the project group, the short note that accompanied the rejection showed the position of MERA, in accordance with Document Excerpt 10. Since the project had to rely on external funding during 2005, the decision of MERA made it difficult to carry on. During a final meeting of the project group, Odette declared their withdrawal from the project. The representative from Volvo Trucks also declared that he saw difficulties in continuing participation in the project after the rejection by MERA – there were no remaining possibilities to find external financial support for a pilot study.

Document Excerpt 10., Results from the MERA program committee (Source: e-mail correspondence, 2006-02-09)

Supply Chain Monitoring – Rejection; as the program [MERA] only supports logistics within factory and not in-between factories. VCC will together with FKG raise this issue to change the program text so that logistics between factories is an option at the next program committee meeting.

A few weeks after the decision from MERA, the SCMo project leader at Volvo Cars went on leave of absence. Therefore, the project was also halted within Volvo Cars. Volvo Cars did not close the project, but were not actively planning to initiate a project unless new doors were opened offering new possibilities for initiating a pilot study with external funding. The situation for SCMo seemed problematic and the financial situation did not make it easier. When returning from his leave of absence, the project manager at least hoped to have a decision on how to continue. The managing director of Odette commented on his view of the future of SCMo:

I'm fully convinced that this will eventually be implemented... in suitable supply chains... it will take time... perhaps under different conditions when it's finally accomplished... driven by the IT firms, other solutions... no intervention from us or from universities... I don't know when but I'm sure it will happen... we can see similar developments in other industries... they are interested in jumping aboard...

4.3.5 Within-case analysis: drivers and barriers in the Volvo SCMo study

Looking back at the critical period for the SCMo project, from the turbulent fall of 2005 to the decision of the MERA board, the actors involved in the SCMo project all felt it was unfortunate that it had failed to reach implementation. A great deal of irritation was directed toward the MERA project. The view was, however, that the concept of SCMo would eventually be implemented. During the process Volvo Cars had been an important part of the development team, and there were strong forces within Volvo Cars that were convinced that with an increasing level of outsourced activities to suppliers and supplier networks, it seemed clear that the need for an overview and visibility had never been more present. With new technology, allowing firms to follow supply movements in real time, this visibility was a possibility that could be realized through the implementation of SCMo. In the case of SCMo, the major driving force among the actors involved was to develop capabilities for a flexible and reliable supply chain. If this was the case, why then did Volvo Cars not reach implementation? A simple answer is impossible to single out. There are, however, some important drivers and barriers that can be outlined.

From a supplier point of view, flexibility and reliability formed a demand so important that it could have a profound impact on firm performance. Upholding

JIT and working along the principles of build-to-order, speed and reliability in supply are key factors in modern vehicle production. Exploiting new technology in order to obtain this capability was therefore strategically important. Although automobile production is ultimately a global industry, there are clear geographic boundaries in the industry. Therefore, especially for competitive purposes, if one area can develop a standard means of communicating in areas other than, for example, EDI and PDM, this would be a significant competitive advantage in the development of reliable and functioning supply chains.

Table 13. Organizational levels and drivers and barriers in the case of supply chain transparency at Volvo Cars

	Drivers	Barriers
Industry network level	<ul style="list-style-type: none"> - Need for visibility in supply due to changes in organization of supply chains toward build-to-order. - Need to develop standardization in supply data communication. 	<ul style="list-style-type: none"> - Interest conflicts along the supply chain since the best interest of the supply chain does not always square with the best interest of a single firm. - Lack of regulations on contracts, responsibilities and standard language in supply monitoring.
Buyer level (Volvo Cars)	<ul style="list-style-type: none"> - Need for flexibility and reliability in supply. - Outsourcing. 	<ul style="list-style-type: none"> - No immediate interest in financing the project during time of broad cutbacks. - Lack of support from potential sources of financing from the MERA program.
Supplier level	<ul style="list-style-type: none"> - Need to follow the interests of key customers, e.g., Volvo Cars. - Need to respond to increasing demands for flexibility, reliability and speed in deliveries. 	<ul style="list-style-type: none"> - Lack of possibility to solely handle the costs in a project like SCMo. - General reluctance to enter projects without any immediate or direct benefits.

Looking back at the development of SCMo, it is clear that the development in Sweden has not followed that in Germany or France. In the fall of 2006, although the project had still not been forgotten or abandoned, its status was unchanged. The industry organization Odette Sweden had failed in their aim to push the Swedish actors in the direction of the industry as it developed in greater Europe. Although the manager at Odette Sweden believed that the concept of SCMo would eventually be adopted among Swedish OEMs, these expectations and beliefs had not yet been fulfilled. The rejection from the MERA program had clearly been a key barrier in the adoption process.

In addition to barriers to and drivers for adoption, a few remarks can also be made on the barriers to the implementation of SCMo. When running the SCMo project and preparing for implementation in Sweden, four specific but to some extent interrelated problems were identified (e.g., Borgström et al. 2005; Hultman et al. 2006). The first problem outlined in the report was the trust problem, which in SCMo refers to the extended line of visibility and transparency that a concept like SCMo entails and the inertia to extend the line of visibility across firm borders due to lack of trust. This relates back to the industry-level barrier of conflicting interests. The second problem outlined was the compatibility problem, which refers to the characteristics of production of components that are made in the supply chains selected for implementation of SCMo and the difficulty to implement new practices due to problems in compatibility with current processes. As it seems, an assumption made by the developers of the SCMo concept is that if the production along the supply chain has disturbances, this has to do with the business process. When implementing a concept like SCMo that has the purpose of propagating end-customer demand upstream to enable a smooth supply, the fact that different actors in the supply chain have different perspectives and are still autonomous actors needs to be taken into consideration.

The third problem the report identified was the interoperability problem, which refers to the confusion and problems in communication, trust and commitment that having two separate demands causes. Each relationship in a supply chain is built on agreements regarding supply and demand that on the one hand are built on forecasts from the OEM but on the other hand are dealt with individually by each firm on its own. The fourth problem, labeled the commitment problem, refers to the fact that supply chain concepts like SCMo are dependent on a strong commitment among their users, and to the problem of lack of commitment among users due to the increased effort of data feed and administration that an adoption can cause. In the case of SCMo, all actors involved need to commit and give input and use data; otherwise the demand propagation (upstream) will lead to a decrease in accuracy and preciseness and the data in the system will be less useful and in some cases completely false.

4.4 Sapa Profiler and the promise of data feed automation

The fourth case outlined in this thesis describes the adoption process following the introduction of an application enabling data feed automation in the relationship between Sapa Profiler and a supplier called A-lackering. The Sapa Group is one of the world's leading producers of aluminum components, and has approximately 8,000 employees in 25 countries. Apart from its production on the outskirts of Vetlanda in the province of Småland, Sweden, the Sapa Group has its production in more than ten countries around the world and has its headquarters in Stockholm. Its subsidiary, Sapa Profiler, markets several major product lines of aluminum profiles and specializes in aluminum profiles that are extruded and processed into various shapes and sizes.

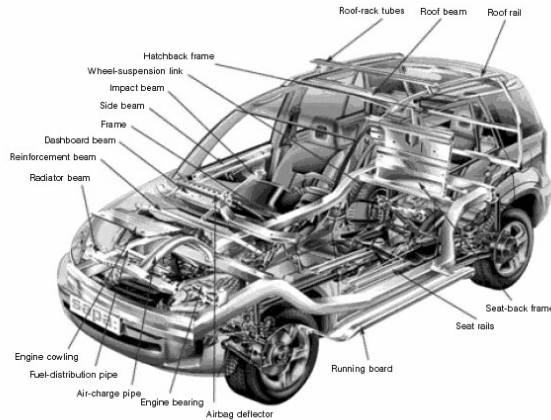
Table 14. Sapa Profiler AB: Firm data (Source: Affärsdata, www.ad.se)

	2001	2002	2003	2004
Turnover (in MSEK)	2.634	2.496	2.384	2.730
Employees	1,469	1,348	1,296	1,346
Net result (in MSEK)	86.7	39.3	86.8	73.6

Sapa Profiler (Sapa) has approximately 1,300 employees and an annual turnover of approximately 2.7 million SEK (see Table 14) and is headquartered in Vetlanda. Although Sapa operates in a very fragmented market with multiple key segments, a major customer group is the transport industry including automobile, truck and bus production. During 2003, Sapa's transport segment accounted for an approximate turnover of € 55 million, which corresponds to about 25% of the Sapa Group's total business. In a modern passenger car, extruded aluminum can, for example, be found in seat and roof rails and in a range of different engine components (see Figure 34). Sapa has experienced significant and continuous growth since the firm was established in the 1960s. In 2004, net sales rose by almost 20%, and the firm made a few acquisitions and direct investments overseas.

The firm growth is related to the increased interest in aluminum as a raw material. For several reasons, an increasing number of components in a car are made of aluminum.

Figure 34. Examples of aluminum profiles from Sapa in a car (Source: Sapa Group Annual Report 2004)



One important reason for using aluminum is its low weight compared to alternative metals. To be able to reach reduced carbon dioxide emissions, a key issue in the automobile industry (e.g., Nieuwenhuis and Wells 2003), car manufacturers are, besides finding new engine types and alternatives to fossil fuel, working to reduce the weight of automobiles. One way to reduce weight is to increase the use of aluminum in automobile components. The Sapa Group's annual report for 2004 reads:

Document Excerpt 11. Annual report – Chapter on Sapa's products, markets and competitors (Source: The Sapa Group, March 2005)

The transport industry has, for a long time, been one of Sapa's largest customer groups and the proportion of aluminum in transport vehicles continues to increase at the expense of heavier materials. Reducing weight is a priority, providing both financial and environmental benefits.

As shown in Figure 34, Sapa supplies components for almost all details of a car. As specialists on aluminum extrusions, Sapa is active both as 1st and 2nd tier supplier to the automobile industry. Although all automobile manufacturers active in Sweden have some relationship with Sapa, the geographic spread of Sapa's customers is concentrated in central Europe. As the German automobile market is 15 times the size of the Swedish market and the largest in Europe, this is of course the most important market for Sapa. As 1st tier, Sapa supplies the vehicle manufacturer directly with extruded components like roof rails. As 2nd tier, they supply 1st tier systems suppliers like Autoliv with components like airbag deflectors, a component that houses the gas generator in an airbag that has the task of distributing the gas into the airbag when it is activated (see Figure 35).

Figure 35. Three automobile components produced by Sapa: at left a seat rail, in center a doorsill panel and at right an airbag deflector (Source: The Sapa Group, www.sapagroup.com, 2005-05-18)



Although the automobile industry is demanding, with great pressure to cut costs and low profitability, according to the marketing department it is still an important market for Sapa to act in for several reasons. For Sapa and many other firms, the automobile industry is seen as a market where they can learn and then transfer this generated knowledge to perform better in other markets where they are lagging in some respect, i.e., ICT use. The development of IT support for business in the automobile industry has been followed closely by business developers at Sapa. For example, the extensive diffusion of usage of EDI within the Sapa Group and among

suppliers is very much a result of its activities in the automobile industry. The market coordinator responsible for the automobile segment at Sapa explains:

We have always considered automotive as a strategic business area. Sapa decided to go for automotive since new things are always happening there and since there is such a strong competition and strong driving forces in the industry. It is of course no gold mine, but a substantial market with a relatively stable production. Then of course we see that the demand for aluminum is increasing in the automotive industry. This is something that we hear from both interest organizations and institutes in our business. All seem to agree that aluminum is a material of the future.

4.4.1 The relationship between Sapa and its (co-) suppliers

To deal with an uncertain environment and a customer base with increasing demands regarding efficiency and effectiveness, the management at Sapa has for some years worked on a system with an organized and closely knit set of suppliers, of which many can be found around Vetlanda and Ekenässjön in the Swedish province of Småland. To achieve closer relationships with a select set of suppliers, Sapa has divided their suppliers into two groups: suppliers and co-suppliers. To become a co-supplier, a selected supplier with specific treatment and status, a supplier needs to commit to place all their aluminum business with Sapa and not any other competitor. The benefit for the co-suppliers in engaging in this agreement is that they will be treated and rewarded as a preferred supplier (e.g., Dorsch et al. 1998) and will therefore have access to a more stable demand from Sapa than otherwise. Much of the work to develop and organize Sapa's suppliers had been managed by the logistics department. When asked about the criteria and co-supplier concept, the logistics manager at Sapa commented:

To be a co-supplier of Sapa means that they have close collaboration and more opportunities to influence than an ordinary supplier. However, we demand a certain degree of exclusivity from our co-suppliers. Of course, this also entails some dependencies. When a firm becomes a co-supplier, we give them a guarantee that if we have orders then they get orders pooled from us. At the same time, we are also dependent on our co-suppliers. For example, if a co-supplier makes a

larger investment in a new machine, we can also guarantee a certain degree of utilization.

With only a few exceptions, the co-suppliers currently tied to Sapa are privately owned, relatively small firms with an annual turnover ranging from a few hundred thousand euros to approximately € 10 million. Supposedly, the firms engaged in metal machining and especially aluminum see Sapa as a very attractive customer. However, the exclusivity demand as stated by Sapa is complicated by the fact that one of Sapa's most important competitors, ProfilGruppen AB, has its headquarters and main production in Åseda, only a one-hour drive from Vetlanda. According to a supplier of Sapa, being a co-supplier can be troublesome since it entails a great deal of dependency on a single customer. As already mentioned, it means that in order to become co-supplier, you need to exclude other potential customers. However, on the other hand, the services offered by the co-suppliers are those that often require specific knowledge and machinery that, if bought in-house or elsewhere, would entail significant investments. The manager of one of Sapa's co-suppliers, Stålov AB, a workshop specialized in aluminum roll-bending, described the mutual dependency of Sapa and its co-suppliers during an interview:

A lot of people say that it sounds frightening to be in our shoes, but it is not as bad as it sounds. Sapa's operations are spread out across many different markets and customers, which often means that if you have a decrease in one market there is an increase in another. [...] We saw this during the construction crisis [early 90s] when we had filled up our losses of activities in that market with other activities in other markets in less than half a year. In addition, the dependency is mutual. Sapa cannot bring home all that we produce here since we are specialists. Also, the policy of Sapa through the years has been to try to stick to 50% outsourced production. In fact, during recessions, they have lost more themselves due to the inertia in bringing home work they have given us, before the business cycle has turned again.

The co-suppliers of Sapa are very specialized and would therefore be difficult to replace. This makes Sapa's supply base quite stable. On the automobile segment demand side, many of the components made at Sapa are part of five- to seven-year contracts between Sapa and its customers. The situation is that if an investment is made in machines or IT, for example, this investment needs to be covered and risks shared through signing long-term contracts. However, on the supply side, the development has been to reduce the supply base even further and let a few large co-suppliers take more responsibility on the supply chain.

4.4.2 The promise of data feed automation and the ETUI project

Since the mid-90s, the IT development at Sapa has focused on the implementation of a system for resource planning. In 1999, Sapa initiated its implementation of SAP R3. SAP R3 is considered one of the leading alternatives in the market for ERP systems. In 2000, only nine months after the project started, the implementation was complete. The implementation of SAP R3 has generally been successful but quite costly, and has concerned not only Sapa's subsidiaries but the whole Sapa Group. In general, an ERP system focuses on the coordination of internal activities integrating and automating different activities in a firm, including the order process, product and supply flow, staffing and accounting (e.g., Shanks and Seddon 2000). Although many operations can be automated by an ERP system, there are still several types of flows of products and supply that range beyond the flow of information within the ERP system at Sapa that need to be managed manually. A major issue at Sapa, especially in its logistics department, related to the implementation of ERP systems and their function, is the sharing of data across firm borders, i.e., between Sapa and its co-suppliers.

Alongside the identification of issues due to information sharing and different ERP systems, Sapa had worked with a few of its co-suppliers in a project called ETUI (Elektronisk Tekniköverföring av Industriella Tjänster). The project was a broad IT project funded by Vinnova and driven by project leaders at Länsteknikcentrum in Jönköping. Within the ETUI project, a two-year project launched in 2001, Sapa found financial support for addressing the problems of shared information. Two key persons were involved in the work with ETUI at Länsteknikcentrum: the project manager of ETUI and the technical project coordinator, both engineers who had graduated from Jönköping University. At Länsteknikcentrum, the ETUI project was a relatively large one that employed a number of people over a couple of years. Apart from staff at Länsteknikcentrum, the project had a steering committee and an advisory board involving persons from Sapa and Sapa's co-suppliers, as well as representatives from other relevant organizations, i.e., Jönköping University and the Swedish Institute for Industrial Research and Development Corporation.

The ETUI project had two major parts. Firstly, the project aimed at creating a model for exchange of contacts between suppliers, primarily within the Jönköping region. A major task in this first part was to create an electronic marketplace using an already existing database containing information about supplier firms in the region. Secondly, the project aimed at testing and developing different types of IT support applications for suppliers within the region. For the second part of the

project, the focus was on the supplier network of Sapa. Based on the issues identified by Sapa, a sub-project under ETUI was created. Within ETUI, the problem was formulated as:

Document Excerpt 12. ETUI – Final report (Source: Länsteknikcentrum: 2004-03-31)

Sapa has step-by-step developed systems support to deal with distribution from co-supplier directly to customer. This has, however, at least partly been done through manual communication within Sapa's ERP system. This has meant that the co-supplier has been forced to feed product information into Sapa's ERP system and its own local ERP system, a task that sometimes has shown to be burdensome. As an example, the number of order positions at Sapa's spray-paint shops can sometimes succeed 17,000 per annum. The ETUI project aimed at finding a technological solution that avoided the feeding of information into two separate systems, and that enabled the firm to go from manual to automated handling.

As noted in the document above, two separate issues were identified. Firstly, the fact that Sapa and their suppliers and co-suppliers did not have the same ERP systems created a series of problems. This caused double work in feeding the two separate ERP systems, i.e., the SAP R3 system at Sapa and the ERP system used by the supplier, often a less expensive and less complex system compared to SAP R3. The work of feeding the system with information had initially been done by each respective firm. However, in 1999 Sapa started to invest in computer screens connected to their SAP R3 system and placed at the suppliers' sites. Thereafter, Sapa demanded that the suppliers feed both systems when they, for example, dispatched supply. This was Sapa's first step in avoiding double feeding. According to both Sapa's logistics manager and several co-suppliers, this idea did not work very well. As the problems with double feeding prevailed, automation was seen as another option. The manager at Stålöv AB, a co-supplier of Sapa, explained why the solution of on-site computer screens had not worked and what he expected from the ETUI project:

We still get our orders by paper. Now, of course there is the way of doing this digitally, but it is still a bit too complicated for us... We have two screens of theirs and we report to R3, I mean report

dispatches, and in addition to that there is an order system that we use as a way to respond to inquiries via the Internet. [...] With a bit of luck this work done within ETUI can allow us to download orders between R3 and our ERP system. The same could also work for dispatch reports. We do the same things in our ERP system as we do for Sapa in R3 so it is double work. It is the savings in this that we are after... we have made a couple of mistakes while doing panic deliveries and remembered to report in R3 but forgotten to feed our own system. In those cases, no invoice is made until we find out that we have made a mistake...

Secondly, another more specific issue in the ERP systems' utilization has been who is responsible, and authorized, to feed the separate systems with data. Related to this, finding ways to develop support for a more efficient distribution has also been an issue that has been part of the current IT development at SAPA. As mentioned earlier, Sapa's management is constantly under pressure from customers to cut lead times and increase flexibility by improving response times in the supply chain. As in many other supply chains, there are things to do to achieve efficiency and effectiveness. Many times in Sapa's production, the final touch on a component is not done by Sapa but by one of their suppliers. For example, this is the case for products that are, as a final step, spray-painted at one of the spray-paint shops associated with Sapa (i.e., either Sapa's own spray-paint shop or a shop run by a co-supplier).

In their work to cut lead times, Sapa's management recognized the opportunity to do so by not having their suppliers return the components to a Sapa warehouse before shipping, but instead dispatching products directly from co-suppliers to customers. To manage this, Sapa's information systems needed to allow suppliers to report directly into the systems used by Sapa's own logistics department. This was, however, quite a challenge. As several other different ERP systems have market shares in Sweden, and ERP supply firms are competitors, there are few – if any – good solutions. The technical project coordinator of the ETUI project expressed the potential savings that could be realized in the project:

What we are doing here is what everyone seems to talk about but no one puts effort into doing. In this project we calculated the expected savings for the total project to be approximately 3 million [SEK] per year. If the investment is 1 million, it's easy to see the potential through calculating the return on the investment.

4.4.3 Introducing the application

When the technical staff at Länsteknikcentrum in Jönköping, the agency in charge of running the ETUI project, received the task of creating a solution to the problem at Sapa, a thorough problem analysis was conducted. Länsteknikcentrum had, together with Sapa and a handful of co-suppliers, applied for funding from Vinnova. The stakeholders in the future application – the ETUI project did not have a ready-made product to consider for adoption – were many. Besides discussions directly with Sapa and representatives of co-suppliers, the technicians also had to collaborate with the two firms supplying ERP services to Sapa and its co-suppliers. In addition, Sapa had a clear picture of how the application should work. According to the technical project coordinator at Länsteknikcentrum in Jönköping, the application needed to perform the following tasks:

Document Excerpt 13. Technical report (Source: Länsteknikcentrum: 2004-01-14)

The problem area can be divided into four major parts:

- *Export/Import of information from/to ERP system A*
- *Data interchange between co-suppliers and Sapa*
- *Adaptation of the different file formats*
- *Export/Import of information from/to ERP system B*

Since the majority of Sapa's co-suppliers had the same ERP system, the task was narrowed down from finding a general solution that could translate several different file formats used in different ERP systems to a solution that allowed file exchange and translation between SAP R3 and one single other ERP system. To avoid double feeding of information into the systems, and to support automated interchange of data used in the two separate systems, each system needed to be able to import and export data, i.e., receive and dispatch data, that came from other ERP systems. Since an import/export function is a relatively standard module in an ERP system, the problem lies not in how to import or export but rather in what to import and export. Therefore, the most critical aspect of the project was the adaptation of the different file formats used in SAP and the other ERP system that was to be selected. Another critical aspect was the infrastructure of the solution. Here, the project

needed to overcome the physical transportation of data, the usage of different types of systems, and other technical hurdles.

An important condition for the technical solution was to keep costs down and keep the application as simple as possible. To fulfill this condition, the solution the technicians at Länsteknikcentrum decided to try was to place the adaptation process 'outside' the ERP systems so the data flow had the system's own format when dispatched from the sender and adapted to the new format before it was imported into the receiving ERP system. For the purpose of file adaptation, a separate server would be used. On this server, each firm had two separate folders, one for received and one for dispatched messages. The plan was to have both firms use the same server, which would be physically located at Sapa in Vetlanda. A major advantage of using such a server solution was that it provided the firms with a neutral platform that other ERP systems could be connected to in the future. To deal with data interchange, which was complicated by the conditions for the technical solution concerning data security, a specific EDI solution (ODEX), supplied by Sapa's ERP system provider Strålfors, was chosen. With this solution, security was ensured through communication over a private ISDN one-to-one network (cf. the Internet – many-to-many). The technical coordinator explained one of the advantages of the technical solution:

The application was pretty simple and the price was around 15-20,000 [SEK] for the technical solution plus a couple of adaptations per co-supplier and when this was presented to them, it was like 'oh... phew..., not more than that...'. These people are used to making decisions that involve machine investments of four to five million [SEK].

4.4.4 An overview of the adoption process

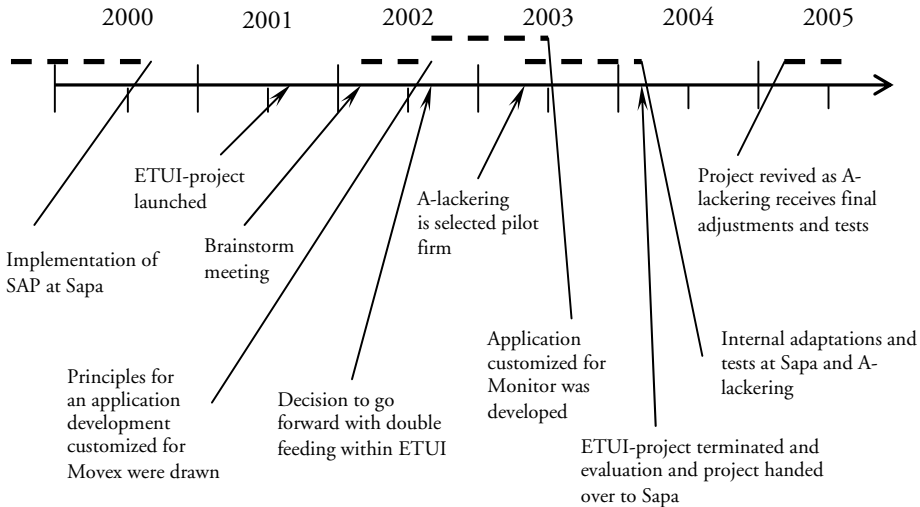
The technical application in this case was the product of a collaboration between Sapa and Länsteknikcentrum in Jönköping. The application did not completely fit the purpose of ETUI, and also was not part of the original ETUI project plan. During the spring of 2002, while running the project, the ETUI project manager found that one of the project legs, that of supplier support, was losing thrust. The project participants only showed half-hearted interest in the activities that had been initiated and therefore a meeting was set up to discuss new activities and possible ways to change the direction of the project so that it suited both the project participants (mainly suppliers to Sapa) and the original project purpose. The idea to try to develop a solution that made file exchange and translation between SAP R3

and other ERP systems possible came up at a brainstorm meeting held during the summer of 2002. The purpose of the brainstorm meeting was to discuss what to do with the remaining part of the ETUI project. The idea of trying to find a solution to double feeding was not new, but was something that had been discussed among co-suppliers of Sapa for some time. From the co-suppliers' perspective, not least those who had trialed computer screens connected to Sapa's ERP system, the initiative was received as promising. The setup with computer screens at some suppliers, which was the first initiative in dealing with double feeding, had not been very successful. Also from Sapa's point of view, this was a project with potential. Sapa had finished their implementation of SAP R3 in 2000, and identifying and reducing costs related to ERP data feed was seen as a priority. It was also a way to continue working with systems support to strategically manage operations and relationships. The logistics manager at Sapa explained:

This was the result of a process that stretched over many years. The project that we called 'double feeding' existed long before ETUI, it was a way for us to take this to a second step, to also address the problem of double feeding. We had our eyes on this since we had completed the implementation of R3 when we saw that this needed to be dealt with - the communication with our co-suppliers and our own external workshops.

At a subsequent meeting in September 2002 that brought together the ETUI project group and a couple of co-suppliers, the ideas presented at the brainstorm meeting were presented to the members of the steering committee of ETUI. During this meeting, a decision was made to go forward with the idea of trying to solve the problems with double feeding. After this meeting the project leader of ETUI gave the technical staff at Länsteknikcentrum, the agency in charge of the ETUI project, the task of finding a solution to the problem. At this time, the co-supplier Pallco AB played a very active part in the setup of the project. Pallco, and especially their spray-painting department, had been very active in the discussions with Sapa regarding double feeding. Therefore, Pallco was considered a prime candidate to pilot the future solution for file exchange and translation between two ERP systems.

Figure 36. Milestones in the Sapa Case

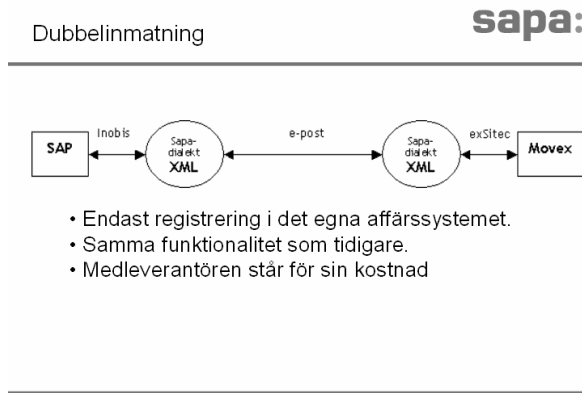


There was a great deal of savings potential in the communication between spray-painting firms and Sapa since the exchange between the firms involved many more order rows and positions than most other supplier communication. When Pallco was presented with the idea of having a computer screen at their shop to feed with data, they were not pleased. A logistics and purchasing assistant for spray-painted products at Sapa explained:

We have a huge flow of orders with a high number of order positions. That's what makes this interesting. There is a lot of work that can be cut down on, on both sides. This discussion started at the time when Pallco was in charge of most spray-paint operations and they did not accept the conditions that were set up when Sapa put out printers and computers at their shop for them to use.

To get around the solution of having two separate systems to report to, Pallco had initiated a discussion with their ERP supplier Movex to find a solution for automated translation. During the spring and summer of 2002, an application customized for Movex had been developed (see Figure 37).

Figure 37. Powerpoint presentation by Sapa at the November meeting outlining ongoing work on double feeding of data, showing the principal idea of the future solution (Source: Sapa Profiler, 2002-09-24)



However, at this time, the management of Pallco had decided to sell their spray-paint operations to a local competitor, a firm named A-lackering. From a project point of view, this was a backlash that would slow down the project. The technical project coordinator of ETUI explained the situation and why they needed to put it on hold:

When Pallco were on their own, they ran the ERP solution Movex. When they were bought by A-lackering, they were careful not to make any unnecessary investments in Movex since they did not know what would happen with ERP since A-lackering had Monitor as their ERP. They said that it was very likely that they would stick with Movex, but that there was a possibility that they would have to change. They did not want to make any investment, and that's easy to understand.

The A-lackering acquisition of Pallco's spray-paint operations halted the ETUI project, since Pallco was seen as a natural candidate to test the solution on. Instead, the project leader of ETUI and her partners needed to find another pilot firm. Project management knew that the pilot firm selection and decision on ERP system used in the solution were two very critical decisions. Therefore, the search for a

pilot firm candidate was based on ETUI's aim at creating a solution that would work for as many of the firms in the Sapa network as possible. The choice of ERP system to target was not Movex as originally intended (e.g., in Figure 37, Movex is mentioned), but Monitor. The choice of Monitor was made based on a survey, issued in January 2003, with the purpose out of determining what ERP system would be suitable to try. The decision fell on Monitor since it was the most commonly used ERP system among Sapa's co-suppliers and suppliers. At Sapa, the change of direction and decision to go for a solution that supported file exchange between SAP and Monitor was seen as positive. A logistics and purchasing assistant for spray-painted products at Sapa explained:

When Pallco worked with this they had Movex. Switching from Movex to Monitor was much more interesting for us since we could cover a significant number of our co-suppliers if we worked with Monitor.

When the decision on which ERP system to develop a solution for came, a discussion with the developers at Monitor was initiated immediately. At this time, the technical solution had started to develop. Two different technical solutions were finally evaluated. In one, the initial investment was somewhat higher but the integration work was somewhat easier. In the other, the initial investment was lower but the solution demanded more work in integration. A major advantage of the second solution was that if the project failed for some reason, the hardware could be used for other purposes and therefore the investment would not be a waste of money. The technical project coordinator at ETUI explained:

The advantage of the solution that we picked was that Sapa could find returns on the investment somewhere else if that would be necessary... they would not waste the money if I can use that expression... they could find ways to use it elsewhere.

When Pallco was out of the picture, a new pilot firm was needed. A logical solution would be, since it was in spray-painting that the most significant savings potential had been found, to try to convince Sapa Lackering AB, a subsidiary to The Sapa Group and sibling to Sapa Profiler AB, to become a pilot in the double feeding project. However, at this point in time, Sapa Lackering was in the middle of the process of making a decision on ERP system implementation. The chances that this decision was going to be made within the time limit of ETUI were very small. Therefore, after a first contact during May, a decision was made in June 2003 to go forward with A-lackering as the pilot firm for the application. At this point, the

technical staff of Länsteknikcentrum in Jönköping had put quite a few hours into the development together with Monitor and Sapa.

The management of A-lackering, a firm situated in Sävsjö not far from Vetlanda with around 100 employees, assigned its logistics manager to work with ETUI. A-lackering targeted their operations at four major segments: construction, sanitary, electronics and automotive. As the Swedish firm name reveals, their main competence was in spray-painting. At least initially, the logistics manager was a bit skeptical of the project. Even though Sapa was an important customer, they were also competing on the spray-paint market with their own subsidiary, Sapa-Lackering AB. The logistics manager at A-lackering made the following comment on their decision to participate:

From our perspective, this is important stuff. I mean, our business, the spray-paint business, has never been anything in these matters. You send an order on the bloody fax machine or bring the aluminum profiles to our door and then someone paints them and then they are picked up and after that you invoice the client. This is how things ordinarily work. On our part, this makes the project interesting. We have an opportunity to get ahead of our competition. We have an opportunity to learn something new.

The skepticism that A-lackering manifested before agreeing to become a pilot firm originated in the history of the IT development at Sapa. Although the firms were eager to try new technology and do something new and the relationship had a very good general atmosphere, a few of the co-suppliers had had poor experiences with Sapa. For example, when implementing EDI technology a few years before, Sapa had put considerable pressure on their suppliers to invest in EDI (e.g., either in or out). The manager of another of Sapa's co-suppliers, Stålov AB, made a clear point of this:

Of course we have felt the pressure. At one point, it was Odette and EDI. At that time, the bosses for automotive and manufacturing at Sapa came to us and told us that if we did not take part in the IT development, we were not going to be considered as suppliers anymore. We had to pitch in 85,000 [SEK] and it was never used. Sapa is using it but it did not work to run it in our relationships. I don't remember the full story, only that it was damn expensive...

A-lackering had strong ties with Sapa Division Systems, a division in the Sapa Group that supplied the construction industry with aluminum profiles. In the ETUI project, they also had contact with Sapa's logistics' overall department. After the decision made in June 2003 to let A-lackering be the pilot firm, both Sapa and A-lackering started to work with internal adaptations. Parallel to their work, the engineers at Länsteknikcentrum started to work with mapping and a translation application. In addition, an investment was made in the server that was to handle the adaptation of the different file formats used in SAP and Monitor. During the fall of 2003, the project had a second backlash. The two focal firms, Sapa and A-lackering, could not agree on how to distribute the costs. Even though many of the man-hours needed for the development were taken by ETUI, there were still investments to be made in hardware and adaptations of the ERP solutions at each firm. Sapa wanted the two firms to share the costs, but A-lackering was not very interested in distributing the costs on these terms. Sapa's logistics manager commented on the situation that escalated just before Christmas 2003:

We saw this whole thing as an experiment. Our idea was to try a project like this with a third party [ETUI] running things and where Sapa was going to act more neutral than we perhaps had done before. So, we never showed any attitude or told anyone that 'if you don't'... [...] However, projects like these sometimes need to be managed with force. To speak clearly, we have a supplier that is throwing costs on us and are acting rather reluctantly... ETUI had a rather slim chance of pulling this through before the end of 2003...

After the arrival of the new year in 2004, a couple of things changed the conditions for the double feeding project. First of all, the time frame of the ETUI project was initially to run until the end of June 2003. With new money arriving during the spring of 2003, the project timeline was stretched to January 2004. Since the project was coming to an end, the responsibility for the technical solution that had been developed had to be transferred to Sapa from the team of engineers who had developed it at Länsteknikcentrum in Jönköping. Second, at the time when Sapa took over the project, Sapa and A-lackering had come to an agreement on how to distribute the costs. Therefore, with all arrangements in place, the implementation could start and test drives were initiated in early March 2004. Although the first test files initially did not work as expected, both Sapa and A-lackering predicted that the adaptations needed would be fixed shortly.

During the summer of 2004, the double feeding project was still not in operation at A-lackering. The final implementation had run into some minor problems, but the

implementation work was still being conducted. After returning from summer vacation, the logistics manager at A-lackering ran a couple of additional tests to send data files. At that point, the focus was to make the application deal with data flow in both directions: orders coming from Sapa to A-lackering and data concerning dispatches coming from A-lackering to Sapa. After the ETUI project was closed, project management was left to the logistics manager at Sapa, who in his turn left Sapa for another automobile supplier half a year later. Therefore, a couple of months after the ETUI project was finished, the responsibility within Sapa to deal with the double feeding project was handed over from Sapa's overall logistics department to the more specialized subsidiary of the Sapa Group, the Sapa Division System. When the logistics manager at Sapa handed over the responsibility to the technical staff at Sapa and to the Sapa Division System, he made the following comment when interviewed:

I've signed off on the coverage of the matter and when I dropped it, there were only a couple of small things left to solve and the solution was in use as planned.

However, although it seemed that the implementation of the application had almost been reached during spring 2004, the situation at Sapa changed again during the spring and summer. This time, the drive for change was on another level. After a few minor incidents and a growing general concern for communication security, The Sapa Group had issued a policy concerning security of their communications through internal and external networks on all levels. This policy involved the notion that Sapa was to be very careful in data exchange with external parties and, for example, should direct all data flow through firewalls. This policy reached the logistics manager, who the following point:

Things are getting tighter with security after one realized that there had been insufficient security. With the type of computer viruses we see today, although we have not been badly hit, there have been a few attacks. This affects projects that work with these customized or individual solutions like the solution developed within ETUI. As it seems, the general trend is to move toward standardized solutions and this affects our connections with suppliers and not just A-lackering. Therefore, we need to have another go at the work we have done with our suppliers during the past three years. It's not primarily about functionality. It's about security and all the technical features.

Together with the policy on communication security and its consequences for data exchange at Sapa, a new project was also started concerning implementation of a new production planning module connected SAP during 2004. This task involved people who had also been involved in the implementation of the double feeding application, i.e. programmers and system developers. According to the logistics and purchasing assistant for spray-painted products at Sapa, work with the policy and the new project on product planning had higher priority than the double feeding project. The purchasing assistant made the following statement:

It seems to be a constant fight between departments on which project we should prioritize. As it seems, what we are fighting for is the limited time that programmers and technical staff have for this type of thing.

During spring 2005, two years after the selection of A-lackering and one year after the ETUI project had been finished, there was still no permanent use of the application. In May 2005, an answer on the test files sent to Sapa in 2004 was received. Receiving these files was the first sign of life in the project since 2004. As it seemed for both Sapa and A-lackering, the project had run aground. The logistics manager at Sapa, having almost lost faith in a final implementation ever being reached, expressed:

We have just recently received files from Sapa to import. This is what makes this project interesting. This is where our savings potential is. This has been going on for some time now, all this seems to have been halted by other things happening at Sapa. For some time, everything was quiet. I received a new file in May and this file has been imported recently. We've had a server change here, which made things a bit slow, but now it seems to work quite well. What is left is that I'm waiting for a report from our local ERP consultant. We are down to details that are left when the results are back and when this report is processed.

To his surprise, the project had been brought back to life after almost a year of silence. He expected the application to be implemented before the end of 2005. The logistics manager at A-lackering finally commented:

I think we have reached the point where we are so close to implementation that we actually will reach our goal. We are still

waiting for feedback from Sapa but really, the quality and format of the information that we send to them is their problem. Honestly, my hope is that we will get our orders in a format that lets us get rid of double feeding and I think that this will happen soon. I have been skeptical but I think now that one important reason this is all happening now is that it was left to Sapa Division System to take over and finish the implementation.

4.4.5 Within-case analysis: drivers and barriers in the Sapa study

Although the atmosphere in the relationship between A-lackering and Sapa during the time of the ETUI project was at times frosty, the two firms seemed to agree that in order to stay competitive, the supply network of Sapa needed to cut lead times and response times. For Sapa, the automobile industry was a key future market. In order to be successful, Sapa needed to develop an application that outclassed previous solutions between themselves and their co-suppliers. Sapa's management was constantly under pressure from customers to cut lead times and increase flexibility by improving response times in the supply chain. The dissatisfaction with the solution with computer screens connected to SAP R3 placed at the suppliers' sites made Sapa management consider other solutions, as this was not a sustainable solution. The logistics manager at Sapa saw participation in the ETUI project as a timely opportunity to use the resources available for application development. From a supplier perspective, A-lackering found it interesting to participate in the project, not least to learn more about data feed automation in order to exploit this knowledge in other business relationships as a competitive advantage. This points toward an important empirical observation in the case of Sapa Profiler and the promise of data feed automation, and this observation is that the process of adoption, i.e., obtaining acceptance of an application, seems to be intimately interconnected with the development and design of the application.

The ETUI project experienced a few problems in the collaboration between Sapa and A-lackering. These problems seemed partly a result of unclear boundaries of responsibility of the development of the double-feeding application within the ETUI project, especially in the latter part of the project when things became concrete in the form of investments. After the decision on what solution to adopt, the firms involved could not agree on how to distribute the costs in the project. ETUI assumed a significant portion of the costs, but not all. In January 2004, the ETUI project was terminated and the technical solution that had been developed was transferred to Sapa. This meant that the momentum of the project was in the

hands of the two firms involved. At first, this seemed to have had a positive impact on the adoption process in the sense that at this time the two firms agreed on how to distribute costs and initiation of tests occurred a few months later.

Table 15. Organizational levels and drivers and barriers in the case of data feed automation at Sapa Profiler

	Drivers	Barriers
Industry network level	<ul style="list-style-type: none"> - Need to cut lead times and response times in supply chain. - Industry growth. 	<ul style="list-style-type: none"> - Development of various systems to solve problems of double feeding, especially from ERP suppliers.
Relationship level	<ul style="list-style-type: none"> - The development of an application that automated double feeding would outclass present alternatives. - External support for the project from the ETUI project. 	<ul style="list-style-type: none"> - Unclear how to distribute the costs in the project. - Unclear boundaries of responsibility in the development of the application.
Buyer level (Sapa Profiler)	<ul style="list-style-type: none"> - Need to find a new solution for co-suppliers to enable supply transparency. - Interest in experimenting with a development project run by an external party. 	<ul style="list-style-type: none"> - Policy issues on how to handle external data within the Sapa Group. - Priority of other ICT-related projects, especially the implementation of updates in SAP R3.
Supplier level (A-lackering)	<ul style="list-style-type: none"> - Interest in developing the ability to handle double feeding. 	<ul style="list-style-type: none"> - Previous experiences with ICT implementation in collaboration with Sapa.

Sapa was clearly a driving force in the development within the ETUI project. The idea was initially theirs, and they took over responsibility for the project when the ETUI project was terminated. For Sapa, it was important to find a good solution to a problem they had worked with for quite some time. The adoption did, however, meet barriers from within the firm. Two major barriers can be outlined. Firstly, policy issues on how to handle external data within the Sapa Group made the double-feeding application difficult to implement. Secondly, a new project on product planning had higher priority than the double feeding project. This project was launched after the double-feeding project but the stakes were much higher and therefore the project received higher priority. From the supplier perspective, the management at A-lackering was first quite skeptical of the project, not least because of their previous experiences with Sapa in other ICT implementation projects. In addition, the lack of momentum in the project did not strengthen their commitment to participate. A-lackering was, however, as manifested by the logistics manager, eager to participate in a project like this since it presented an opportunity to try something new that could improve their position in terms of technical

support of customer relationships. The drivers and barriers in the Sapa study and in the case of data feed automation in the Sapa study are summarized in Table 15.

4.5 Nässjötryckeriet and the promise of electronic procurement

The fifth and final case takes its starting point in the promise of electronic procurement and, specifically, the promise of electronic auctions, with a focus on Volvo Cars and a supplier of indirect materials called Nässjötryckeriet AB (Nässjötryckeriet). The establishment of Nässjötryckeriet dates back to the 1920s. Even though the company has expanded geographically over the years and invested in three sales offices - one in Gothenburg, one in Stockholm and one in Malmö - the headquarters and most of the production activities have stayed in Nässjö. Most Swedes are probably not familiar with Nässjötryckeriet and its activities, but their products are surely known. Nässjötryckeriet prints the widespread self-assessment tax return form (självdeklarationsblankett) and the popular Bingo lottery ticket (Bingolott). In 2003, Nässjötryckeriet had somewhat more than 200 employees and an annual turnover of SEK 468 million (see Table 16). Nässjötryckeriet is a subsidiary to Condi Print Tool AB in Nässjö, a firm that in its turn owns Nässjötryckeriet alongside a few other co-located firms in the printing business (e.g., NT Vårdetryck AB and NT Mediaprint AB). Condi Print Tool AB is part of the Herenco Group, an important actor in the Swedish media industry.

Table 16. Nässjötryckeriet: Firm data (Source: Affärsdata, www.ad.se)

	2001	2002	2003	2004
Turnover (in MSEK)	495	526	468	256
Employees	208	214	206	169
Net result (in MSEK)	0.95	4.7	3.8	12.3

During its more than 80 years in the printing business, Nässjötryckeriet has experienced a great deal of change in the industry in which it operates. Although most of its customers are still found in Sweden, recent developments in both product and process have transformed the graphics industry from mainly a local

handcraft to an international and at least partly digitized market. Quite a few Swedish firms have tried to outsource parts of their production to low-salary countries in Eastern Europe, causing an increased pressure to cut costs in production in order to keep up with diminishing margins for firms like Nässjötryckeriet, which has kept its production in Sweden. The marketing dimension has also turned international, with marketing and competition for bids having spread outside Sweden. In addition to the changes in competition and the internationalization of the industry, the general development of ICTs has also affected the printing business. For Nässjötryckeriet, ICT has changed the prerequisites for not only production but also the distribution of printed products. Two such innovations in the industry are on-demand service and electronic forms and documents.

Since many of Nässjötryckeriet's customers have long-term contracts with sequential call-offs on printed products, the relatively standardized order process has been automated to a great extent. For Nässjötryckeriet, this has been developed under the concept "*print on demand*". Through a product called SmartPrint, customers can order a number of products via the Internet. Print on demand means lower costs for storage and shorter lead times as products are often produced on standardized and predetermined templates. When printed on demand, products are delivered within three days compared to a week when ordered by any other means. Around 2000, Nässjötryckeriet acquired the capacity to offer forms available via the Internet as e-documents, for either printing locally or distribution between computers. This capacity seemed necessary in order to offer customers a full range of products. Also, since a few years back, Nässjötryckeriet has offered a concept called SmartDoc. The website of Nässjötryckeriet reads:

Document Excerpt 14. Product description of SmartDok, Nässjötryckeriet, (Source: Nässjötryckeriet, www.nassjotryckeriet.se, 2005-09-30)

SmartDok is Nässjötryckeriet's software for the design and distribution of electronic forms. The form can be provided with logical functions which automatically make sure the form is correctly completed, perform calculations, etc. The form can be made available via the Internet/intranet for either printing locally or distribution between computers.

In addition to product-related ICT, the development of ICT support, the management at Nässjötryckeriet had experienced an increased need for the firm to be prepared to supply customers with not just printed products, but also a complete offering including e-enabled components in both products (i.e., electronic forms), and the supply of the products (i.e., administrative routines or distribution). In 2004, after quite a few years of development work, Nässjötryckeriet has acquired many of these capacities. As customer interest in using new technologies like the Internet grew stronger, the demand for new types of printing services with e-components increased heavily in 2000 and onward. A business area manager at Nässjötryckeriet expressed the following concerning the development of new technology and the ways in which the firm stayed competitive:

We value IT as an important component [of our business]. Our position is that we are one of two leading firms in our market. And we target the customers we want; the customers for whom we become a leading firm in our branch are actually big firms that demand a supplier that can offer breadth. To be a partner [that will be taken into consideration by big firms], it is as important to be good at those emerging e-commerce functions as well as to produce the pieces of paper we produce here. There are many suppliers out there that can produce pieces of paper, what makes us competitive is that we offer a complete solution.

4.5.1 The relationship between Nässjötryckeriet and Volvo Cars

If a firm on a regular basis needs to send goods to another firm in an efficient way (e.g., sequentially produced components that are shipped to be assembled into a vehicle), the goods need to be marked with proper and standardized labels including the names of the sender and receiver, weight and number of packages. In addition, some form of content specification (see, for example, Figure 38) is necessary. Traditionally, firms have used consignment notes to handle the need for appropriate transport documentation. A consignment note is a document whose structure and design is specified by the firm responsible for the transport, i.e., firms like DHL International GmbH or Schenker AG. Not many years ago, however, around 1999-2000 when the new ST transport label was introduced, Nässjötryckeriet had more than three quarters of the market share of traditional consignment notes in Sweden.

Figure 38. Example of batch identification and transport documentation at Volvo Cars Torslanda (Source: Volvo Cars Corporation, 2004-10-07)



Since 2000, the development trend in the industry seems to have been to replace the old consignment note with new improved STL transport labels. An STL transport label is a standardized transport note system with a number of types of transport labels that are used for scanning of goods in an EDI-based system to transfer information all along the supply chain. Compared to the old consignment note, which only a handful of firms in Sweden had the capacity to produce, the new transport label can be supplied by several printing firms. The Swedish Freight Association comments on the STL transport label on their website as follows:

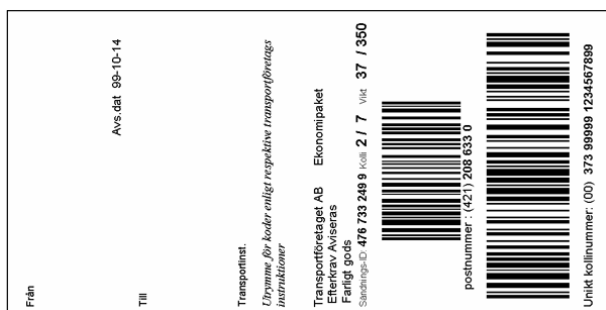
Document Excerpt 15. Description of STL (Source: Swedish International Freight Association, www.swedfreight.se, 2005-06-07)

All leading suppliers of transport services in Sweden have decided to support the standard and to adapt it to their proprietary systems. The label simplifies transport administration, especially for large customers that earlier used a different labeling system for each transport supplier. The result is considerable savings in time and money.

Nässjötryckeriet produces both the traditional consignment note and the new STL transport label. According to its management, there are two main reasons the consignment note is more lucrative for Nässjötryckeriet. Firstly, Nässjötryckeriet is

one of few producers of this product in Sweden. Secondly, the product is complex in the sense that it demands a great deal of paper and requires many man hours in production. However, the STL transport label is on the other hand a very simple and low-cost product. Both the consignment note and the STL transport label are standardized products. One buyer of consignment notes and transport labels is Volvo Car Corporation (Volvo Cars). Although Volvo Cars is neither the largest nor the most important customer of Nässjötryckeriet, the size of operations makes their purchases large in volume and therefore important to keep. Although the range and volumes of products that have been sold have varied over the years, the relationship between the two firms has proven to be very stable and in 2004 Volvo Cars had been a customer at Nässjötryckeriet for over 15 years, a respected and appreciated one. From 2000 and onward, not least due to the changes in demand for transport documentation, sales to Volvo Cars have been declining substantially.

Figure 39. Example of a STL transport label (Source: Swedish International Freight Association, www.swedfreight.se, 2005-06-07)



The administrative manager of Nässjötryckeriet commented on the market for transport documentation:

We have certainly lost some business here. A couple of years ago we were pretty much alone but since the introduction of ST sometime around 2000 the demands for traditional transport documents have declined. The ST label is a very simple product. We do some punching but most of the printing is made by the customers themselves. [...] We are not alone on this market anymore... only in Sweden there are about 50 producers that have the capacity to produce these labels.

In addition to indirect materials like transport documentation, the operations at Volvo Cars require a number of printed products (e.g., forms, labels, brochures, manuals). For Nässjötryckeriet, potential volume customers like Volvo Cars were attractive. According to Nässjötryckeriet, having one of the largest Swedish firms as a customer reference was really worth the effort. In fact, the management of Nässjötryckeriet felt the relationship had so much potential that they were interested in developing it further. A couple of things pointed at this willingness. For example, the relationship with Volvo Cars was the type that would suit a few of the form management systems that Nässjötryckeriet had developed and were quite unique in supplying to the market for printed products in Sweden, and Volvo Cars had the need to buy a range of products in relatively large volumes. For example, the sales department at Nässjötryckeriet had noted that Volvo Cars, like many other of their other large customers, had problems with disorganized maverick buying (e.g., van Weele 2002) on the business-unit level (i.e., purchasing without long-term contract). To solve this problem and make the procurement of printed products more efficient, Nässjötryckeriet had the capacity to offer a broad range of printed products and could also offer a number of digital products, which meant that they could supply Volvo Cars with basically all they needed and also support the efficiency at Volvo Cars in procuring these products. The area manager of Nässjötryckeriet explained how the firm tried to deal with the changes in the industry and keep customer relationships:

The electronic forms business is a market that we are active in. In our traditional business, the general trend is that we see a transition toward keeping the forms in digital format. To capture some of these business deals, we act on this. With many of our larger customers, Volvo is one example, we are already doing this. They're looking for a partner that can solve it all. A partner that can both solve these demanding volume paper products and also do the easier stuff and be helpful in converting paper products to digital products. I mean, for every digital deal we can obtain, we lose a physical deal.

At Nässjötryckeriet, the ambition was to become a systems supplier of printed products only with certain selected customers. The concept of system supplier meant that, as a step of reducing the supply base, one or a few suppliers are assigned the responsibility to supply systems (i.e., all printed products) rather than single components (i.e., a single type of document or form). Without a certain volume, a supplier would not be considered as a candidate for close relationship and integration. In 2003, the relationship with Volvo Cars did not reach such volumes.

4.5.2 The promise of electronic procurement

Although Volvo Cars has long expressed the explicit ambition (e.g., communicated through purchasing policy documents and corporate web sites) to develop long-term-oriented supplier relationships built on trust, involvement and continuous improvements, the attitude from the automobile manufacturer has changed somewhat over time. According to Nässjötryckeriet, the tone had especially changed regarding procurement of what Volvo Cars considered to be standardized or indirect material. This partly had to do with the development of electronic procurement (e-procurement), that is, using ICTs in the purchasing process. The implementation of e-procurement within Volvo Cars during the time of the Ford Motor Company (Ford) acquisition of Volvo Cars in 1999 should be considered in the context of the strategic efforts at Ford to change its purchasing orientation within a development program called eVerest. According to the project, the key to efficient procurement of both direct and indirect material (at Volvo Cars called production and non-production procurement) was to centralize and digitalize the function across all firms in the Ford group. A project leader in charge of Volvo Cars' transition to the eVerest program expressed:

These things take time you know. Just within Volvo there are a lot of things to do. We have managed to implement these ideas to 60 or 70%. Our employees are going to work paperless. They order via computer, the order goes to the buying center via computer, the suppliers get the order via computer and they deliver and send a delivery confirmation via computer, we pay via computer. [...] This is a giant step and we are still learning... [...] Just a few years ago, we were highly decentralized. Every factory had its own purchasing department and its own system. We had about five to ten different systems that we worked in.

Within e-procurement and e-commerce, one application that had received significant interest was the electronic auction (e-auction). At the time of the launch of eVerest, using e-auctions in procurement was very promising and very much part of the future for both Volvo Cars and Ford. Within the Ford group, Volvo Cars was, even though they were a relatively small firm compared to other firms in the group, at the forefront exploiting the promise of e-procurement. Both Ford and Volvo Cars put a great deal of effort into e-implementation during the hype years following the commercialization of the Internet. The size of Ford caused their case to be carefully studied by their environment – they were market leaders and many

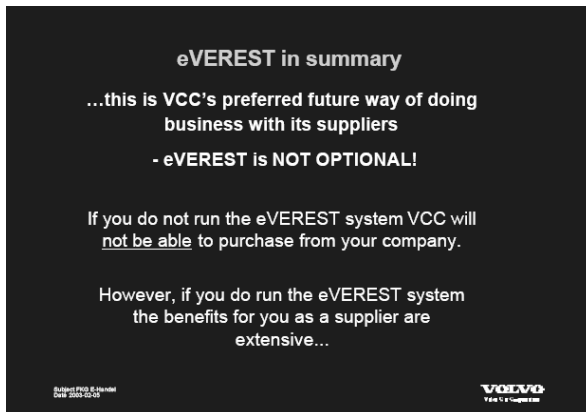
followed their example. According to a group manager of purchasing development at the Volvo Cars headquarters in Gothenburg, the first e-auctions within the group of firms constituting Ford were held at Volvo Cars in 2000. At this time, the message was clearly that e-auction was an application that was here to stay, and the belief in the superiority of e-auction as a procurement tool seemed rock solid.

The rhetoric used by Volvo Cars and Ford in these matters was sturdy. A top executive at Volvo Cars expressed the standpoint clearly; this was something they demanded that their suppliers adopt:

Volvo demands that suppliers make a bid for e-commerce via the Internet [...]. This is a message that is communicated to all the suppliers to firms in the Ford Group. Suppliers that do not learn and apply will be left behind and will risk going out of business.

The quote above is seemingly typical. Either suppliers conformed to the demands made by the buying firm or they would no longer be considered as suppliers. Another example is the signal given at the presentation by a purchasing director at Volvo Cars during an e-commerce seminar in Jönköping in 2003, as shown in Figure 40.

Figure 40. eVerest project in summary (Source: Volvo Cars Corporation, 2003-02-05)



The key benefit of e-auction is the way it enables the creation of a virtual market and finding the optimum price, regardless of whether the e-auction is initiated by a seller (traditional forward auction) or a buyer (reverse auction). E-auctions are certainly the applications that have received most attention in e-commerce during recent years and the fastest growing segment of e-commerce (e.g., Bidgoli 2002). Firms that have successfully implemented e-auctions have reported significant benefits. For example, the Swedish telecom firm Ericsson has assessed that 30% of their total spends were suitable for e-auctions and that the already performed e-auctions had generated 15-20% savings in procurement volumes and significantly reduced negotiation times for purchasing (Hultman and Axelsson 2005). Savings of this magnitude ought to be attractive to any firm. According to Volvo Cars, a couple of successful e-auctions were conducted during 2001 and onward. The former vice president of Volvo Cars, at the time of the study in charge of purchasing, commented on the promise of electronic procurement when interviewed:

We provided our purchasing department with the tool and they were perhaps not that enthusiastic. We made sure all suppliers had the same prerequisites and that put enormous pressure on our purchasing department to make sure all documents were provided to our supply base. We managed to conclude a big e-auction on machinery to our welding operations in Gent. We had specified the need and created some sort of basis for our demand and then we played a couple of suppliers against each other on this. The deal went for 670 million [SEK]. At that time, the suppliers came down significantly, we brought the deal down 150 million [SEK]. It was a serious European firm who got the deal. That wasn't bad at all.

From Volvo Cars' point of view, e-procurement carried a promise of improved procurement processes. At a conference in Jönköping in 2003, a number of benefits for both them and their suppliers could be listed and discussed: reduce handling of paper, have all information available online, automate and speed up transactional dealings, reduce costs and so on. Although many of the promises presented by Volvo Cars at a conference in Jönköping may very well be valid for those willing to auction, many suppliers think of e-auctions as a considerable threat to their business. As an illustration of the concerns in the industry, the European association of automotive suppliers, CLEPA, issued a common statement on reverse auction conduct together with its Japanese and North American counterparts in 2003:

Document Excerpt 16. Press release from CLEPA (Source: CLEPA, www.clepa.be, 2003-10-23)

The issues of greatest concern at yesterday's meeting were twofold - not only to increase mutual understanding and cooperation among suppliers, but also to develop interdependent original equipment manufacturer (OEM)-supplier relationships in order to promote the further sound development of the automotive industry as a whole. It was agreed that building strong OEM-supplier relationships involves a comprehensive mutual understanding on both sides of shared issues.

From that standpoint, meeting participants resolved to establish common guidelines on e-procurement and the conduct of so-called reverse auctions (wherein supplier bids are solicited by OEMs through electronic exchanges) as applied to the OEM-supplier business model. In addition, a preliminary review and discussion was held on the terms and conditions included in purchasing contracts with OEMs.

In 2003, CLEPA also published industry guidelines on the matter, These were primarily a reaction to concerns that e-auctions would be used for other purposes than intended, for example that the buyer would by force use e-auctions to collect market data without any real intention to reward the winner of the auction.

Document Excerpt 17. Global automotive industry guidelines for the conduct of reverse auctions (Source: CLEPA, February 2003)

Conclusion: These guidelines for the conduct of reverse auctions have been developed because the auction can be abused by both buyers and sellers to the disadvantage to the other party. When a tool provides a potentially unbalanced advantage to one party over another, significant concerns quickly raised concerning the integrity and value of the process. During the period where individuals and companies are adjusting to this new tool, it is important that consequences for deviation from these guidelines be defined and enforced by the various stakeholders. Questionable behavior will be discouraged as a result of the entire industry commitment to these guidelines and will become

self-policing. A non-conforming buyer might find there are few, if any, sellers willing to participate in future auctions.

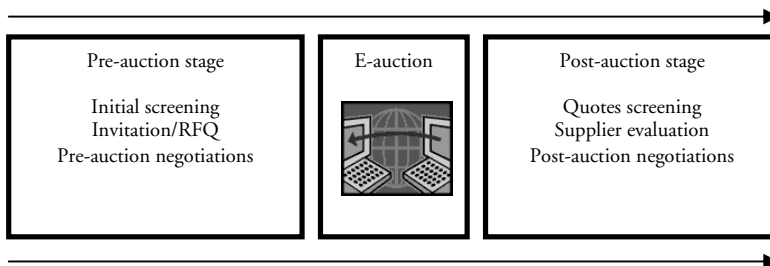
Despite the concerns in the industry, e-auctions answered the demands of Volvo Cars to put additional pressure on suppliers. According to purchasing at Volvo Cars, this was a pressure that should always be sensed if you supply to them, even though it might impede an established and well functioning relationship. A statement made by a group manager of purchasing development at Volvo Cars shows our point:

If it [e-auctions] risk a good relationship? Well, of course it is uncomfortable, [...] A good purchaser should, in principle, have one supplier who supplies all one needs but make this supplier feel a constant threat [of being replaced].

4.5.3 Introducing the application

An e-auction is an auction made accessible for participants over the Internet. Through this, the number of potential users increases immensely. What is needed is access to the Internet, which many firms in Sweden in fact have today. To enter the e-auction, a password and a login are usually needed. This is a way to make sure that it is only those authorized by the initiator of the e-auction who place bids. A reverse e-auction can be divided roughly into three phases (Figure 41).

Figure 41. Stages of a reverse e-auction (Hultman and Hertz 2005)



Firstly, a number of firms are invited to participate. An invitation is made on the basis of an initial screening of potential and known sellers. At this point, it is also

possible for the buying firm to perform pre-auction negotiations in which, for example, certain criteria can be laid out. Secondly, the auction is performed. There are a number of ways to perform e-auctions (Bidgoli 2002). Regarding the bids that are placed, prices can be either ascending or descending and bids can be either sealed or open. In addition, bids can be placed asynchronously over a defined time (i.e., a week or two with days/hours left showing on each auction item) or synchronously with a shorter defined duration (i.e., all bidders in front of the computer for an hour or more). Participants' identities can either be sealed or revealed. In addition, the offer that sellers bid on can be either divided into smaller pieces or defined as a single item. Thirdly, after the auction is performed, some form of post-auction stage is entered. During this stage, the bids that have been placed are evaluated and additional contacts and clarifications can be made.

4.5.4 An overview of the adoption process

The invitation to start doing business using e-auctions in the relationship with Volvo Cars came as a surprise to the management of Nässjötryckeriet. The first contact regarding electronic procurement was made in 2002. The invitation to start doing business electronically was embedded in a request from Volvo Cars regarding their purchase of printed products. The invitation was presented alongside with an offer to increase sales volumes. The administrative manager at Nässjötryckeriet commented on the invitation:

The first contact in this matter was made in May 2002. That was one year before the auction. At that time, they sent us an invitation to participate in this purchase and an RFQ. The material was in such bad shape that they had to send out a new version a couple of months later. I think the new documents came during the New Year holidays 2002-2003. [...] The fact that we were invited was seen as very positive. At this time when the first invitation arrived, we did not know that this was to be done through an e-auction. This was first made clear to us when we received the documents in print.

The administrative manager continued:

A lot of documents came to us. It was a gigantic task to go through them. I think we had twelve or thirteen binders of material to go through. And then they had to do it all over again due to the poor

quality of the documents. We cannot make calculations on a photocopy of a form. We need to know more than that.

Although Nässjötryckeriet was initially reluctant to use e-auctions, and although the invitation from Volvo Cars had to be resubmitted because the quality of the documents was not good enough to make accurate calculations, the invitation was too good to turn down for several reasons. First of all, the relationship with Volvo Cars was important to nurture. The management of Nässjötryckeriet did not want to lose the business they had with Volvo Cars. In addition, the deal offered alongside e-auctions would in effect mean that the volumes sold to Volvo Cars would increase manifold. The deal meant either no business at all or to sell printed products to Volvo Cars for approximately € 1 million. Supplying printed products to Volvo Cars under the conditions the new deal prescribed would mean that Nässjötryckeriet in effect would also become a systems supplier to Volvo Cars. Regarding the potential of the Volvo deal, the area manager of Nässjötryckeriet made the following comment:

The way we work right now is to try to diversify our business and to add components and sell our products in blocks. [...] I think that this is our only real possibility to handle this [survive] in the coming years... to sell more to existing customers.

The administrative manager filled in:

We weren't selling much to Volvo at the time of the invitation [...] they had been our customer for fifteen years but they were perhaps not a big customer in relative terms. We made the decision to take part in this auction immediately after our evaluation of the invitation. [...] We were a bit hesitant but there was not much to negotiate. If Volvo wanted to have an e-auction then this was what we had to negotiate with. The auction was an inseparable part of the deal and it was a big deal for us.

After deciding to go forward and accept the conditions in the invitation, Nässjötryckeriet started to prepare for the e-auction. They had some experience of e-auctions in the past with another customer. Nässjötryckeriet formed a group of three to handle the e-auction. Most of the work with preparations and negotiations with Volvo Cars was done by the administrative manager and one person from the sales staff who was responsible for the Volvo Cars account. The group was headed by the area manager. Volvo Cars provided Nässjötryckeriet with instructions and

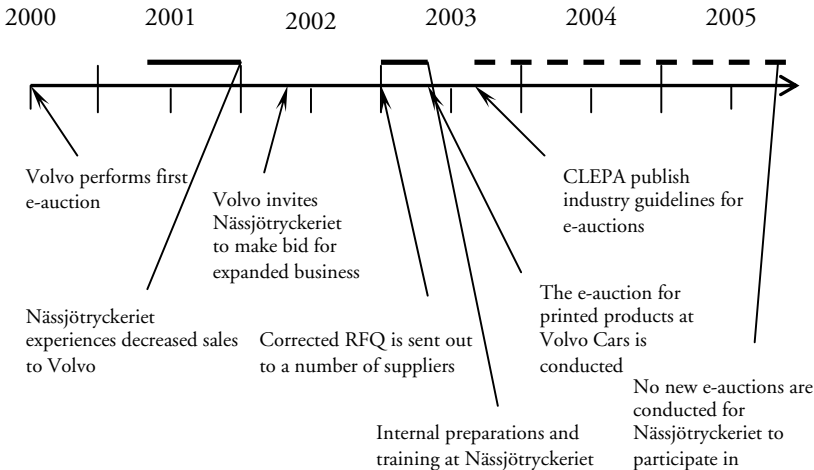
even the possibility to test the auction environment through a dummy version available over the Internet. On the question of whether they had made any investments to be able to start using the auction provided by Volvo Cars, the administrative manager answered:

No, we made no investments whatsoever. The procedure was extremely smooth. We had all the technology we needed.

Although there were not any specific IT investments made in the matter of e-auctions, i.e., Nässjötryckeriet felt that they already had the technological abilities to participate in the auction, a great deal of time was spent on preparing for the auction scheduled for May 2003. The administrative manager estimated the time spent to around two hundred hours, and made the following statement:

There was a lot of communication going on with Volvo at the time. We had the usual communication channels with their purchasing department but also with an IT department that took care of the technical aspects of the auction.

Figure 42. Milestones in the Nässjötryckeriet case



Consequently, many things were still at stake when the time for the auction finally arrived. The auction was scheduled to last one hour. Nässjötryckeriet was the first firm to place a bid. From Nässjötryckeriet's point of view, it was unclear how many counterparts participated in the bidding process. The auction was sealed and the only thing visible for them were the placed bids. Nässjötryckeriet had devised some tactics on how to become the winning party in the e-auction. For example, as a safety measure, they had decoupled the sales assistant from the group at the time of the auction. Also, they had put the area manager in an adjacent room so that any possible bid would be made by someone 'outside' the e-auction, to avoid any rash decisions. With only ten minutes left in the auction, another firm placed a bid that Nässjötryckeriet could not match. According to the administrative manager, the bid was so low that he saw no possibility for any firm to manage this bid without significant financial losses. Nevertheless, it was the lowest and winning bid.

For Volvo Cars, the number of e-auctions performed has decreased over the years. The management at Nässjötryckeriet has not been presented with any additional invitations to participate in e-auctions. Even though Nässjötryckeriet did not wish to relive the experience they had with Volvo Cars regarding e-auctions; they were very well aware of their relative position regarding Volvo Cars and other important customers. Nässjötryckeriet was simply not in a situation to dictate whether a deal should be negotiated via e-auction or not. This decision was in the hands of others. The administrative manager at Nässjötryckeriet made a final comment:

We have not had any e-auctions on our table here since the auction Volvo had in 2003. What matters regarding e-auctions is if this is part of the deal or not. If a customer suggests that we bid on an interesting business deal and one condition is that all this will be done as an e-auction, then that is what they will get. There is nothing more to it than that...

4.5.5 Within-case analysis: drivers and barriers in the adoption process

Looking back at the development of e-auctions as an application for procurement, the interest has seemed to come and go over the years. Linking this back to adoption and the case of Nässjötryckeriet and the promise of electronic procurement, an important observation in the case is the temporary adoption

decision that the management of Nässjötryckeriet made in 2002-2003. For Nässjötryckeriet, the adoption of e-auctions seems to have been only a game to reach short-term goals (e.g., to negotiate a contract) and the decision was strongly driven by the pressure put on them by a single customer on a single occasion. At the time of the study, e-auctions were enormously hyped among both academics and practitioners. The management of Nässjötryckeriet did not like the idea of being played against other suppliers, but valued the possible business as more important than the means of transaction. E-auctions did, however, clash with the relational orientation that the firm had nurtured in their relationship with Volvo Cars and other customers for a few years. The drivers and barriers in the adoption process of e-auctions in the case of Nässjötryckeriet are summarized in Table 17.

Table 17. Organizational levels and drivers and barriers in the case of electronic procurement and Nässjötryckeriet

	Drivers	Barriers
Industry network level	<ul style="list-style-type: none"> - Several external suppliers developing the ability to supply e-auction services. - General hype of ICT tools. 	<ul style="list-style-type: none"> - Critical voices raised against e-auctions as a way to play suppliers against each other.
OEM Group level	<ul style="list-style-type: none"> - Need to follow the trend as e-auctions were reported to grow in popularity. 	<ul style="list-style-type: none"> - Different purchasing cultures among firms in the Ford group.
Buyer level (Volvo Cars)	<ul style="list-style-type: none"> - Will to be a pioneering firm in ICT within the Ford group. - Interest in the benefits of decreasing costs in indirect materials procurement through e-auctions. 	<ul style="list-style-type: none"> - Internal ambiguity toward e-auctions as an effective procurement application.
Supplier level (Nässjötryckeriet)	<ul style="list-style-type: none"> - Pressure to adopt in order to take part in the bidding process that Volvo Cars invited them to. 	<ul style="list-style-type: none"> - The technology seemed to clash with the relational orientation the firm had held on to for quite some time.

At the time of the study, strong pressure to be at the forefront seemed to have pushed firms toward trying to reap the benefits of new means of procurement. Several items in the case point to the fact that Volvo Cars was very driven by Ford to be at the forefront of electronic commerce. The hype also brought forward several external suppliers developing the capability to supply e-auction services. At the same time, critical voices were raised in the industry against e-auctions. The argument was that the application encouraged unethical behavior and unfair competition. One of the key players in this criticism was the European association of automotive suppliers, CLEPA. Although CLEPA realized the power of the

application, it expressed concerns about abuse. As long as guidelines were accepted and used, e-auctions were considered beneficial for the industry. At a conference in Eskilstuna in 2004, the managing director of CLEPA brought up e-auctions as an example when discussing the changing atmosphere in the European automotive industry – changes he saw as worrying and problematic.

Clearly, Volvo Cars was interested in being a pioneering firm in ICT within the Ford group. They were also interested in the benefits of decreasing costs in indirect materials procurement through e-auctions. Although this might be the case, the view on e-auctions within Volvo Cars was not all positive. When analyzing the case of e-auction adoption outlined here, an additional question that needs to be raised is how well Volvo Cars' approach to purchasing system solutions through e-auctions meets the requirement of 'specification' stressed in previous research (e.g., Wagner and Schwab 2004). The view on e-auctions differed greatly among various departments at Volvo Cars. These conflicting views were mainly on the value and effects of e-auctions within established relationships. In the case of Nässjötryckeriet, the purchasing department knew about the complexity of the item to be purchased, but the department responsible for the e-auction (which was not the purchasing department) did not have this knowledge. This ambiguity created problems in the specifications and conduct of the e-auction.

CHAPTER 5

Analyzing information and communications technology interaction

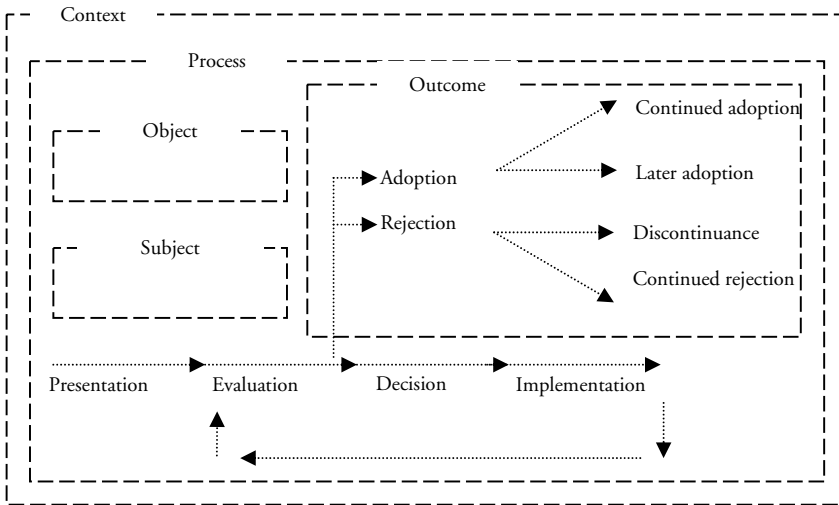
This chapter is divided into five sections. I follow the conceptualization of adoption presented in Chapter 2 and later applied as framework for the collection of empirical materials presented in Chapter 4. I analyze the empirical data across a set of themes derived from my conceptualization. In my analysis I explore information and communications technology adoption in an industrial context in order to build an empirical discussion on which I can challenge prevalent conceptualizations of adoption. In the final section of this chapter, I summarize the empirical exploration by discussing the necessity of rethinking adoption in an industrial context.

5.1 Analyzing the subject of adoption

The purpose of this thesis is to empirically explore information and communications technology adoption in an industrial context in order to challenge prevalent conceptualizations of adoption. In the coming sections I will outline a cross-case discussion on a set of themes derived in the outlined cases of ICT adoption processes outlined in Chapter 4. By showing how the industrial context and its specific and complex characters also affect how adoption processes function, this chapter aims at providing an empirical exploration on which the prevalent conceptualizations of ICT adoption processes can be discussed, assessed and later challenged. When writing up the analysis of my empirical materials, I have at times chosen to focus on unique or typical exemplifications. To facilitate for the reader, each section in this chapter contains a vignette case in which I specifically look into the dynamics and complexities of a particular case. When deemed appropriate, again to facilitate an overview for the reader, I summarize some of the analysis made in cross-case displays where I display and focus on a certain aspect across all the cases. In this first section, I will reflect on the subject of adoption.

The structure of this chapter is based on the conceptualization presented and outlined in the theoretical framework. Therefore, each section in this chapter is devoted to exploration on one of the entities of the conceptualization outlined in Chapter 2. This form of dissection of the empirical materials has been challenging, as the entities of the conceptualization are interrelated and also, to some extent, overlapping. In Figure 43, drawing on the discussion developed in Chapter 2 and specifically in Section 2.1.3, I aim to graphically demonstrate this challenge. In the final section of this chapter, I summarize the empirical exploration by discussing the necessity of rethinking this conceptualization of adoption in an industrial context.

Figure 43. Graphical overview of the entities of the conceptualization and their conceptual interrelatedness



5.1.1 Discussing adoption as a process of interaction

In the literature on adoption, a common delineation made is between organizational level and individual level adoption. It is often argued that the two levels of adoption are intertwined, with adoption then viewed as a two-sided phenomenon with a decision made on both an individual and an organizational level (e.g., Frambach and Schillewaert 2002; Rogers 1995). In addition, the

prevalent conceptualizations of adoption often approach it more or less solely as a single firm problem with external influences affecting the decision to adopt or not. The most established definition of adoption, provided by Rogers, clearly suggests that this decision process concerns a single decision-making unit (Rogers 1995:20). In addition, the adoption-decision process depicted as a process passing the certain stages seen from a single-firm perspective (e.g., knowledge, persuasion, decision, and implementation) is a typical example of this approach. Concerning the subject of adoption, a fundamental question that emerges from an empirical exploration of the subject of adoption in the industrial context as outlined in Chapter 4 is; who is the adopter in the adoption processes taking place in the industrial interactive setting? In order to provide an empirical base on which such prevalent conceptualizations can be challenged, the question of who the adopter is needs to be analyzed further. I will further develop this reasoning using the case of Sapa Profiler and the promise of data feed automation as the vignette case.

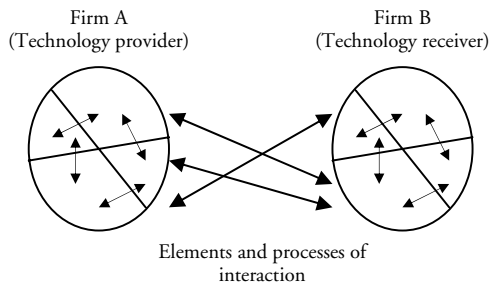
In the case of Sapa Profiler and the promise of data feed automation, Sapa Profiler's purpose was to find a solution for how to improve the way supply data (e.g., order information, dispatch notifications, delivery messages) was transmitted between the two firms. For many years, it had been the custom at Sapa Profiler to outsource several activities in the refinement of the aluminum components to what they called co-suppliers. Since Sapa Profiler and its co-suppliers did not use the same ERP system and since there was not software available that could support automated interchange of data used in the two separate systems, data had to be fed into both systems manually. Sapa Profiler had participated in a government funded project called ETUI that was driven by Länsteknikcentrum in Jönköping and within this project a discussion on developing an application that would avoid double feeding of data into two separate systems. Since an import/export function is more or less a standard module of an ERP system, the problem was not how to import or export but rather what to import and export. Since there was no proprietary solution available, the engineers in the ETUI project working at Länsteknikcentrum had to come up with their own solution. Through the ETUI project and in interaction, an application aimed at solving the problem of automatically translating ERP data was developed for Sapa Profiler and its supply network.

Looking across the empirical findings, an empirical observation that stands out, just as in the exemplification above, is that the adoption process described there is a process involving several firms in interaction. A necessary condition for interaction is that there be more than one entity that is active, i.e., a relationship in which the interaction can take place. Having two or more parties interacting also entails that we might have different perspectives on the technology and its boundaries, on the

process and its outcomes. In the chapter in which I outline methodology, I also discuss perspectives. I argue, for example, that we as researchers could, unlike our respondents, change perspective to the aggregate and thereby look at the whole and its relation to the part. In the literature on industrial markets the network level is a common aggregate of the relationship level (e.g., Axelsson and Easton 1992; Håkansson and Snehota 1995).

In the case of Sapa Profiler and the promise of data feed automation, the two firms in the focal relationship are both active in the development and implementation of the application for handling the double feeding problem. In this case, the initiative to engage in the adoption process was taken 'outside' the focal relationship, by the ETUI project, as the double feeding problem was brought up during a brainstorm meeting with both the ETUI group and a couple of co-suppliers present in 2002. During this meeting, a joint decision was made to go forward with the idea of finding a solution to the double feeding problem rooted in the fact that Sapa Profiler did not share the same ERP system. In this case, adoption is part of a broader interaction pattern taking place between the two firms in the focal relationship, with interaction involving both the exchange of products and services as well as additional interaction with the aim to make the exchange as flexible and efficient as possible. Along the process of interaction that led to the development of an application, the character of the technical solution changed. Also, A-lackering came into the picture during the process as its counterpart firm Pallco, who Sapa Profiler originally planned to pilot the application, sold their spray-paint operations to a A-lackering.

Figure 44. Adoption in interaction in a focal relationship



The case of Sapa Profiler and the promise of data feed automation is not the only case in which interaction stands out as a key feature. On the contrary, interaction is a key feature in one way or another of all the cases in this thesis. An additional empirical observation of importance is how adoption in interaction concerns not only interaction between firms and then the technology receiver and the technology provider constituting a focal relationship, but also s interaction within an organization and in this case between different organizational entities within firms or within firm groups (Figure 8), a situation comparable to the generic descriptions on industrial interaction described in the interaction model (Håkansson 1982:24).

As firms as units in the interaction process are not homogeneous, in the interaction concerning adoption, for example, there can be significant differences in perspectives, roles and interpretations regarding what should be adopted and why. For example, the case of Volvo Cars IT and the promise of shared product data highlights how different departments at Volvo Cars interact in order to overcome the problems of handling collaborative product development. The case also shows how clashes between separate ways of working impeded the implementation of ENGDAT and how the acquisition by Ford Motor Company changed priorities concerning how to handle shared product data at Volvo Cars. In the case of Volvo Cars IT and the promise of shared product data, the development of general principles on how to manage product data exchange within the C3PNG impeded a decision on the implementation of ENGDAT at Volvo Cars. In the next subsection, I will elaborate further on firm position and role, and their bearings on adoption.

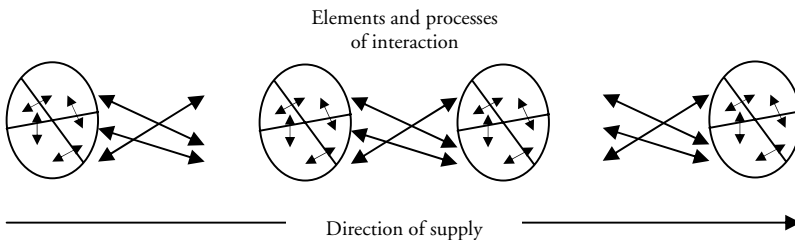
5.1.2 Disseminating firm position and role and discussing its bearings on adoption

By approaching adoption as interaction and the presence and activities of several firms and firm departments and functions in interaction, we also need to take firm position and role into consideration in the adoption process. As shown in the within-case analyses that concluded each case description in the previous chapter, these different perspectives are important in the aim to extend the understanding of adoption in the industrial context. Keeping focus on the view of a focal firm adopting a technology and this adoption being a process of interaction that takes place in a focal relationship, one will be able to see adoption as a single-firm decision but not as a single-firm problem. An empirical observation is that although decisions are made by single firms, these decisions have to be understood as being embedded in relationships including positions and roles. With this in mind, one

could further analyze the cases and look specifically into the focal firm and its position in the adoption process and the focal relationship.

Returning to the vignette case of Sapa Profiler and the promise of data feed automation, an interesting observation is that adoption processes primarily concern a dyad of two firms with separate perspectives - a focal business relationship. This relationship is explicitly identified and discussed in a section for each case in the previous chapter. For Sapa Profiler, the application solving the double feeding problem was a way to bind co-suppliers closer to them. For A-lackering, the adoption of the application was a consent with the motivation to learn more about how to solve a problem that existed not only in their relationship with Sapa Profiler but also in those with other customers. Looking across the five cases of adoption processes presented in the empirical chapter, the focal firm in the cases has one of two roles: either the firm receiving technology under study or the firm providing the technology under study. It is these two roles that define the focal relationship. In addition to this, in accordance with the roles drawn from the buying behavior literature described previously (Webster and Wind 1972), it is also important to understand roles in terms of what role the focal firm has in terms of development, influence, decision and use of the technology. It should also stand clear that the adopting firm, the focal firm, is interacting with its counterpart in the adoption process, as already discussed in Section 5.1.1. In Figure 45, this interaction as well as parallel ongoing interaction in a supply chain is demonstrated graphically. In this view, the interaction concerning adoption is only one process of interaction among several processes of interaction between two firms in a focal relationship. In the following sections in which I discuss and analyze the adoption process and the context of adoption, I examine this embeddedness further.

Figure 45. Adoption in interaction and supply chain position – an exemplification



Approaching adoption as interaction also taking place within a firm or a firm group creates difficulty in attempts to analyze a single view or perspective in the adoption process. In some cases, is it even possible to identify a single unified firm perspective concerning a technology and whether or not it should be adopted? An example of the complexity involved in taking on a certain perspective is the case of Volvo Cars IT and the promise of shared product data. In this adoption process, Volvo Cars IT is the firm providing the technology and Volvo Cars Corporation is the receiving firm. At the same time, through participation in SASIG and other organizations, Volvo Cars IT is also part of the development of ENGDAT. As the case outlines, Volvo Cars Corporation's decision was to avoid technological lock-in and keep the door open for alternative solutions for product data file transfer. In this case, an empirical observation is that the stakes in the technology and the approaches in the ICT adoption process vary within the firm.

Table 18. Cross-case display – firm position and role

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
The focal relationship in the adoption process	Volvo Cars IT and Volvo Cars Corporation	Tidamek and Sandvik Coromant	n/a	Sapa Profiler and A-lackering	Nässjötryckeriet and Volvo Cars Corporation
The focal firm and its position in the adoption process	Focal firm is technology provider	Focal firm is technology receiver	Focal firm is technology provider	Focal firm is technology provider	Focal firm is technology receiver
The focal firm and its position in the supply chain	In-house service provider of IT consultancy	1 st tier supplier of metal machining	Automobile OEM	1 st tier supplier of aluminum components	Service provider of printed products

In the case of Volvo Cars IT as well as, for example, that of Nässjötryckeriet and the promise of electronic procurement, influencers of the decision to adopt include actors connected to the adoption process. In the case of Volvo Cars IT and the promise of shared product data, and also for ICT development in the Swedish

automotive industry in more general terms, key actors are Odette and organizations organizing automotive suppliers locally and regionally. In order to influence and boost technological development in the automotive industry, interest organizations have been part of the development of several important applications and concepts, specifically in questions regarding industry standardization. One such example is the influence that Odette Sweden has had in the development of EDI in the Swedish automotive industry during the past two decades. In the case of Nässjötryckeriet and the promise of electronic procurement, Ford Motor Company is influencing Volvo Cars to push for use of e-auctions in supplier relationships. As shown by Damsgaard and others, for example, the strategies and policy decisions made by the industry groups and interest organizations seem to have significant importance on technological development in the industrial context (e.g., Damsgaard and Lyytinen 2001).

A firm's position in its supply chain could be described in terms of, for example, what type of business it provides in the industry or industries it is present in as well as what relative position or role the firm has in a supply chain (Table 18). One could further analyze the subject of adoption by disseminating and discussing different aspects of position in the adoption process and its bearing on adoption. The focal firms in my cases represent both product and service producers. Although the automotive industry network is a common denominator and general focus point, only one focal firm is an automobile producer and OEM. Two focal firms provide services and two firms provide products to the automotive industry. A common view in the automotive industry is that the automotive component suppliers are dependent on the automotive producers, being relatively few in number and driven by scale advantages implying that volumes are large. This view is present in one case especially, that of Nässjötryckeriet and the promise of electronic procurement. In this case, by introducing the e-auction through a business proposition, Volvo Cars put pressure on Nässjötryckeriet to adopt. The view of the automotive producer as the most powerful in the supply chain has been questioned in more recent studies on the automotive industry as supplier consolidation in the industry has created automotive component suppliers that surpass the size of some or several automotive producers (e.g., Holweg and Pil 2004:71).

If one continues to disseminate the focal firm and its position in the supply chain, an OEM is treated as the focal firm only in one particular case. In this specific adoption process, the case of Volvo Cars and the promise of supply chain transparency, the adoption of SCMo never reached the stage of having a counterpart in the adoption process – a receiver. The project met serious setbacks and the adoption process was halted before Volvo Cars had introduced the

technology for implementation in its supplier network. In all the other cases, although not in the role of focal firm, the Volvo Cars Corporation or any other automotive manufacturing firm is, in its role as OEM in the automotive supply chain, an important actor. Although the cases differ in many other aspects, the cases of adoption in which Sapa Profiler and Tidamek are focal firms, the focal firm is a 1st tier supplier to the automotive industry. The nature of their business also makes them 2nd tier suppliers, as they in some aspects also produce components sourced by 1st tier suppliers to the automotive industry. Both Nässjötryckeriet and Volvo Cars IT act as service providers to the Volvo Cars Corporation, located internally and externally, respectively.

In sum, through an empirical exploration and analysis focusing on the case of Sapa Profiler and the promise of data feed automation, the subject of adoption stands out as a process of interaction and, in essence, a single firm decision but not a single firm problem. Approaching adoption in this way is different from many of the prevalent conceptualizations of adoption in which the adoption decision process is viewed as a single firm problem (e.g., Rogers 1995). In addition, adoption in interaction concerns not only interaction between firms but also interaction within a firm, which in the case of Sapa Profiler and the promise of data feed automation led to problems such as other commitments and processes taking place within the firm sometimes being prioritized. Looking at adoption and considering firm position, one can also see how the adoption process stands out as being embedded in the exchange taking place in a focal relationship or supply chain. The events taking place in this chain, and the positions and roles taken, cannot be overlooked when one searches for understanding of an adoption process taking place embedded in these roles and positions.

5.2 Analyzing the object of adoption

In studies investigating the many variables that may affect adoption on the organizational level, compared to other variables like management support and external pressure, the product characteristics are often and somewhat surprisingly only marginally considered. There are probably several reasons for this, one being that variables like trialability are more associated with individual level adoption studies. For example, Karahanna et al. (1999) studied individual level adoption over time and compared post-adoption and pre-adoption beliefs. One of their findings was that pre-adoption attitudes were based on trialability whereas post-adoption beliefs were based on usability. As individual level and organizational level adoption are closely associated, object characteristics have some impact. In the stream of organizational level adoption studies, technology traits include compatibility (e.g., O'Callaghan et al. 1992) and level of complexity (e.g., Beatty et al. 2001), technology characters (e.g., Power 2005) and the perceived benefits of the object of adoption (e.g., Iacovou et al. 1995) impact adoption. In the following section I will continue to empirically assess the prevalent conceptualizations of adoption by analyzing the characters of the object of adoption in the adoption processes outlined in Chapter 4, further discussing how the object of adoption should be treated in the industrial context. I will further develop this reasoning using the case of Volvo Cars IT and the promise of shared product data as the vignette case.

I have earlier discussed the promise and problems of information communications technology in the industrial context. In Chapter 4, I explicitly used the promise of technology as a starting point in each empirical case. An important observation in my empirical material is the influential and important role of the promise of technology across all cases (Table 19). And, in all cases, some party found this to be something of “a good thing” or a promise. When the discussion on what role this promise of technology plays in the cases outlined in Chapter 4 is extended, a view on the object of adoption emerges as something open for negotiation after an initial agreement of the promise of a solution. As shown in the case of Volvo Cars IT and the promise of shared product data, for example, this promise does not require a given product. In the case of Volvo Cars IT, the promise of ENGDAT had already been formulated in the late 1980s after an investigation of how the automotive industry used and transferred product data that industry actors had issued. At a later stage, after the identification of a shared need across the industry, it was Odette Sweden that initiated the development of a single European standard for product data, later labeled ENGDAT. Detailed planning for the launch of a

standard was initiated in 1992 and the first version of ENGDAT (ENGDAT V1) was launched in 1994.

Table 19. Cross-case display – technology characteristics

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Information technology	File-exchange standard	Extranet application	ERP data exchange concept	ERP data translation application	E-auction
Managerial challenge that the case has its starting point in	Need to handle increasing PD file exchange	Need to channel communication in relationship	Need to enable visibility in component supply flows	Need to overcome double feeding inefficiencies	Need to adapt to customer demands in use of procurement technology
Information technology promise	Boosted communication through a standard data exchange message	Improved project overview and boost communication through a shared collaboration space	Enhanced supply chain overview and boost coordination through shared supply data	Avoided double feeding and boost coordination through automatic ERP data translation	Lower procurement costs and boost competition through price transparency

5.2.1 Considering the nature of technology in the industrial context

Within the domain of business administration, especially the branch concerning the consumer marketing context, a product or, in adoption studies the *object of adoption*, is considered a given ready-made offering, for example a mobile phone, that a consumer can test and evaluate before adopting. Over time, however, those studying the business exchange in the industrial context have come to question this view of offerings as ready-made and given (e.g., Håkansson et al. 2004; Håkansson and Waluszewski 2005). In contrast to the consumer context, in the industrial context ICT could involve complex ICT systems, tailored and adapted to fulfill the needs and wants of a single specific business. In the first chapter of this thesis, I outlined a number of examples of how such technologies could work and what promises they meant for business managers. The fact that technology in the industrial context might mean something different than in the consumer context

has been discussed further by scholars within the domain of industrial marketing. For example, based on a critical evaluation of the concept of product, Håkansson and Waluszewski (2005:113) claim:

[...] the marketing mix model's reduction of the product to a given, basic parameter of the boundaries of the market, appears as rather unfair. Although it is possible, and also probable, that some actors choose to see the product as a given, it can simultaneously be treated as a variable by other actors, with the possibility of being developed due to how it is combined with other resources.

A key conclusion in the literature cited above is the importance of interaction in the industrial context. Reducing the “product”, in this case ICT, to a given would be to delimit the scope of analysis. This view on technology is typical but not unique to the field of industrial marketing, being broadly discussed across many different fields of research in terms of both scope and role (e.g., Orlikowski 1992). Although discussed as knowledge or abstract (cf., artifacts), it is still more or less considered a given before-hand defined problem or solution as discussed by, for example, Herbert Simon (1973:1110):

But to view technology in terms of machines and tangible substances is to mistake the shell for the snail, or the web for the spider. Technology is not things; it is knowledge - knowledge that is stored in hundreds of millions of books, in hundreds of millions or billions of human heads, and, to an important extent, in the artifacts themselves. Technology is knowledge of how to do things, how to accomplish human goals.

In the coming section I will further elaborate on the nature of the technology in the industrial context as the technologies are handled, developed, adopted and marketed in the empirical material. The characteristics of the objects of adoption in the five respective cases are outlined in Table 20. An observation across my cases is that the view of technology as something negotiated, as an alternative to the given, has much potential.

In the case of Volvo Cars IT and the promise of shared product data, the story of the technological application called ENGDAT starts as early the late 1980s. For more than two decades, the general idea of ENGDAT has been to function as a solution to the need for an efficient and safe way to exchange product data in the automotive industry. Although the idea is quite simple, the application is intangible and has many dimensions of complexity. An additional aspect that adds to the

complexity of ENGDAT is that during its course, the adoption process has concerned an application in development. The ENGDAT launched in 1994 is different from the ENGDAT launched in 2004, in terms of both user scope and technical content. At Volvo Cars, ENGDAT is one piece in a larger development of technological development concerning product data management. This development concerns not only Volvo Cars and the European automotive industry and its aim to standardize product data exchange but also, through the acquisition of Volvo Cars by the Ford Motor Company in 1999, the global automotive industry and how product data management can and should be managed globally. With this in mind, a view emerges on the object of adoption as something that can be very complex and also significantly embedded.

Table 20. A cross case display – characteristics of the objects of adoption

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Character of the object of adoption	Standard message to enable structured and secure product file data exchange	Application enabling project planning and communication	Concept enabling data exchange to and from current existing back-end systems	Application enabling import and export of ERP data	Standard application to enable competition through price transparency
Setup of project that developed the object of adoption	Standard message created in European/Global task force followed by sequential adoption by industry actors	Application built on standard Quickplace application and adapted to the specific needs of Tidamek	Concept created by European task force and pilot project driven locally through Odette and the logistics division of Volvo Cars	Application created in joint development project run by Sapa and third party	n/a

Looking across the cases in my empirical study shows that only one of them concerns what could be considered a somewhat a more or less given object of technology. In the case of Nässjötryckeriet and the promise of electronic procurement, Volvo Cars invites Nässjötryckeriet to participate in an e-auction. The e-auction in this case is a sealed reverse e-auction, presented to Nässjötryckeriet as a given product visible on the Internet. In this case, there is no room for

Nässjötryckeriet to negotiate the content of the application; nor is there a collaborative development of the application. Further on, the nature of the application also dictates that there is no room for collaborative development. The application is a given product open for evaluation (and to some extent trial). As noted in the case, Volvo Cars provided Nässjötryckeriet with instructions and even offered the possibility for the firm to test the auction environment through a dummy version available over the Internet. Although the case of Tidamek and the promise of shared project space only include minor customizations, it is still a negotiated product by which Tidamek was part of the development of the extranet solution. In the case of Tidamek, the offer from Sandvik was an application built on a standard Quickplace application and adapted to the specific needs of Tidamek. At the initial meeting at which the pilot study was rigged, the two parties, including the project manager from the Sandvik headquarters, had an open discussion on what features the extranet solution needed to fulfill the needs of Tidamek. At Sandvik, the extranet application has been the point of departure for a discussion how the future interaction with clients should be handled – this process is in all aspects ongoing. The process started during the late 1990s when the firm developed a conceptual demo of how they expected client interaction would work in the future – the concept was named after fictive and virtual Sandvik associate “*Steve Roth*”. In 2004, the project manager at Sandvik responsible for the launch of this collaborative platform commented on the role of the conceptual platform:

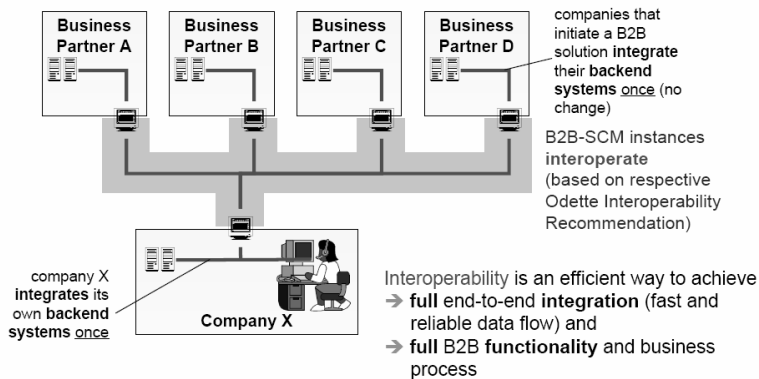
The general idea from the beginning was to focus on the customer and what they really wanted... we started with a blank piece of paper and created a demo... we had Steve Roth ... very futuristic ... we did not really have anything further than that... we did not really know where to start [...] We are still working with the same ambitions... although the ambitions are a bit more sober at this point... we know what systems we need to connect to make this work.

Also in the case of Volvo Cars and the promise of supply chain transparency, the concept, created by the European task force and pilot project driven locally through Odette and the logistics division of Volvo Cars, would be a solution adapted to the needs of Volvo Cars and the suppliers in the pilot study. During the course of development of SCMo, an observation again was that the solution and its technical components are not a given from the beginning. In this case, a key aspect of the promise of SCMo was that it did not demand any specific technological platform. The idea was that operations within SCMo would be based on proprietary solutions supplied by one of the targeted systems providers. The conceptual setup of information flows would, however, be standardized and based on the Odette

recommendations. Yet, as exemplified in the recommendation document issued by Odette, integration does not come without technical adaptation of back-end systems from each party engaging in SCMo, although these changes only need to be made once.

The reason for selecting the development path of having integration with existing systems was that the parties in the relationships in which SCMo was meant to be implemented had made large investments in ERP implementations. Any solution that included a replacement of ERP systems was unrealistic. The development of SCMo as a technical solution that could use data from several systems was therefore seen as the only possible way to establish visibility based on ERP data. With a promise of an interoperability recommendation, the likelihood of success in diffusion was also increased since it made SCMo compatible with all possible ERP solutions with adequate support by the systems provider. Note in the figure below that the SCMo development team emphasizes that the integration with back-end systems would not be changed and would only be done once (Figure 46).

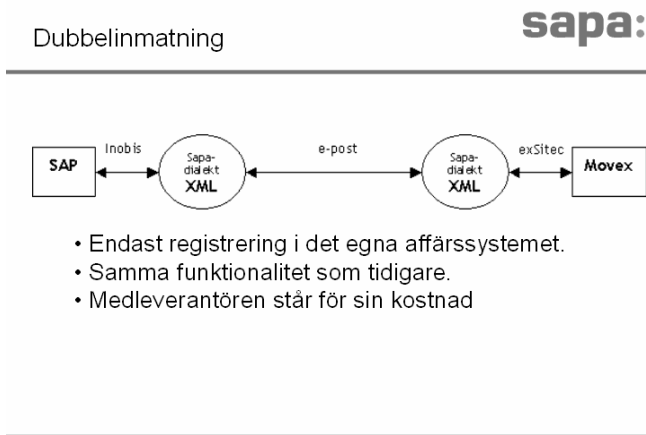
Figure 46. Supply Chain Monitoring V1.0 recommendations - demands for integration/adaptation in the case of SCMo implementation (Source: Odette, 2003-05-28)



In the case of Sapa Profiler and the promise of data feed automation, the situation differed from previous examples. In this case, the adoption process was initiated without a finalized application. At the time of the study, although ERP systems

have export and import functions, no solution for the particular problem found in the relationship between Sapa Profiler and its co-suppliers was available on the market. Instead, the application that would enable the avoidance of double feeding was created in the joint development project run by Sapa Profiler and the third party, the ETUI project. After the requirements of the application were specified, the responsibility for development was handed over to the technical project coordinator at Länsteknikcentrum in Jönköping. The development had its starting point in two broad technical solutions. In one of these, the initial investment was somewhat higher but the integration work was somewhat easier. In the other solution, the initial investment was lower on the one hand, but the solution on the other hand demanded more integration work. The adoption process was initiated with a conceptual model or idea that the project had accepted. This concept was developed by Sapa Profiler and was presented in November 2002. The solution implemented in 2005 was in principle the same as the concept from 2002, but several important adaptations had been made along the way (Figure 47).

Figure 47. PowerPoint presentation by Sapa Profiler at the meeting in November outlining the ongoing work on double feeding of data, showing the principal idea for the future solution (Source: Sapa Profiler, 2002-09-24)



5.2.2 Discussing the overlap between technology development, marketing and adoption of new technology

Returning to the case of Volvo Cars IT and the promise of shared product data, when the idea of ENGDAT was developed by engineers affiliated with Odette Sweden and the European automotive industry, their work was problem-driven in the sense that they recognized the potential of what would become ENGDAT in the development in the industry and how product data management was handled. The first industry recommendation of how the ENGDAT message should look was published in 1994. Since then, two updated versions have been developed. The ENGDAT adoption process involved several different actors in interaction, on several different levels and over time, and did not concern a given technology but a technology under development. Not long after the publication of the first ENGDAT recommendation, work was initiated to improve the application and publish a new version. ENGDAT V2 was in development when the development of ENGDAT V3 was initiated.

As argued by Brown and others in the theoretical framework I have outlined (e.g., Brown 1981), the bulk of research seems to have addressed two aspects of the aggregated diffusion process. Researchers have addressed either the phenomenon by which a technological innovation travels from drawing table to market and how this process is managed (e.g., Burgelman and Sayles 1986), or the phenomenon by which an already invented technology, product or practice reaches the market and diffuses (e.g., Rogers 1995). The prevalent view on the object of adoption as a given is clearly underpinned by this kind of reasoning and division of the phenomenon. As in the case of Volvo Cars IT and the promise of shared product data, not all cases of adoption processes concern proprietary applications. On the contrary, the observation that the adoption processes involved negotiated solutions has implications for how we need to consider the boundaries of adoption as a theoretical concept. In the case of ENGDAT as well as other cases outlined in this thesis, there is an evident overlap between the different processes of technology development, marketing and adoption. Therefore, an empirical exploration shows that these processes should be seen as interconnected and not as separate and isolated processes.

Following the reasoning about the assumptions asserted regarding the industrial context previously presented in this thesis, it seems logical that these characteristics are also valid for adoption processes – and that adoption in interaction involves technologies that more resemble open solutions than givens. An empirical exploration strengthens this view. In several instances of my fieldwork, the cases

describe a situation in which the adoption process is clearly a process of intimate and committed interaction regarding adoption. Several things point toward this. Firstly, except perhaps for the case of Nässjötryckeriet, depending on what we decide on the boundaries of the adoption process, the adoption processes stretch over a significant period of time. The case of Volvo Cars and the promise of supply chain transparency stretches across a number of years after the initiative to develop an Odette task force on SCM in 2001. Already discussed concerning this, the case of Volvo Cars IT and the promise of shared product data stretches back to the beginning of the 1990s with the development of the first version of ENGDAT. The case of Sapa Profiler and the promise of data feed automation started as an idea during a brainstorm meeting in 2002. After changes in the project and a new pilot firm and negotiations between Sapa and A-lackering on how to distribute the costs in the project, the implementation of the application started in spring 2005. The technical project coordinator of the ETUI project expressed how he learned that the technical solution had not been fully decided on when he was involved in the adoption process:

My mission was to perform a technical implementation. I thought the politics has been dealt with and that we were all into where this was heading. After a while, I found out that everything had not been taken care of. This situation made me feel pretty perplexed.

In the processes of interaction, it is not only what has earlier been discussed such as receivers and transmitters that are mutually involved in the development of the technologies in question but also other, external parties with stakes in the industry development. In the case of Sapa Profiler and the promise of data feed automation, a third, external party financed the development of the application. According to the logistics manager at Sapa, this somewhat unique situation was of course beneficial for both Sapa and its co-suppliers who were involved in the project. However, with an additional actor in the adoption process, the project became more difficult to manage. In two of the cases, Odette was an active party and initiator of the application development. In the European automotive industry, with the EDI development as an example, this approach seems to be commonly applied. Emphasizing iterations between the group and Volvo Cars, the project manager of SCMo at Volvo Cars commented on how the work was done in the group:

... the group was made up of representatives from almost all automotive manufacturers. The group had a meeting scheduled every three months. The person managing the group was very active and

engaged. There were a number of parts that the work was divided into and every time we met we were sent home with new things to solve for when we met again the next time. Our meetings usually lasted for two days.... nice evenings... we were always short on time...

In the adoption processes I have studied it seems that the starting point in adoption processes is not the introduction of a given product, but rather the introduction to a problem and the promise that one or several actors in the business relationship in question experiences this problem and wishes to deal with it. On different levels, the problem identified in a focal relationship and its potential solutions are evaluated. Across my cases, such problem identification was performed on both a more aggregate level and the relationship level. Without the industry context and a knowledge of how the firms in interaction seek the solution to a problem, the understanding of the adoption process will be significantly circumscribed. Although the complex process of adoption, including interaction and joint commitment in development and simultaneous development and adoption, are clearly important and probably typical for the industrial context, this is not true of all cases of adoption in an industrial context. For example, a distinction can be made in the type of application (e.g., proprietary applications), the scope of the adoption process (e.g., inter- or intra-organizational application) and complexity (e.g., time and investment in development, number of alternatives). However, in the cases in which we need to view the adoption process through a lens including assumptions regarding the industrial context, leading to an interpretation of simultaneous development and adoption taking place over several years like the cases of Volvo Cars IT, for example, inevitably leads to a more complex decision process – and sometimes difficulty in separating or even identifying the decisions made. This will be discussed in the coming section.

In sum, through an empirical exploration and analysis with focus on the case of Volvo Cars IT and the promise of shared product data, the object of adoption stands out as something that, in contrast to studies that view the object of adoption as a given, instead suggests that adoption should be treated as something that develops rather than something that is accepted or not accepted. Looking back at the definition of adoption in prevalent research outlined in Chapter 2, adoption traditionally concerns a given in terms of a predetermined given “innovation”. An object of adoption as an open solution further implies that the adoption process of the object needs to be seen as a process with natural overlaps between adoption and development and marketing of the application in question.

5.3 Analyzing the process of adoption

When outlining the conceptualization applied in this thesis, I support my reasoning on mainstream literature within adoption research, claiming that the adoption process can be delineated into different stages. The stages of the adoption process are typically outlined as presentation, evaluation, decision and implementation. According to this view, the path is that after evaluation, a decision is made and is followed by implementation, including adoption and usage on the individual level. In accordance with Rogers (1995), for example, I also extend the otherwise often assumed binary nature of adoption by adding four secondary options after an initial decision to either adopt or reject a technology. This is represented by a feedback loop and a possible re-evaluation of both decisions to adopt or to reject. In Chapter 2 I asserted that the field of adoption views adoption as the process by which a technology is presented to, evaluated by and decided on by an organizational entity. In this section, I will further analyze the adoption process using the case of Volvo Cars and the promise of supply chain transparency as the vignette case.

An empirical exploration of the adoption processes outlined in my empirical materials shows that the view of the adoption process as linear and straightforward needs to be rethought. An outline of the organic and non-linear aspects of the adoption processes under study is shown in Table 21. Although my empirical material shows this dissonance between theory and empirical observations, I can also support my argument in some previous studies. There is a stream of studies that, for different reasons, question this linear view of the adoption process. For example, Philip and Booth (2001) explicitly suggest that adoption should not be viewed as linear. Through a re-conceptualization of the adoption literature, they suggest an alternative model, outlining six roles of ICT and asserting that the adoption and diffusion of technology in organizations is a non-linear process and that organizations need not graduate from one step to another. Other studies have also noted similar problems with previous research on technology. In their book on technological development, Håkansson and Waluszewski (2003) also suggest that technological development in the industrial context should be viewed as a non-linear process.

When adoption is studied in the industrial context, empirical exploration is difficult due to the limited availability of models for such an analysis. In the following sections I will outline an empirical exploration of the adoption process through a suggestion for such a model with specific reference to the ICT adoption process. With strong influences from the assumptions made about the industrial context,

the model seems to be especially suitable for understanding the dynamics of organizational level ICT adoption in an industrial context.

Table 21. Cross-case display – organic and non-linear aspects of the adoption processes under study

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Non-linear aspects of the adoption process	Although part of the development for many years, Volvo Cars were postponing the decision to adopt ENGDAT in order to 'wait and see' regarding the development of a competing concept	A process demonstrating initial adoption and positive attitudes that during the pilot project in 2002 was replaced by non-adoption or a fadeout of usage of the application	Although the adoption process was initiated with a positive response and evaluation from Volvo Cars (and its suppliers), a pilot test of the application in Sweden failed to start in 2006 due to lack of financial resources	A process demonstrating initial non-adoption, but after negotiation and adaptation the application begun implementation in 2005	Initial adoption of e-auction, but since the occasion with Volvo Cars in 2002, no additional e-auctions have been performed

5.3.1 Discussing linearity and the organic aspects of the adoption process

When the task force consisting of OEMs and suppliers from across Europe came together to investigate how to manage supply chain visibility within the Odette B2B committee in 2001, Volvo Cars represented Sweden and Swedish automotive interests. The purpose of the task force was to find a standard solution for supply chain management in the automotive industry. Although the adoption process that followed concerning Volvo Cars did not reach the expectations by Odette Sweden and the Volvo Cars project manager, this process is still ongoing and a few European automobile manufacturers have either implemented or are piloting SCMo for their critical supply networks. With its many dimensions and actors involved in interaction, the case of Volvo Cars and the promise of supply chain visibility is probably a typical example of how complex and interconnected

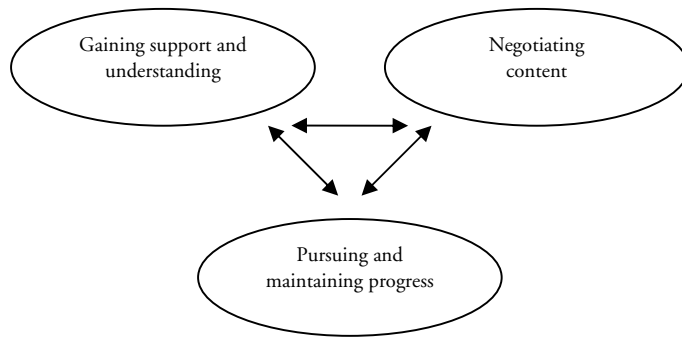
technological development in the industrial context is. The case highly fits assumptions of the industrial context outlined in the theoretical framework. An empirical exploration shows, however, that the prevalent conceptualizations of the adoption process do not square with how the adoption processes this study examines have evolved over time. Following the pursuit of an implementation of SCMo in Sweden shows that the process can hardly be described as linear. Although the adoption process was initiated with a positive response and evaluation from Volvo Cars (and its suppliers), a pilot test of the application in Sweden failed to start in 2006 due to a lack of financial resources. Before reaching a complete stop in the plans to start a pilot project for SCMo at Volvo Cars, the project had changed direction at least once in order to find new room for financial support in order to adapt to changed conditions in the process.

The case of Volvo Cars and the promise of supply chain visibility demonstrate the presence of interaction in many dimensions in the adoption process. The adoption process entails interaction in terms of application development, marketing the application and negotiating on funding for a pilot test providing the management of Volvo Cars with a business case showing the returns on the investment. The case also shows how Volvo Cars involved Odette Sweden and other actors in the planning and preparation for pursuing the implementation that would follow a decision to fund a pilot test of SCMo at Volvo Cars. Similar empirical observations can be found in the other cases of adoption processes, outlined in the previous chapter. For example, the case of Volvo Cars IT and the promise of shared product data shows how complex and embedded the process of adoption can be. In the particular case of Volvo Cars IT, the technology, simultaneously developed as it is adopted, is complex and shared across firms involved in the adoption process. The adoption process of ENGDAT is influenced by both the development toward a standardization among European stakeholders and other processes taking place within the Ford Group. At a different level of aggregation, and with a different perspective in terms of the roles held by the firms involved in the adoption process, the case of Sapa Profiler and the promise of data feed automation also shows patterns of interaction, joint commitment, negotiations on content and features and a simultaneous process of adoption and development.

The shortcomings of much of the prevalent conceptualizations of the adoption process can be summarized in my view that the adoption process is a process of interaction. If the adoption process is characterized by interaction, a model depicting it needs to consider decisions regarding information and communications technology being circumscribed or at least shared in interaction. Further, it needs to see adoption, technological development and marketing as interrelated and

overlapping processes. Given this, the objects of adoption being more or less up for negotiation and adaptation and status in an adoption process becomes a more relevant notion than outcomes. In Figure 48, I outline an alternative model of organizational level ICT adoption. The model is comprised of three interrelated sub-processes of adoption, and is highly influenced by the ideas asserted by those who have argued for a more organic approach to strategy and marketing (e.g., Farjoun 2002; Ford et al. 2002), specifically concerning information and communications technology adoption. The model has three interconnected facets or sub-processes.

Figure 48. Organic approach to organizational level ICT adoption process



In contrast to more established models of adoption like the adoption process depicted by Rogers (1995) or other phenomena in business administration, a stream of research suggesting a more organic approach to strategy or strategy development the industrial context has been suggested by several authors (e.g., Ford et al. 2002). This development is driven across the broad field of business administration, with its locus in different branches of the field of strategic management (Farjoun 2002). In contrast to the prescriptive or planned approach to strategy, attempts to describe how strategic actions actually “*come about*” have been presented in different branches of the field of strategic management (e.g., Farjoun 2002; Mintzberg et al. 1998). According to the proponents of an organic approach to strategy (e.g., Ford et al. 2002), the key fundamentals of this approach is that industrial actors often lack choices and, based on the constitution of markets, industrial actors are circumscribed in their ability to act independently. A key point in the organic view on strategy in the industrial context is that, although the managers can act independently, the outcomes of their actions are affected by other

actors. Therefore, rational and linear models are not sufficient for explaining what happens in the industrial context regarding how decisions are made. By contrasting a more mechanistic, rational approach to strategy, Farjoun (2002) outlines a conceptual elaboration on the organic approach to strategy. In line with Ford et al. (2002), he stresses the iterative and integrative qualities of the process and that strategy is an adaptive coordination of goals and actions. He outlines a model that emphasizes that strategy development is an iterative and interactive process and is presented by and comprised of four main (meta-theoretical) elements including organization, strategy, environment and performance. Farjoun (2002:566) elaborates:

Alongside the progress made in the field in particular content areas grew several streams of ideas that questioned, complemented, and partially adapted the prevailing approaches at a more fundamental level. Particularly challenging and extending in their impact on the core assumptions of the mechanistic perspective on time, flow, and coupling, and its predominately rational and prescriptive tone, were research on strategy processes, evolutionary and process models, models highlighting interaction, and integrative research.

If we return to the previous discussion on the outcomes of the studied adoption processes, a non-linear view of the adoption process makes a great deal of sense. My point here is that this non-linearity and organic nature includes, for example, multiple actors involved with multiple perspectives, involved in an ongoing process. An organic process does not have a clear goal (i.e., definitive implementation in the strict ostensive meaning). Along these lines, in a previous section of this chapter discussing outcomes, an observation across my cases was that a single definable and stable outcome was difficult to find. The first facet in the adoption process model is that of gaining support and understanding for the process and object of adoption. As previously discussed, it is not only the process of adoption that can be complex; the technological applications, ICT not excluded, can also be very complex and difficult to grasp. In an integrated process between actors, environment and not least previous experiences, firms involved in the adoption process of the technology in question need to resolve questions like: What will be the immediate and long-term outcomes of implementation – what is the promise of technology? What process(es) is the technology meant to support? How will the application interrelate with other applications? Gaining support and understanding for the process and object of adoption is a process in which more than one firm has its stakes – it is a process of interaction. The process of gaining support and understanding for the

process and object of adoption is one that the different stakeholders need to manage in, both internally and across firm borders.

In the case of Volvo Cars and the promise of supply chain transparency the manager of Odette Sweden, representing an external party in the process, described the process of interaction and how the SCMo project sought support from the suppliers of Volvo Cars as well as from senior management at Volvo Cars:

It was after the initial meeting with the suppliers that this was brought up with senior management. Two questions remained unsolved with the suppliers after the first meeting with the suppliers. First, it was unclear if the suppliers should be further targeted in the project since they were not willing to take any of the costs. Second, we needed to find out whether it was possible to find financial support for the project within Volvo Cars... before this meeting, the general approach from senior management had been to say that this seems to be a good thing and that we were supposed to proceed as we were...

The second facet in the adoption process model is that of negotiating content regarding the object of adoption. Previously, with empirical underpinning, I asserted that delimiting the scope of analysis of ICT to a given object of adoption implies a risk of not giving a full overview of the adoption process. In the model of organizational level ICT adoption process suggested here, through interaction, the actors involved in the process negotiate the content of the object of adoption, either in terms of features or more radically regarding the design of the application, in parts or as a whole. The firms involved in the adoption process of the technology in question need to resolve questions like: How can the application best be designed? What should be the scope and scale of the technology? For example, in the case of Tidamek and the promise of shared project space, Sandvik Coromant used the feedback from Tidamek to receive additional input on how to develop the extranet solution in order to improve the probability to reach a successful implementation. In the case of Sapa Profiler the technical platform, in this case the ERP system for which the application would be developed to translate data, was changed to fit the selected pilot firm, A-lackering. The project management of ETUI knew that the pilot firm selection and decision on ERP system used in the solution were two very critical decisions. The choice of ERP system to target was changed from Movex, as was originally intended, to Monitor. According to the logistics manager at Sapa Profiler, systems provider Movex was also involved in the development of the application:

We have a number of co-suppliers who run Monitor. We contacted them and as they do not have a connection to XML in their system today but feel that they could do this, they are willing to invest in this without additional cost to us. From their point of view, this is a path toward software development.

The third facet of the adoption process model is that of pursuing and maintaining progress. In an integrated process between actors taking part in the process of development and adoption, through interaction, progress in the adoption process is pursued and maintained. In order to create and preserve momentum, the actors involved in the process need to resolve questions like: How should responsibilities and costs be distributed? How do we maintain involvement and commitment? What are the time frames and why are they important? Given the nature of interaction, decisions and progress can be blurry and contradictory. For example, in the case of Volvo Cars and the promise of supply chain visibility, the project manager commented on his difficulty to see how decisions were made and implemented:

I'm not sure how this decision [to initiate planning for a pilot project] was made because it is not completely clear in the sense that there were many of us involved, at different levels. A senior manager told my boss that this should be done. My boss made this part of our business plan where you take it from operational to individual level. At the same time, the SCMo concept was a part of our vision, a bit higher up in the organization, and it is still there...

In sum, there are several aspects in which the organic adoption process model outlined here differs from linear adoption process models. For example, unlike linear adoption process models, an organic approach is approachable from any point. It implies that the three facets are intimately interrelated and cannot be understood in isolation. Unlike linear adoption process models, the organic approach implies that the adoption process is one of interaction. A linear adoption model is unquestionably seen from a single firm perspective. Moreover, unlike linear adoption process models, the organic approach proposes that there is no predetermined point of departure or point of arrival in the adoption process. Instead, it implies that adoption can emerge from any direction.

5.3.2 Commenting on the importance of non-technical aspects of technology adoption processes

In the outline of an organic and non-linear model of the adoption process, I discussed the many stakes and levels an adoption process is influenced and affected by. An additional observation is that some of the cases, each in its own unique way, show how evaluation of the technology is much more than an evaluation of the object of technology and its particular benefits. In line with Teo and Ranganathan (2004), for example, the empirical materials show that the decision to adopt a technology is also to a great extent a business decision and not (only) a technology decision. This aspect of evaluation in the technology adoption process seems understudied, especially since it seems to fall between the external pressure factors and the evaluation of potential benefits of the technology in question. There are, I argue, several instances in the empirical materials in which a technology adoption decision is business related. For example, in the case of Sapa Profiler and the promise of data feed automation, the technology was presented to A-lackering as part of a collaboration within a project. The evaluation A-lackering performed on the application and their participation as a pilot firm cannot be separated from the role of Sapa Profiler in its network of business relationships: the few of competitors, the scope and scale of business and, all in all, the relative strength of Sapa Profiler in relation to its supply network, consisting mainly of small industrial shops. In retrospect, when asked to elaborate on the background to the conflict, the logistics manager at Sapa commented that the conflicts in the case would not have surfaced if Sapa would have made the application part of a business offer – thereby more clearly using its relative power:

We had a tough time making this work, not only in the relationship with A-lackering but also internally. [...] One of our conclusions on this project is that if we should implement something this difficult and tough again, we would probably need to do things differently and on our own, by stating demands to our sub-suppliers. Demands on commitment, perhaps in the shape of a business offer – if you do A then you will be a candidate to supply B...

The case of Nässjötryckeriet and the promise of electronic procurement also shows how the decision to adopt e-auctions was mainly a business-related decision. In this case, the technology was secondary and was not thought very highly of by the management of Nässjötryckeriet. From their perspective, adoption would not have been an option had it not been for the attractive offer the technology was bundled

with. Considering the potential benefits for Nässjötryckeriet that the extended business with Volvo Cars would have, the e-auction was evaluated as an acceptable condition. The administrative manager described the situation in which Nässjötryckeriet was involved in the adoption process:

We were approached by the usual purchasing channels at Volvo Cars... the first contact was made in May 2002, a year before the actual auction. [...] being invited to be part of this process was of course very good news for us... we did not know at the moment that this was about e-auctions. That became clear first after we had received the written documentation including the offer and specifications.

In the case of Tidamek and the promise of shared project space, the adoption of the extranet solution was an extension of the business partnership agreement the two firms had signed. The account manager at Sandvik who is responsible for the Tidamek account commented on the partnership agreement and how the technologies this agreement included changed his conditions so that he worked in close interaction with a customer like Tidamek:

This is part of our partnership agreement. We offer them applications without additional costs... tooling supply is one step and this is something more than that[...] the better support I get and the closer we work together the more efforts I can put on strategic, long-term improvements...

For the production manager at Tidamek, the offers from Sandvik, strengthened business ties through technology were seen as positive. For him, the guarantees of improved productivity formed the justification for all business with Sandvik Coromant – whatever technologies that included. Returning to the case of Volvo Cars and the promise of supply chain visibility, this case also shows the business relatedness of the adoption process. In this case, the promise of strengthening supplier relationships and improving supplier collaboration was the primary concern of the Odette work group on supply chain management that was formed during the late 1990s and that presented the concept of SCMo through the publication of industry recommendations in May 2003; the technology to support the promise was in all aspects secondary.

In sum, through an empirical exploration and analysis with a focus on the case of Volvo Cars and the promise of supply chain visibility, the process of adoption

stands out as something that does not square with the prevalent view on the adoption process as linear and straightforward. On the contrary, as suggested in the exploration of the process as demonstrated in Chapter 4, this view needs to be rethought. This corroborates previous research with approaches similar to this study. For example, Philip and Booth (2001) explicitly suggest that adoption should not be viewed as linear. A problem with approaching the adoption process and trying to view it as a non-linear phenomenon is the limited availability of models for such an analysis. Therefore, in this section I have outlined a proposition for such a model with specific reference to the ICT adoption process. With strong influences from the assumptions made about the industrial context, the model seems to be especially suitable for understanding the dynamics of organizational level ICT adoption in an industrial context. In addition, this exploration of the process of adoption corroborates the view of Teo and Ranganathan (2004) on the business relatedness of technology adoption. In the industrial context, the business environment and relational commitments and the interaction in which the adoption process is embedded need to be investigated carefully and in-depth in order to understand adoption.

5.4 Analyzing the context of adoption

Through analysis across the cases in my empirical chapter emerges a recurring instance in which it is the context, external aspects connected to the adoption process, that strongly influences the outcome in the adoption processes. In modeling adoption, the external influence is viewed as an important aspect affecting the decision to adopt – this has again and again been shown in empirical studies on information technology adoption (Jeyaraj et al. 2006). My study, however, shows that the context is more than a factor (i.e., external influence as independent variable) affecting the decision to adopt but is instead an important dimension of the whole essence of the process – including the technology itself and how it is negotiated. In the upcoming subsections, I will further outline arguments to underpin the need for an extended perspective on technology adoption processes – that is, to further analyze how the context can be discussed in analysis of ICT adoption processes. In this section, I will further analyze the adoption process using the case of Tidamek and the promise of shared project space as the vignette case.

5.4.1 Discussing adoption and interaction in terms of cooperation and/or conflict

As in all aspects of business, firm interests drive actions and intentions. Taking on the view of adoption as something that entails interaction, we also need to consider that the actors involved might not share these driving interests and intentions as part of the context of adoption. In the early work on interaction and the development of the interaction model, it was proposed that a classification of atmosphere could be achieved using different dimensions (Håkansson 1982:21-22). For the purposes of this analysis on the subject of analysis and adoption as interaction, I have found relationship atmosphere, discussed in terms of cooperation and conflict, especially interesting. Given that adoption can be approached as interaction, what characterizes the focal relationship in which this interaction takes place?

In the adoption processes studied in my fieldwork, the situation in the focal relationship was not always that of shared interests and shared plans. When describing the interesting dynamics of organizational level adoption, Kim and Srivastava (1998:233) use the constructs organizational structure (i.e., centralization and formalization), organizational climate (i.e., interdependence, management support, conflict and internal openness) and organizational attitudes (i.e., resistance

to change, risk-taking attitude, external openness, technological and price sensitivity). In discussions of organizational level cooperation and conflict, these constructs have proven to be useful. Hausman et al. (2005) discusses adoption in a cooperative industrial setting as a special type of inter-organizational cooperation and states that this phenomenon is distinctly different from other types of adoption and therefore requires a particular framework to be understood. The view of Hausman and colleagues corresponds well with the assumption made in this thesis on the stable nature of industrial relationships. The particular settings of the adoption process and the focal firms in the five cases are outlined in Table 22.

As shown in the within-case analysis provided at the end of each description of the empirical cases of adoption processes in Chapter 4, I present different types of drivers and barriers affecting the adoption process. Again, this corresponds with my point that the adoption processes are cases of interaction and that there is a need for an extended view on the subject of adoption. Drivers and barriers can be found both within the focal firm and the focal relationship of each adoption process, and in the industrial network in which the focal relationship is embedded. I would like to argue that the cases are embedded in various settings that can be discussed in terms of a collaboration-conflict continuum. A case that should strike the reader as a very collaborative setting is that of Tidamek and the promise of shared project space. Over a period of many years, the two firms had developed close cooperation on productivity projects. In 2000, the relationship between Sandvik and Tidamek was formalized in a partnership agreement. The invitation to pilot an extranet solution as part of the e-service project that Sandvik was working with was received as positive and as something that potentially could strengthen the relationship even further. However, as the case reveals, the positive atmosphere the adoption process was embedded in did not help the project reach successful adoption. Both firms were willing, but during the project the situation at Tidamek, a situation that was also affected by the current status of the company's production, led the management at Tidamek to not adopt the extranet. A couple of months after the pilot study, the e-service project management at Sandvik closed down the testing at Tidamek. The production manager at Tidamek, who was the one who championed the application internally, commented on the failure of the project and accepted that although he wanted to have things more structured and shared, the organizational structure did not seem to fit the application:

Our engineers were not committed... [...] To sit down and put data into this system, reports... a firm our size – well, I understand how this could work at Volvo... but at our firm we talk about planning during coffee breaks, we need to keep distance short and have everyone

informed. In addition, the people from Sandvik are here so often and take part in all this... I would like to have things more formal and structured, but ...

An adoption process that shows a situation embedded in conflict on both the project level and other levels is the case of Sapa Profiler and the promise of data feed automation. In this case, as a step in creating an efficient order delivery process, Sapa Profiler had a need to automate data feed into their ERP system. Before the development of the application in question, before the initiation of the ETUI project, Sapa had forced their suppliers to feed both their own systems and Sapa's system when they performed actions such as dispatching components to customers. In 1999, Sapa placed computer screens connected to their SAP R3 system at the supplier's site. This solution was, however, deemed not sustainable. When the ETUI project had been initiated, Sapa and the technical team at ETUI developed a solution that could translate several different file formats used in different ERP system to a solution that made file exchange and translation between SAP R3 and one single other ERP system possible. During the project, however, the two firms had problems negotiating how to distribute the project costs. During fall 2003, the problems reached satiation and the project almost lost momentum. Part of the conflict between Sapa and A-lackering was that they did not share views on who the application would benefit. The logistics manager at Sapa Profiler had one view, and the logistics manager at A-lackering had another. The logistics manager at Sapa Profiler commented on the potential benefits:

Why should I put half a million on this if my potential savings at best are 100,000, while the co-supplier maybe puts in 30,000 and can save 250,000 per annum and perhaps more?

At A-lackering, the calculations looked somewhat different. Engaging in the project also meant risks in terms of having to invest in man-hours and hardware. Clearly, the conflict in distributing the costs of the application was partly due to their not agreeing on who would benefit from the implementation. The two cases of Sapa and Tidamek described above are both, in various ways, examples of how adoption processes can be characterized by cooperation or conflict. In the case of Sapa as well as that of Nässjötryckeriet and the promise of electronic procurement, the conflict developed across firms. In the case of Nässjötryckeriet, the invitation to participate in the e-auction came as a surprise as well as a disappointment. Judging from the invitation, the interest of Volvo Cars was not to develop a close collaboration in the exchange of printed products but rather to develop an exchange characterized by competition and focused on low price. Although the management of

Nässjötryckeriet was in conflict over the idea of negotiating prices with Volvo Cars through e-auctions, they valued the possible business opportunity as more important than the means of transaction and negotiation that e-auctions meant. The management of Nässjötryckeriet realized the importance of having Volvo Cars as a customer and that this could mean stable and large order volumes over a long period of time – if the relationship was managed properly from their side.

Table 22. Cross-case display – Description of the background of the adoption process and the key factors that hindered the adoption process

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Brief description of the background of the adoption process	In times of consolidation and globalization, Volvo Cars needed to handle collaborative product development	Although the relationship was well established, Tidamek and Sandvik needed to channel communication when running projects	To secure and manage smooth production, Volvo Cars needed to increase visibility in component supply flows	As a step in creating an efficient order delivery process, Sapa Profiler needed their suppliers to automate data feed into an ERP system	As part of an offer to become supplier of a range of products, Nässjötryckeriet was invited to negotiate prices electronically
Key factors that hindered the adoption process to reach implementation	Parallel development of standards for product data exchange	Prioritizations made due to parallel implementations in other relationships	Prioritizations made during the project due to financial situation	Conflicting views on how to distribute costs of development	Conflicting views on how to develop the focal relationship

5.4.2 Considering the intra-processual dynamics of adoption

Reflecting on the context of adoption, one could ask whether just as other firms are interconnected through dependencies and interdependencies, if this would also be the case for technology adoption processes? Although briefly, in the exploration of linearity and the organic aspects of the adoption process I have already discussed the need to extend the analysis of adoption processes to also consider other actors and processes and their role in how an adoption process emerges over time. One key reason for suggesting an organic approach to the adoption process is the importance

of connected processes, a phenomenon identified in the five case studies. The influence from other connected and ongoing processes is an observation found in an analysis across my cases. Among those who have been critical of the factor approach and the somewhat atomistic view on adoption processes, several authors point to the importance of considering process connectedness and network considerations (e.g., Damsgaard and Lyytinen 1998; Kurnia and Johnston 2000). For example, according to Damsgaard and Lyytinen (1998:291), considering the inter-processual dynamics is a key aspect of understanding industrial ICT adoption processes:

[...] different diffusion processes cannot be understood without the interference of the other processes. Diffusion patterns criss-cross one another and may change over time from one pattern type to another through changes in the service scope, underlying technology, or institutional arrangements.

Based on my empirical fieldwork, the view of the adoption process as embedded and connected to other processes emerges (Table 23). Through the five cases of adoption processes I outline, an interesting point is that the inter-processual dynamics that can be elevated is that such processes can function as both a driver and a barrier in the adoption process in question. In the case of Nässjötryckeriet, Volvo Cars clearly made an offer that the management at Nässjötryckeriet could hardly refuse as they were interested in expanding their business with Volvo Cars. On the OEM level, however, the attitudes toward e-auctions were not all positive. On the contrary, they differed quite greatly among different departments at Volvo Cars. These conflicting views were mainly on the value and effects of e-auctions within established relationships. However, the process of adoption of e-procurement in the Ford Group affected the adoption process of e-auctions at Volvo Cars and Nässjötryckeriet in the sense that Volvo Cars had wanted to be a pioneering firm in ICT within the Ford group, despite the concerns of what effects it would have on the relationship level.

Table 23. Cross-case display – inter-processual dynamics

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
Inter-processual dynamics that surfaced in the case	Parallel processes of PDM technology adoption in the Ford Group affected the adoption process of ENGDAT	Parallel processes of technology adoption at Tidamek affected the adoption process of the extranet	The process of broad cutbacks in costs across Volvo Cars affected the adoption process of SCMo	Parallel processes of technology adoption at Sapa Profiler affected the adoption process of the ERP data translation application	The process of adoption of e-procurement in the Ford Group affected the adoption process of e-auctions at Volvo Cars and Nässjötryckeriet
Consequence of the inter-processual dynamics in the case	Inter-processual dynamics worked as a barrier to adoption	Inter-processual dynamics worked as a barrier to adoption	Inter-processual dynamics worked as a barrier to adoption	Inter-processual dynamics worked as a barrier to adoption	Inter-processual dynamics as driver worked as a push toward adoption

Except for the case of Nässjötryckeriet, considering inter-processual dynamics, the remaining four cases present dynamics that functioned as a barrier to the adoption process. In the case of Volvo Cars IT and the promise of shared product data, where parallel processes of PDM technology adoption in the Ford Group affected the adoption process of ENGDAT, the inter-processual dynamics placed the adoption process at Volvo Cars in a wait-and-see status. For Volvo Cars, this meant that in order to avoid conflict at the group and industry levels, the management at Volvo Cars avoided making an active choice on the adoption of ENGDAT V3. An associate at Volvo Cars IT working with strategic analysis on PDM close to Volvo Cars commented on the situation for Volvo Cars and how they needed to take the progress in C3PNG and the fact that the industry was global into consideration when evaluating ENGDAT and arguing for a situation in which Volvo Cars would use several options:

There are at least two aspects to this... Firstly, should we migrate to this in the first place? Clearly, it is quite a changeover to do this,

including changeover costs for our suppliers. Secondly, to what extent does Volvo Cars' supply base have the volumes that make direct communication cost efficient? We have both cross-brand suppliers and suppliers who are unique for our production. Suppose we have a unique supplier with small volumes. I'm very doubtful that they will be able to make any return on an investment in migrating to direct communication.

Similar to the cases of Volvo Cars IT and Tidamek, that of Volvo Cars and the promise of supply chain transparency also shows how inter-processual dynamics functioned as a barrier in the adoption process. In fall 2005, when Volvo Cars announced a savings package with an aim set to a billion SEK in cost cuts, due mainly to profitability problems within the Ford Group, this resulted in (among other things) significant cuts in administrative personnel and consultancy service sourcing. The process of broad cutbacks in costs across Volvo Cars affected the adoption process of SCMo and when the project in 2006 was rejected for MERA funding, the project management soon realized that there was no room under the circumstances for Volvo Cars to fund the project further.

Returning to the vignette case, the case of Tidamek and the promise of shared project space shows how inter-processual dynamics functioned as a barrier to adoption. In this case, with parallel processes of technology adoption at Tidamek affecting the adoption process of the extranet, the inter-processual dynamics made the management at Tidamek and their commitments to other system implementations halt the adoption process of the extranet and caused the pilot project to fail. The project manager at Tidamek emphasized that their focus had to be on the customer and the systems and concepts they introduced. In this case, Volvo Powertrain and its introduction of Pipechain had priority for Tidamek. The production manager explained his rationale for changing focus and re-prioritizing the implementation extranet solution coming from Sandvik:

What comes from the customer must have priority... [...] I don't think we have ever slowed down anything with Volvo at any point... they have priority... let's say that a customer comes to us with a concept or technology, let's say QS, and then Sandvik comes to us with this extranet... in that case, I have to go with QS since it is from a customer... I can always come back and change my mind on the extranet but if I don't have any customers, I won't need an extranet.

The case of Sapa Profiler and the promise of data feed automation also shows how inter-processual dynamics affected the adoption process. During the ETUI project and the development of the ERP data translation application, Sapa Profiler also launched an implementation of updates in SAP R3, a project that demanded quite some attention from the IT staff at Sapa Profiler. This parallel process affected the adoption process in the relationship between A-lackering and Sapa Profiler within the ETUI project.

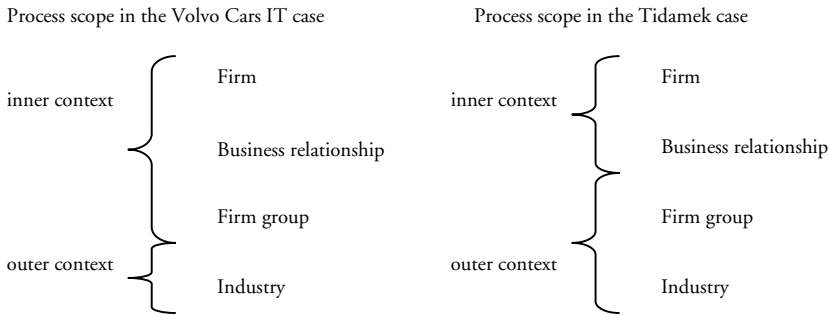
5.4.3 Considering the adoption process scope

Inter-processual dynamics have the potential to bring an additional perspective on the view of context in the adoption process. Given the view of the adoption process as a process of interaction, concerning a set of firms rather than a single firm, an exploration of the empirical material leads to the question of whether we also need to consider the boundaries of the adoption process more thoroughly. Looking across the cases in the empirical study, an additional important observation is that the scope of the adoption processes involved varies remarkably. For example, returning again to the vignette case, that of Tidamek and the promise of shared project space, the dyadic relationship between Sandvik Coromant and Tidamek was where the application developed and tested. In this case, the adoption process primarily concerns the dyad and is not primarily dependent on whether or not other firms adopt the application. In the case of Tidamek and the promise of shared project space, and in other cases in Chapter 4, an observation is how the prerequisites of the adoption process are affected by the context. Using the terminology of Pettigrew (1985:240), we could distinguish between the inner and outer contexts of a process. Depending on the scope of the adoption process, the boundaries distinguishing its inner and outer contexts process vary. In order to fully grasp what the inner and outer contexts include in relation to ICT adoption processes, we could make a distinction between what directly concerns the technology and the adoption process of that technology and what indirectly concerns the technology and adoption process, as both drivers and barriers.

In the case of Tidamek and the promise of shared project space, the adoption process primarily concerns the dyad, and the dyad constitutes an inner context of the adoption process. In other cases, the adoption immediately concerns a network of firms, and the decision to adopt a specific application in one dyad is dependent on the outcome and status in other dyads. For example, in the case of Volvo Cars IT and the promise of shared product data the application called ENGDAT, a solution for product data communication in the automotive industry, was by nature a technological application that concerned something broader than the dyad.

In this case, the inner context as boundary involved the European branch of the automotive industry. In the case of Volvo Cars IT and the promise of shared product data, beginning in 2000 the application, driven by Odette International, was developed in interaction through a task force for product data communication standardization called SASIG, broadening the inner context of the adoption process to also include what had formerly been considered the outer context.

Figure 49. Comparing the process scope in the case of Volvo Cars IT and that of Sapa Profiler and the promise of data feed automation



Considering the two processes outlined and analyzed in Figure 49, an important observation is that the boundaries, or the process scope, are not necessarily given to be the dyad but could also include what in other cases might be considered the outer context of the adoption process. In addition, based on the case of Volvo Cars IT and the promise of shared product data, for example, we also need to view the process scope as possibly subject to change. As discussed in a previous section of this chapter, the adoption processes of ICT could also be initiated by a willingness to create business renewal through creative destruction. It should be noted that as in several of the cases of adoption processes described here, the initiative to embark on adoption could come from either inside or outside a relationship. In the Swedish automotive industry, some of the largest standard applications have been initiated by industry groups (e.g., Odette and EDI). Although the initiator defines the process scope, it can later be redefined, either purposely or through the development within, or in the inner or outer context of, an adoption process.

In sum, through an empirical exploration and analysis focusing on the case of Tidamek and the promise of shared project space, the context of adoption stands out as more than a factor (i.e., external influence as independent variable) affecting the decision to adopt but instead an important dimension of the whole essence of the process – including the technology itself and how it is negotiated. This approach corroborates with studies that have suggested that adoption research needs to go beyond the factor approach to extend the understanding of adoption (e.g., Woodside and Biemans 2005a). In addition, the empirical exploration and analysis propose that in an extended approach to adoption, both the intra- and inter-processual dynamics of adoption need to be taken into consideration. Considering the inner and outer contexts of adoption also enables a view on adoption by which scope is something that may vary over time and across cases of adoption.

5.5 Analyzing the adoption process outcome

The fifth entity in the conceptualization applied in this thesis is the outcome of adoption. As mentioned in the overview of empirical studies on organizational level ICT adoption, a few researchers have called for a more multifaceted view on adoption outcomes. This call entails a challenge of the otherwise more or less static and binary view on adoption outcomes. It is among the processual and exploratory approaches to adoption research that the extended views on adoption outcomes are found. For example, in their study on EDI adoption in Finland with analysis on multiple levels, Damsgaard and Lyytinen (1998) discuss adoption as something that unfolds in different patterns rather than in an orderly and binary manner. In line with the arguments offered by Damsgaard and Lyytinen (1998), Philip and Booth (2001) discuss the problems in isolating or defining adoption outcomes and suggest that adoption should therefore be treated as something that develops rather than something that is accepted or not accepted. In the following section I will analyze and discuss the nature of adoption outcomes in the five cases of adoption processes included in my study, using the case of Nässjötryckeriet and the promise of electronic procurement as the vignette case.

5.5.1 Considering the outcomes of the studied adoption processes

In the case of Nässjötryckeriet and the promise of electronic procurement, Nässjötryckeriet was approached by Volvo Cars and invited to bid on a contract using e-auctions. Given the attractive offer and Nässjötryckeriet's position in the relationship, as well as Volvo Cars' role in the industry, the management at Nässjötryckeriet accepted the invitation and "*adopted*" the application. However, due to the longitudinal nature of the study, I was able to return to the case of Nässjötryckeriet a couple of times after their decision to adopt. Seen from a long-term perspective, the firm used e-auctions only at this time and did not continue to use the application after the lost deal with Volvo Cars. What were then the outcomes of the adoption processes in this case and the others described in Chapter 4? Can we, at all, find conclusive outcomes or do we need other tools to describe what happened?

Looking across the empirical study, the multiplicity of shapes an adoption process can assume and the rich dynamic nature that the developments in an adoption process has should be evident from the descriptions of the five cases of ICT adoption. Given the assumption that we still consider it valuable to discuss

outcomes, we first and foremost need to distinguish between outcome and effects. As already stated, outcome refers to the results of the adoption process (cf. effects, which refer to the results of implementation). Secondly, we need to distinguish between planned outcomes and the current status in the processes under study. Previous studies have investigated formal planning as a key determinant of successful adoption (e.g., Power 2005; Teo and Ranganathan 2004; Vlosky et al. 1994). For example, based on survey data Vlosky et al. (1994) emphasize the need for inter-organizational pre-implementation planning in a study on EDI implementation in the wood product retail industry. However, the fact that planning is a key variable in adoption does not necessarily mean that the plans are fulfilled or even found feasible along the process. Also, plans might change during the course of the adoption process. The outcomes and status in the five cases of adoption processes, seen from the focal firms' perspectives, are outlined in Table 24. By analyzing what was expected and planned in each of the cases and what turned out to be the outcome of adoption, one can appreciate the dynamic nature of the adoption process and what implications these dynamics have for the identification of outcomes in the adoption process.

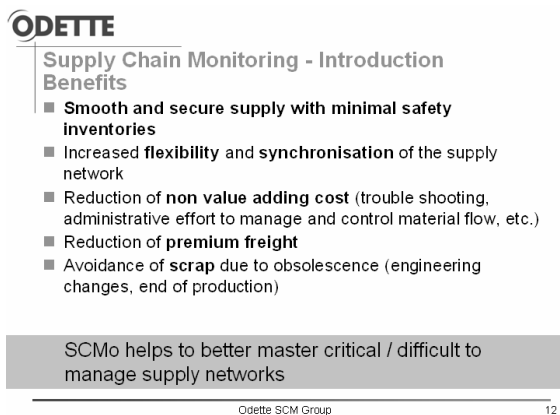
Table 24. Cross-case display – studied adoption process status

	Volvo Cars IT and the promise of shared product data	Tidamek and the promise of shared project space	Volvo Cars and the promise of supply chain transparency	Sapa Profiler and the promise of data feed automation	Nässjötryckeriet and the promise of electronic procurement
The expected and planned outcome in the adoption process	Adoption of the ENGDAT standard	Pilot project and followed adoption of the extranet service	Pilot project and followed adoption of SCMo	Adoption of application enabling data feed automation	Adoption of e-auction
Status in the adoption process	No formal decision made after internal evaluation	Non-adoption after only brief occasions of use during pilot project	Pilot project not launched	After initial non-adoption, the application was adopted and implemented	Adoption of e-auction on only one occasion

The cases presented in this study show that formal planning is part of the adoption process but that the dynamics of the process need the plans and intentions of the projects seen from a focal firm's perspective, and therefore sometimes need to be modified and negotiated. To achieve an extended understanding of outcomes, it is

necessary to have perspective and an appreciation of the dynamic and complex nature of ICT adoption. In the case of Tidamek and the promise of shared project space, Sandvik and Tidamek aimed at testing an extranet solution tailored to Tidamek's needs. After the pilot project, the plan at Sandvik was to permanently implement the solution in the relationship with Tidamek as well as in other customer relationships. The status in the case of Tidamek was, however, that the pilot project did not work as planned and was therefore not followed by adoption of the extranet service, at least not in the case of Tidamek. Parallel to the project at Tidamek, Sandvik's subsidiary in Copenhagen worked with a pilot study at a set of Danish firms. In these cases, the pilot study was a success and the project was carried on and later phased over from a pilot to a more permanent solution.

Figure 50. A general description of the benefits from - the promise of - SCMo concept (Source: Odette Sweden, 2004-08-23)



Volvo Cars and the promise of supply chain transparency is another example of how planned and current status and by the project management perceived current outcome in an adoption process differ – in this case due to failure to achieve internal support. When the SCMo project was initiated in 2004, the project group expected that a pilot study with selected suppliers would be launched within the year. In 2006, after significant drawbacks in the project, no pilot study had been launched. At this point, Volvo Cars did not close down the project, but were not actively planning to initiate a project unless new doors were opened offering new possibilities to initiate a pilot study with external funding. When the project group

initiated its work with SCMo at Volvo Cars, the project had been developed based on a conceptual idea from the Odette recommendations on SCMo. When the project lost its impetus, no other technical solution except for that conceptual idea had been presented. Therefore, all that was lost was the promise of supply chain transparency (Figure 50). In the case of Volvo Cars and the promise of supply chain transparency, the application never reached the stage of implementation – the outcome was instead that Volvo Cars for various reasons had to halt their plans to implement SCMo. However, as noted at the end of the case, the manager at Odette Sweden claimed that time would tell whether or not SCMo would be promising for the industry. From his perspective, its failed implementation at Volvo Cars and in the Swedish automotive industry did not necessarily have to mean that the concept would never be implemented in Sweden – it might happen under different circumstances. From his point of view, if SCMo were to reach broad acceptance in other countries, this would mean that the Swedish industry would also eventually implement it.


A key reason for the inherent problem of planned outcomes and their realization is that the adoption process is one of interaction and development between two or more active parties. For example, the case of Sapa Profiler and the promise of data feed automation is an example of the complexity of adoption processes and the multiplicity of shapes an adoption process can take on. The case shows that Sapa did not have any clear counterpart or technological solution when the process to develop the application enabling data feed automation was initiated. Therefore, the aspects of planning in this case were based on the promise of technology rather than known 'facts'. This brings us back to the view of how the promise of technology is an important starting point in the adoption process. As an application was developed during the project, it was likely to change during the course of the project. Therefore, outcomes might not be what the firms involved in the adoption processes expected or planned.

The case of Sapa shows that conflicts in the adoption process and other development projects within the Sapa Group changed the prioritizations on supplier communication, which subsequently affected the conditions in the adoption process. When the double feeding application project was launched within the ETUI project in 2002, the logistics manager of Sapa Profiler, who was in charge of setting up and planning for the project at Sapa Profiler, estimated the realization of the project to have reached implementation by January 1 2003, as shown in Figure 51. At the time of the launch of the project, the logistics manager did not know – and could not know – that the implementation of the project would be much more complicated and take much longer than expected. In 2003, a

decision on the technical platform Monitor was made. In May 2003 the future target for the pilot project, A-lackering, a firm working as co-supplier to Sapa Profiler, was first contacted.

Figure 51. PowerPoint presentation by Sapa on the meeting in November outlining the ongoing work and plans for the double feeding project (Source: Sapa Profiler, 2002-09-24)

Var befinner vi oss ?	sapa:
• VPN-plattformen	Våren
• Förstudie av Exsitec	Augusti
· Möjlig implementation	
· kostnad	
• Beslut från Sapa	September
• Tekniskt möte Stråhlfors – Exsitec	September
• Genomförande	Klart 1/1-03



5.5.2 Discussing the adoption process and the process status

Although many researchers within the domain of adoption research depict an adoption process that is linear and has a clear (and sometimes explicit) bias towards successful adoption, there are a few interesting deviations from this path. Within this stream of research is a growing number of studies that open up for alternative views on organizational level ICT adoption decision outcomes. For example, these studies discuss outcomes in terms of incremental steps toward adoption (e.g., Volkoff et al. 1999) or a continuum or range of adoption (e.g., Teo and Ranganathan 2004), or assert that adoption, seen from a functional perspective, can be valid for some functions but not others (e.g., Armstrong and Sambamurthy 1999). Nevertheless, most research seems to treat the adoption process as linear and its outcomes as binary yes/no. For example, O’Callaghan et al. (1992) assume that potential adopters either adopt or do not adopt EDI due to the binary nature of adoption. As outlined in the theoretical framework, Rogers (1995) also discusses alternatives to this seemingly static approach by addressing the decision to adopt or not adopt and subsequent evaluation of such a decision along four options: continued adoption, continued rejection, later adoption or discontinuance. When

elaborating on non-adoption, or rejection, Rogers (1995) suggests that a distinction be made between active and passive adoption.

Among those suggesting alternative views on adoption processes outcomes are those who assert that adoption is an ever ongoing process, which means that it is perhaps more useful to discuss status rather than outcomes (e.g., Bush et al. 2005; Philip and Booth 2001). Philip and Booth (2001) discuss the problems of isolating or defining adoption outcomes and suggest that adoption should therefore be treated as something that develops rather than something that is accepted or not accepted. Bush et al. (2005) present empirical data on adoption of sales force automation from three case studies and discuss the cases in question in terms of status, as the adoption processes in question are long-term and are ongoing, without immediate success. An observation across the cases outlined in this thesis is the problem of isolating and defining adoption outcomes. Volvo Cars IT is one example of how status is useful in discussing outcomes in the adoption process. By not making a final decision on product data file transfer standard and having several different options for business partners, Volvo Cars kept all doors open. By using this tactic, they could also follow and evaluate other developments in the industry. For example, during 2006 the German automotive industry initiated implementation of ENGDAT V3. As there was no immediate need to make a decision on standard, Volvo Cars seemed to continue to keep their options open. With the established view on adoption as binary, one could ask whether Volvo Cars is a non-adopter of ENGDAT V3. Given their wait-and-see approach, they had not made any decision regarding the technology at that point but does that make them non-adopters?

Through a processual approach, it becomes natural to view adoption processes as those of interaction and change, with outcomes being tentative rather than final. Adoption is an ongoing, interactive process. My field study presents two similar situations in which this becomes critical to our understanding of how the case evolves. Returning to the case of Nässjötryckeriet and the promise of electronic procurement, the invitation from Volvo Cars was accepted and the technology was adopted. Looking back at Nässjötryckeriet a couple of months later, no new invitations to participate in e-auctions had come. The company had only limited experience of e-auctions with another customer, and since they did not like the general concept of a transactional relationship, they did not push for further use in any way. For them, it was business as usual. A question that arises is then whether Nässjötryckeriet is an adopter or a non-adopter of e-auctions. Or, in this case would it be more relevant to discuss the status of Nässjötryckeriet regarding adoption processes at the time of Volvo Cars' invitation and that they adopted e-auctions at that time but were thereafter passive non-adopters. In the case of Sapa Profiler and

the promise of data feed automation, the ETUI project and Sapa experienced problems in negotiating the setup of the project with A-lackering, which led to a halt in the adoption process that lasted almost a year. The case of Sapa also shows that if the study had not followed up the status of the project, the Sapa case would have been considered one of non-adoption. Addressing outcomes in terms of adoption process status entails a need to also anchor progress and status in time. When discussing adoption and non-adoption as status, we need to determine a temporal context. By doing so, we could also state that at a specific point in time Sapa were non-adopters but at another point in time they were, in fact, adopters.

Given the multiplicity of shapes an adoption process can take on, and the rich dynamic nature that the developments in an adoption process have, this study proposes that in order to broaden our understanding of ICT adoption processes we also need to react to established views on adoption outcomes. One reaction could be to propose an alternative view on adoption outcomes. Through a processual approach to organizational level ICT adoption processes, this study opens up for such a reaction. Given the interactive and ongoing nature of the adoption process, given and planned outcomes might – and are likely to – change during the process. The view of the adoption process as ongoing and interactive, not least in terms of planning for outcomes, implies a revised view on the adoption process outcome. In order to understand the outcomes of the adoption process, one might need to discuss status rather than outcome.

In sum, through an empirical exploration and analysis focusing on the case of Nässjötryckeriet and the promise of electronic procurement, the outcome of adoption stands out as something that develops rather than a process with an outcome clearly defined as either adoption or rejection. Looking at prevalent studies and conceptualizations, this approach is demonstrated in much factor research, in which for example O’Callaghan et al. (1992:50) argued that adoption was binary in nature (e.g., yes/no). In contrast, and in line with previous studies (e.g., Philip and Booth 2001), this study points at the problem with looking at adoption process outcomes as something static and proposes instead that process status as an alternative to outcome is better suited for capturing the dynamic and complex nature of the adoption process.

5.6 Commenting on the necessity of rethinking adoption

In this chapter I have analyzed the empirical materials on ICT adoption processes that have previously been presented. Through this exploration, by revisiting the vignette cases in each section of this chapter, I have recurrently returned to an apparent misfit between established conceptualizations and my empirical findings on ICT adoption processes in the industrial setting. The interactive and industrial environment and its specific conditions that the automotive industry presents seemingly call for alternative conceptualizations of adoption. Therefore, in the upcoming chapter I will propose that the conceptual treatment of the empirical phenomenon of ICT adoption processes in an industrial context needs to be rethought.

In this chapter I have outlined the idea that the ICT adoption process studied in this thesis could be characterized as processes of interaction, and as processes that are non-linear and organic rather than linear and one-sided. In an industrial context, such as the automotive industry, a necessary condition for interaction is that there be more than one actor – i.e., a relationship in which the interaction can take place. Based on the view of the process as one of interaction, I have further analyzed adoption outcomes and the technology about to be adopted itself. I have presented empirical material suggesting that in the industrial context, the object of adoption involves complex ICT systems, tailored and adapted to fulfill the needs and wants of a single specific business. This implies that the technologies studied were not in any way completely given, ready-made products, but rather that they were technological applications that could be seen as unfinished and negotiable solutions.

As all the cases of adoption demonstrate adoption processes that are open in terms of outcome, this exploration suggested that the more or less static and binary view on adoption outcomes is perhaps not the case in the industrial context. With a processual approach to adoption, it seems more useful to discuss status than outcomes. With the interaction and processual approach to the phenomena of adoption, I propose a model of the adoption process that contains three interconnected facets or sub-processes and that, I argue, better captures the dynamics and complexity of the adoption process than do previous, more

established, models. The model addresses adoption, technological development and marketing as three intimately interrelated and overlapping processes.

A key argument extending the perspective of adoption, including its methodological implications to address adoption with a processual, qualitative and longitudinal approach, is that adoption is a process of interaction. This thesis provides empirical materials supporting such an approach. With an interaction approach to adoption, as outlined in the proposed process model in Figure 48, one could avoid addressing adoption as a static and one-sided phenomenon. In addition, by addressing it as an embedded phenomenon, the inter-processual dynamics that might be at work and be affecting the adoption process can be appreciated and taken into consideration. By addressing adoption as a phenomenon involving interaction, thereby involving two or more firms, several perspectives on the adoption process demand flexibility in perspectives and approach to understand adoption processes and their complexity. Adding process scope as an additional dimension shows how the adoption process can change character under the course of adoption, demanding flexibility and multiplicity in levels of analysis. This multifaceted view will, on the one hand, add to our understanding of the complexity of the adoption process. On the other hand, however, the extended perspective on the adoption process also addresses the difficulties of more general insights on the adoption process in the industrial context. In the next chapter I will conclude how this empirical study can be used to challenge prevalent conceptualizations in order to rethink adoption. In Chapter 6 I will extend the discussion on the significance of the entities in the applied conceptualization given the industrial context:

- Object of adoption – technology as an open solution (cf. given product)
- Subject of adoption – adoption as something ongoing between and within actors (cf. adoption as a single-firm issue)
- Process of adoption – adoption as an ongoing process of interaction (cf. linear)
- Context of adoption – adoption as a process of embedded interaction and context as part of the process (cf. context as ‘out there’)
- Outcome of adoption – adoption outcomes discussed in terms of status (cf. binary)

With this proposition, in order to fulfill the purpose of this thesis, I aim to rethink the conceptualization of adoption I have applied throughout this thesis.

CHAPTER 6

Rethinking adoption - challenging prevalent conceptualizations of adoption

In this final chapter, I present a discussion on the conclusions drawn from this study, which can be summarized as a challenge of prevalent conceptualizations of organizational level information and communications technology (ICT) adoption. Based on my empirical study and theoretical and methodological orientations, I will also suggest areas that might be interesting for further research and discuss lessons learnt from this study. To illustrate and ultimately point out that adoption in the industrial context is an ongoing phenomenon that we need to understand through a processual approach, I will close this chapter by returning to the cases of organizational level of adoption one last time.

6.1 Conclusions

Through a processual and longitudinal case study approach, taking the complex and embedded nature of ICT applications into consideration, I have collected empirical materials concerning five separate and unique cases of adoption processes. The cases are, either directly or indirectly, related to the Swedish automobile industry. With its scope and importance for the Swedish economy, the automobile industry has provided me with an interesting and challenging context from which I have selected a set of adoption processes to track and study over time. The empirical materials in terms of case descriptions all follow a structure based on a conceptualization of adoption that is derived from the prevalent literature on adoption and diffusion. Through an exploration of the empirical materials, across the five entities of the conceptualization I have found several instances of misfit between established conceptualizations and my empirical findings on ICT adoption processes in the industrial setting. In this chapter I will outline in detail the conclusions drawn from this study. Although it is perhaps up to others to evaluate whether my study represents a contribution to the field, I also broadly sketch a

suggestion on where I think my contribution lies: an empirical argument for an alternative view on adoption and a challenge on prevalent conceptualizations of adoption.

In the introduction of this thesis, I develop a problem discussion on the promises and problems that the strategic importance of ICT stipulates and the paradoxical nature of technology. Through a structure based on the conceptualization of adoption presented in the theoretical framework, conducting both within- and cross-case analysis, I have disseminated the empirical materials. The purpose of this thesis was set to be:

to empirically explore information and communications technology adoption in an industrial context in order to challenge prevalent conceptualizations of adoption.

From an exploration of the empirical materials, structured along the five entities in the conceptualization, a basis for extended understanding and a rethought conceptualization of adoption in the industrial context has emerged. The proposed view on adoption is strongly influenced by the theoretical positioning and the empirical boundaries of this thesis. I will elaborate on this further in the coming sections.

6.1.1 An empirical argument for an alternative view on adoption

This study approaches adoption as a processual phenomenon. The cases of adoption processes that this thesis concerns and that I have discussed at length all in some way or another, either fully or partly, point toward and demonstrating the problems of viewing adoption as a linear, rational, single-firm problem that concerns a given object and a few predetermined possible outcomes (e.g., adoption or non-adoption). Hence, the two chapters Chapter 4 and Chapter 5 providing empirical materials and analysis in this thesis provide an empirical argument for the need for an alternative, rethought, view on adoption. The necessity of this extended view is a conclusion drawn from this thesis.

Approaching adoption as a process is not new in the field. An overview of previous literature shows that several scholars have called for further studies on organizational level adoption applying a processual approach (e.g., Kurnia and Johnston 2000). However, in contrast to most processual studies on adoption, this study extends the view to also consider adoption as a process of interaction and has in its turn the character of being organic and embedded. This view on adoption as

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interaction is less explored within the field of adoption. The view proposed here is strongly influenced by the theoretical positioning of this thesis. With this alternative view on organizational level adoption one could, instead of and in contrast with prevalent streams in the adoption literature, consider adoption as:

the ongoing process of embedded interaction by which a technology is developed and eventually decided on by an actor, a decision that should be viewed as status rather than a one-time decision

The literature that empirically investigates interaction and marketing in an industrial context often elevates the specific characteristics, distinguishing it from the consumer marketing context (e.g., Ford 2001; Håkansson 1982; Håkansson et al. 2004). This is also the case for some streams of literature on adoption (e.g., Hausman et al. 2005; Webster 1971; Woodside and Biemans 2005b). In the theoretical framework, I outline a few fundamental characteristics of the industrial context. I argue that the characters identified are important since they are likely to affect the nature of ICT adoption processes in an industrial context. These characters are also an important part of my understanding of the automobile industry as an industrial context in which the five case studies I have conducted are embedded.

In light of the proposed lack of empirical studies with a processual, qualitative and longitudinal approach studying organizational level ICT adoption as discussed in the theoretical framework (e.g., Kurnia and Johnston 2000), the study adds to and contributes with both a rethought conceptual framework and an empirical investigation of adoption as a process embedded in such an industrial context. Taking into consideration the proposed fundamental characteristics of the industrial context, and following a discourse of the literature concerning industrial marketing where attention to networks, relationships and complexity has been argued to be a necessary path for studies concerning innovation, diffusion, and adoption processes (Woodside and Biemans 2005a), this study contributes with an empirical investigation of adoption as a process of interaction embedded in relationships and networks.

Through my studying the process longitudinally and following adoption processes over time and not stopping studying them even after points at which one could have considered them to have reached an outcome in terms of adoption or non-adoption, the five case studies show how important it is to understand that adoption is an ongoing process and that adoption outcomes are perhaps better discussed in terms of status than in terms of something as static as prevalent studies

tend to do. The longitudinal approach corroborates the view among scholars who have previously argued that a longitudinal approach is the key to understanding adoption of technology adoption and technological development (e.g., Cooper 2000; Lancioni et al. 2003), including those who developed the notion of the temporal embeddedness of technological development (e.g., Håkansson and Waluszewski 2003; Rosenberg 1994). The approach also sheds empirical light on the adoption process, seen over time, which includes many actors who at times have diverging views in the technology, and its promise, as well as the process, its boundaries and the context of adoption. Further, it is not only the process that evolves over time. The study also contributes with an empirical investigation of how the technology involved in the adoption process develops over time and changes along the course.

The research I have conducted is centered on the automobile industry in the sense that in some way, either directly or indirectly, this industry as a context is an important dimension to consider in the adoption processes under study. This embeddedness in an institutional/industrial context of a technology or technological development fits well with the view on adoption and diffusion asserted by some previous research within the discourse, to which I aim to contribute (e.g., Damsgaard and Lyytinen 2001; Woodside and Biemans 2005b), although my level of analysis is primarily the firm level. Through case studies on five unique adoption processes of ICT in the Swedish automobile industry, the study contributes with an empirical investigation of adoption processes in the automobile industry. ICT development in the automobile industry in Sweden is strongly influenced by the embedded interaction with actors including Odette International and other industry interest organizations, including those who organize the automotive component suppliers. This interaction is necessary due to the global nature of the industry and the need to coordinate technological development both within and across firm borders. Industrial actors like Odette take not only a reactive role as an industry organization supporting its members and their explicit interests, but sometimes also a proactive and leading role for technological development in the industry, aiming for broad adoption and the development of industry standards, like they did in the case of EDI in the 1980s and 1990s and as they currently do in the case of ENGDAT, for example. Approaching the adoption process as one of interaction sheds empirical light on how complex and embedded the development of technology can be and how important it is to grasp that the firms involved in the adoption process sometimes seem to be mutually involved in the development of the application, although they might have different interests and levels of involvement.

6.1.2 The study as a challenge to prevalent conceptualizations of adoption

For some time, the concept of adoption has drawn quite some attention and efforts at conceptual development, often with a starting point in the contributions of Rogers (1995) or Bass (1986), for example. Although much research has approached adoption with cross-sectional research and through a factor approach, considering adoption to be a phenomenon concerning a single firm and its isolated decision, this study contributes with an empirical investigation of adoption as a process of organic and embedded interaction. As discussed in the previous section, this study concludes for the necessity of a rethought conceptual framework and an empirical investigation of adoption as a process embedded in such an industrial context. In my exploration of the empirical materials in this thesis, I systematically and continuously aim to refer to previous research that in some way or another relates to what I have found empirical support for as drivers for an alternative view on adoption. It is perhaps also in the synthesis of these findings as the findings themselves that an additional contribution lies. As pointed out in Chapter 5, my analysis and conclusions tie in to an ongoing discussion on adoption and specifically the streams of criticism of prevalent research on ICT adoption outlined in Section 2.3. By returning to the conceptualization of adoption I outlined in the theoretical framework, a summary of the alternative view on adoption can be proposed. This proposition consists in essence of a rethought significance of the entities in the conceptualization of adoption that I have applied throughout the thesis as outlined in table Table 25.

Firstly, this study concludes for the need to approach the object of adoption as something negotiated, rather than something given. I have discussed the limitations of the established view on both the technology and its nature and boundaries and adoption outcomes, i.e., problems with isolating or defining adoption outcomes, by presenting arguments for treating technological applications as something that develops rather than something that is accepted or not accepted. Through an exploration and dissemination of my empirical cases, I have also called for a more multifaceted view on adoption outcomes. I claim that given the interactive and ongoing nature of the adoption process, given and planned outcomes might – and are likely to – change during the process. For this reason, I have chosen to have the promise of the technological application under study as the starting point of each empirical case. For example, in the case of Volvo Cars IT and the promise of shared product data the object of adoption, ENG DAT, is not a given but rather something developing over time and open for negotiation and interaction within the task force consisting of actors in the automotive industry.

Table 25. Rethought adoption – a proposition on an alternative view

	Conceptualization as outlined in the prevalent literature	Alternative view on adoption in the industrial context
Object of adoption	Technology as a given solution	Technology as an open solution
Subject of adoption	Adoption as a single-firm issue	Adoption as something ongoing between and within actors
Process of adoption	Adoption as a linear and straightforward process	Adoption as an ongoing non-linear organic process of interaction
Context of adoption	Context of adoption as something 'out there'	Adoption as a process of embedded interaction and context as part of the process
Outcome of adoption	Adoption as binary	Adoption outcomes discussed in terms of status

Continuing with the case of Volvo Cars IT and the promise of shared product data, studying and tracking the development of ENGDAT has been a true challenge, not least since the nature of the application is intangible and also seemingly in constant change. This has also had methodological implications since I have been faced with the question of what the application truly is and where its boundaries are. In accordance with the dynamic development in the industry over the past 20 years, ENGDAT has changed character, technical features and scope. Given my empirical exploration, a revised view on outcomes and object of adoption indicates the importance of the promise that the technology under study carries, since it affects the way the firms involved in the adoption process and how they gain support and understanding for the adoption process and the technology to be adopted, how the

firms involved negotiate content and function of the applications under development and how progress in the adoption process is managed and pursued.

Second, this study concludes on the subject of adoption and brings new significance to the concept of adoption as something ongoing between actors, in interaction. My aim here has been to, through a discussion of the multiplicity of actors, perspectives and interests involved in an adoption process, suggest a more nuanced and extended view on the subject of adoption. In Chapter 5, I start by analyzing the empirical materials, addressing and discussing organizational level ICT adoption as a process of interaction. This discussion is driven by what came from the within-case analyses that concluded each case description in the previous section. There, I found that different perspectives are important in the aim to extend the understanding of adoption processes. A necessary condition for interaction is that there is more than one active entity; that is, for example, a relationship in which the interaction can take place. Having two or more parties interacting also entails the possibility of different perspectives on the technology and its boundaries, the process and its outcomes.

In the case of Sapa Profiler and the promise of data feed automation, interaction is demonstrated through the focal relationship and the participation in the ETUI project. The application the case centers around is a product of needs identified in interaction within the ETUI project and later developed by Länsteknikcentrum. Adoption is also demonstrated as something that takes place in interaction within an organization, as the adoption of the application that is to solve the problem of double feeding in the supply network of Sapa Profiler is hindered by other related processes taking place within the Sapa Group. Without considering these related processes and the interaction across and within firms, the adoption process in the case of Sapa Profiler and the promise of data feed automation would look different and the full complexity of the process would not be acknowledged.

Third, this study concludes with the view of adoption as an ongoing process of interaction. An observation across my cases is that the prevalent view on the adoption process as linear and straightforward needs to be rethought. Such an effort has been asserted as necessary from within the field of adoption as well. For example, Philip and Booth (2001) argued that adoption should not be viewed as linear. In my empirical explorations, for example, I demonstrate in the case of Volvo Cars and the promise of supply chain visibility that the adoption process of SCMo is something other than linear or straightforward. The project group working with SCMo at Volvo Cars with representatives from Odette Sweden did not find enough support for implementation and pilot testing of the application in

Sweden. Looking across the industry, the hope to implement SCMo is still present, and across Europe other supply networks have successfully implemented the application. As noted by the managing director of Odette Sweden the question is not when, but how and by whom, SCMo will be adopted in Sweden. Perhaps then, but not as early adopters, Volvo Cars will be ready for implementation.

When proposing a rethought model of the adoption process, I find inspiration for such an effort in previous literature that has presented an organic approach to strategy in the industrial context. As discussed in Chapter 2, an extension of this approach to strategy is sometimes referred to as strategizing in the industrial context, by which the manager needs to negotiate strategy on the micro-level, considering interdependencies and relational embeddedness (e.g., Ford et al. 2002; Gadde et al. 2003; Johnson et al. 2003). With the proposal of a model that suggests an alternative view of the nature of the process, the understanding of the process of adoption is extended beyond the more atomistic approaches to adoption. I propose a view of the adoption process as organic and non-linear in the chapter in which I present my analysis of the empirical material this thesis builds on. The proposed model of the adoption process has three interconnected facets or sub-processes that, I argue, capture the dynamics and complexity of the adoption process better than previous, more established, linear process models. In addition, as a consequence of the organic view on the adoption process, the model also implies adoption, technological development and marketing as three intimately interrelated and overlapping processes. The approach to adoption as a process of interaction, including the model implicating an organic view on the adoption process, is presented later in this chapter as a potentially fruitful conceptual platform for future research on adoption.

Fourth, this study concludes by suggesting that the proposed process model is also embedded in a context of other processes of adoption and interaction. This approach is strongly connected to the approach of viewing the conduct in the industrial setting as interaction, as argued within industrial marketing domain (e.g., Håkansson 1982; Turnbull et al. 1996). I assert that adoption is a process of embedded interaction and context as part of the process and not simply a factor affecting the process from the outside. I suggest that an important path to a broader understanding of the adoption process as a whole is to treat it as a part of something broader – I address this by considering the inter- and intra-processual dynamics of the adoption process and the need to pay attention to a variable adoption process scope. For example, in the case of Tidamek and the promise of shared project space, I demonstrate how the adoption process of an extranet solution providing the focal relationship with a necessary project management platform was hindered by

Tidamek's resource scarcity and the production manager at Tidamek having to prioritize other parallel adoption processes at the expense of the project he was engaged in with Sandvik Coromant. Although the prerequisites seemed perfect, the project to implement an extranet solution failed. The study presented here provided empirical descriptions underpinning the view that context is not only an aspect affecting the decision to adopt but also an important piece of the entire essence of the process – including the technology itself and how it is negotiated.

Fifth, an observation across my cases is that the view of technology as something negotiated and ongoing, as an alternative to the given and static phenomenon, is an important part of the extended understanding of the technology adoption process. In the case of Nässjötryckeriet and the promise of electronic procurement, one could ask whether the outcome was adoption or non-adoption. The case demonstrates a situation in which Nässjötryckeriet, forced by Volvo Cars Corporation and tempted to be able to bid on new and extended business, adopted e-auctions and bid on a contract for printed products. However, when they did not receive the deal or win extended business with Volvo Cars, Nässjötryckeriet did not use the application provided to them again. When returning to the case some time after the sequence of events with Volvo Cars, the management at Nässjötryckeriet claimed that they no longer used e-auctions and had no plans whatsoever to do so again, if not forced to.

The case of Nässjötryckeriet demonstrates an interesting situation that corresponds well with the expressed need to open up for alternative views on organizational level ICT adoption process outcomes and, also, the need for empirical studies focusing specifically on organizational level ICT non-adoption. The view on adoption as a process of interaction pinpoints the difficulty in isolating and discussing success and failure in adoption processes and presents a more nuanced view on the concept. Instead of contributing to the stream of studies that explicitly search for and disseminate processes with non-adoption as the outcome, this study presents an alternative view. An observation across the cases outlined in this thesis is the problem of isolating and defining adoption outcomes. Through approaching adoption as a process of interaction, this study implies and proposes a revised view on the adoption process outcome. In order to better understand the outcomes in empirical studies on the adoption process, one might need to discuss status rather than outcome.

6.1.3 The term adoption and its limitations

In this sub-section I will discuss the term adoption and its implications and limitations. The term adoption is used in many different ways and in many different fields of research, most often with references to some of the important contributors to the field, like Rogers (e.g., 1995) or other scholars with great influence within the field of marketing, like Webster (e.g., 1971; 1969). However, given the conclusions drawn from the study reported here on organizational level ICT adoption, the term adoption can be problematic to handle and adopt as a concept describing adoption in this particular setting. Replacing the term adoption with some other term when discussing adoption in this thesis would probably not benefit the study, either in clarity or in possibilities to communicate its findings.

The concept and term adoption, as demonstrated in the presentation of adoption research I outlined in Section 2.1 and commented on in Section 2.3, seems to have an inherent pro-innovation bias (Abrahamson 1991:487-489; Frambach 1993:36-37). Studying adoption, the term itself refers to a specific outcome of the process in which the firm is about to initiate (i.e., fulfilled adoption). Therefore, the concept seems to assume that adoption, as a positive thing, is the outcome one should strive for. In a study assuming voluntarism and a firm's ability to choose without circumscription, this assumption may be correct. In accordance with the characters of the industrial market as outlined in Section 2.2, the industrial context presents an environment that does not square with this. Given the lack of choices due to the structural, relational and temporal interdependencies and the presence of positions, roles and interests that the industrial context implies, it is difficult to assume either that a certain technology presented to a firm is (always) the right thing or that a technology presented to a firm is possible to adopt (although it might be right and a positive thing).

In addition to technology bias, the term adoption also signals that technology adoption is to be seen from a single-firm perspective, as it essentially refers to the decision to adopt. As I have already discussed in Chapter 5, prevalent conceptualizations of adoption often approach adoption more or less solely as a single-firm problem with external influences affecting the decision to adopt or not. For example, the most established definition on adoption, provided by Rogers (1995), clearly suggests that this decision process concerns a single decision-making unit. However, despite the signals given by the concept of adoption, and as shown in the empirical exploration of the five cases of adoption outlined in this study, the

subject of adoption in the industrial context stands out as a process of interaction and, in essence, a single-firm decision but not a single-firm problem.

This thesis discusses and attempts to extend the conceptualizations of adoption. The purpose of this thesis is to challenge prevalent conceptualizations. An alternative path could have been to re-conceptualize (i.e., to suggest new and more suitable concepts). However, as the use of the term adoption is so established in both the field of adoption and related fields, using or introducing an alternative concept or term would probably not benefit the study, either in clarity or in possibilities to communicate its findings. Instead, this thesis proposes an extended view on adoption – that we instead need to use adoption but add to it by extending its meaning and significance in the industrial context by addressing adoption in interaction. As interaction is a key character of the industrial context, it becomes an important aspect of adoption occurring in the industrial context. This study not only demonstrates the presence of interaction but also shows the important role that interaction plays in the organizational level ICT adoption process.

Before this discussion on the term and concept of adoption is concluded, it should also be noted that using the conceptualization of adoption that this thesis takes on, we also need to consider that the five entities in this conceptualization are interrelated and overlapping. For the purpose of my thesis work, applying such a conceptualization and following through its application throughout the process has been very rewarding. By addressing adoption through such a generic framework, I have come to realize and appreciate that what such a conceptualization demonstrates can be useful for other areas of study as well. Adopting a generic conceptualization certainly increases the communicability of a report and the clarity of the conceptual frame. In Section 5.1, I aim to graphically demonstrate how the entities of the conceptualization of adoption are related and overlapped. This overlapping nature of the concept fits well with my findings on the concept and has important implications for how we use and apply the entities of adoption as well. When studying adoption, we therefore cannot isolate one entity from all others and only look at the process or the object of adoption, but need to consider all possible aspects of the conceptualization.

6.1.4 The development of ICT in the automobile industry

As noted by several previous studies, the speed of development concerning ICT makes it an interesting area for research. Looking at the literature, the promises of ICT are at all times very present and are often demonstrated in a somewhat limited reflective approach and in an uncritical manner regarding how we conceptually and

practically treat ICT. The pace and patterns of change, sometimes revolutionary developments, corroborate my conclusions on how we should approach the object of adoption in the industrial context. The automotive industry itself also represents an interesting and challenging field for empirical research. Combined with the progress and speed regarding ICT during the past decades, I have found the development of ICT in the automobile industry to be a truly promising challenge for interesting research.

During recent years, we have seen an interesting development of new types of promising applications and systems, all targeted toward a more efficient and effective automobile industry. These systems have not always passed the drawing board and have even more seldom reached broad diffusion. Some systems have reached public awareness while others have remained concepts discussed in meetings either within or across firm borders. Two such super-systems that have attracted significant attention are eVerest and Covisint. Neither of these systems has been able to fulfill the expectations from the automotive industry, and both are currently living a life in the dim shadows of the industry. The development is interesting and complex, and difficult to foresee or predict. As noted by a Swedish colleague (Lennstrand 2001), an interesting paradoxical aspect of ICT is that although the development tends to be fast and the technology is designed to make things faster (e.g., automated), changes in behavioral patterns among users tend to be slow.

The systems of eVerest and Covisint, but also SCMo and ENGDAT, must be seen and understood in the light of the forceful developments that have taken place in the industry during the past two decades. With the culmination of mergers and acquisitions among automobile manufacturers during recent years, increasing developments of super-systems have followed. The reason is of course that automobile manufacturers are seeking scale advantages and using ICT as a means to reach those advantages through seeking for ICT solutions that enable standardized ways to boost communication, collaboration and competition. Although ICT has been disputed as being so taken for granted in business activities that it does not form a base for the creation of competitive advantage as it perhaps did a decade ago (Carr 2003), ICT as a means to reap scale advantages across firm operations is still a very valid base for the indirect creation of competitive advantages through cost compression. The question that remains is how these projects can be realized and if they are at all possible to realize. Could it be that the three geographical areas the automobile industry has historically been divided into still largely affect the way business is conducted?

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For the Volvo Cars Corporation, a firm that all my cases are related to either directly or indirectly, the landscape and management of ICT seems to have changed quite dramatically with the FMC acquisition of Volvo Cars in 1999. For the Swedish automotive industry in general terms, the shift of ownership in both Volvo Cars and Saab Automobile has affected the ability of the industry to act as 'one'. Without the existence of Odette Sweden, the industry-common developments would probably have been very different. In this way, my study is not only a demonstration of the presence of interaction but also a study showing the important role interaction plays in automotive ICT development. With their strong influence in the development of EDI in the 1980s, Odette Sweden with their reputation and organization is still an important influence in how ICTs develop and are negotiated in the Swedish automotive industry. For example, the management at Odette Sweden was an active party in the development of both ENGDAT and SCMo, and in 2007 is also running projects on industry-common material tracking as well as global invoicing. With non-Swedish and non-European ownership of automotive actors and with non-Swedish and non-European suppliers acting in Sweden, the preservation of European interests for suppliers and automobile actors who still have Swedish and European operations and ownership is important.

6.2 The implications of this study

The study I have conducted has a number of implications for future research and for practice. Following the reasoning of a pragmatic approach to science and knowledge, that value of and truth in scientific progress lie in the ability to apply the knowledge in the practice, James argued (1907/2000:88):

The truth of an idea is not a stagnant property inherent in it. Truth happens to an idea. It becomes true, is made true by events.

In this section, I have divided the implications into three groups: managerial implications, methodological implications and implications for further research. By tying into the stream of studies that approach adoption as a process of interaction, one can also relate to the implications brought to the fore by this field of study.

6.2.1 Managerial implications

Academic work is most often evaluated by peers based on its theoretical height and precision, methodological rigor and credibility and theoretical and methodological newness. Academics seek to advance their specific and narrow field by doing things that have not been done before, whether it be seeing things from a new perspective or trying new ways of measuring or studying a phenomenon. An additional variable for measuring the value of research in business administration, also by peers, is the practical relevance of the research and what managerial implications can be derived from the research. Managerial implications are implications that spring from the exercise of the researcher turning conclusions into suggestions on how adoption processes in practice can be better and more efficiently managed. Seen from outside the field looking in, practical relevance is naturally valued as the most important of these measurements. Given the nature of business administration, and how it develops in symbiosis with its practitioners and their practice, has historically been important to derive managerial implications in order to legitimate business administration research and education (e.g., Engwall 1992). In my research project, a key to being granted access to the empirical field has been to argue for practical relevance. As argued by Woodside and Biemans (2005a), empirical materials concerning for example adoption processes and explicit retrospection of such materials can be used to revise how the development in such processed can be

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understood and how decisions made in such processes can be improved. My managerial implications can be summarized as follows:

- The importance of understanding the presence and role of interaction in adoption processes
- The importance of understanding the opportunities and limitations for management in adoption processes
- The importance of understanding the opportunities and limitations inherent in the embeddedness of adoption processes

Based on my empirical accounts of the adoption processes that my research concerns, it should come as no surprise that adoption processes from the practitioners' points of view are considered strategically important, intensely complex and often too time- and resource-consuming. Decisions regarding information and communications technology carry both promises and problems. Although this thesis has shown that adoption processes concern multiple actors who sometimes have diverging views on the technology, its promise and the process, its boundaries and the context of adoption, the conclusion is still that these firms can manage within these processes – although given the involvement of multiple actors, the room for choice is somewhat circumscribed. In this section, I will outline managerial implications along two dimensions: managerial opportunities found in the broader understanding of the nature and context of organizational level ICT adoption process and managerial implications for those assigned with managing ICT adoption processes.

Given the alternative and extended view on adoption processes this thesis outlines, there are potential opportunities for competitive thrust found in the broader understanding of the nature and context of organizational level ICT adoption process. I would like to elevate three such opportunities. First, this thesis has proposed an alternative view on the object of adoption in the adoption processes under study. In my analysis, I discuss the limitations of the established view on the nature of the object of adoption. I present a view on the object of adoption as something that develops rather than something that is accepted or not accepted. For practitioners involved in adoption processes, this view has its implications and a potential opportunity for competitive thrust. For practitioners involved in the adoption process, the more open view on the object of adoption in question can be used as an aspect of negotiation – which it often is – and thereby facilitate progress in the adoption process. Through this approach, the key focus is the fulfillment of the technology's promise rather than the technology itself.

Second, in this thesis I have presented a model of the adoption process that contains three interconnected facets or sub-processes and, I argue, better captures the dynamics and complexity of the adoption process than previous more established models. For practitioners involved in adoption processes, understanding that the adoption process is one of interaction is a potential opportunity for competitive thrust. Interaction patterns can work as both drivers and barriers in the adoption process. For practitioners involved in adoption processes, the managerial actions can use the connectedness, and contextedness, of adoption processes as a means of affecting the sub-processes in the adoption process. A deeper understanding of the embedded nature of the adoption process and its inherent dynamics is likely to improve the ability to manage in it. Adoption processes cannot be managed completely from a single-firm perspective in the industrial context, but one can manage within them. Four areas might be specifically interesting to investigate further and develop normative theory on:

- How to manage in an interactive environment such as the industrial context, given the interdependencies, complexities and dynamics that are at play
- How to map and evaluate the process scope and the different actors involved in the process and their respective roles
- How to identify connected adoption processes and evaluate the risks involved in possible process overlaps, as these overlaps can function as both drivers and barriers in the adoption process
- How to identify and exploit “the promise” of technology for each actor and evaluate their ability to influence (both positively and negatively)

An important implication is that these sub-processes efficiently could, and should, be given attention to simultaneously. As technologies might change over the course of the adoption process, and as time and cost are two important factors affecting the way the project is evaluated, pursuing and maintaining progress and winning acceptance for the object of adoption also need to be dealt with during the development of the application in question. An additional implication that can be outlined from the research reported here is the importance of mapping and evaluating the process scope and the possible synergies of and threats to progress, found in both the inner and outer context of the adoption process. Through such an analysis, practitioners involved in adoption processes could actively (cf. reactively) manage in the adoption process, reaching and maintaining progress toward implementation.

Third, based on, for example, my view on the nature of the object of adoption as something negotiable and developing during the course of adoption, and the view of the adoption process as a process of ongoing interaction, I also elevate the role of the promise of adoption. I began this thesis with a discussion on the promise of technology. I argued that technology is fascinating in the sense that we tend to put a great deal of trust in technology to help us make things more efficient and effective. So do firms. For practitioners involved in adoption processes, understanding the importance of the promise of technology has implications and can be seen as a potential opportunity for competitive thrust. In the model I outline, I place the process of gaining understanding and support on equal terms with that of negotiating content and pursuing and maintaining progress in the adoption process. Although a promise for all actors involved is not in any way sufficient for a technology to reach implementation, the communication of this promise to all involved is one way to facilitate understanding of and support for the technology.

In much of the normative literature on adoption, the term success is frequently used. A normal approach in this literature is to generate general critical success factors (e.g., Hong and Kim 2002; Motwani et al. 2005). In light of the conclusions drawn in my study, especially regarding the interactive nature of adoption, the term success becomes interesting to reflect on. With a single-firm perspective on adoption, often seen from the perspective opposite the subject of adoption, with the subject of adoption as an entity, essentially passively passing through a linear adoption process, that needs to be convinced and influenced to adopt a certain technology, critical success factors make sense. With a view on the adoption process as one of interaction, success is not necessarily equal to adoption – success might be non-adoption. Success is fulfilling the promise rather than adopting a specific something. A firm might consider a project successful based on the lessons learnt about the technology or the relationship in which one attempted to implement the technology, without successful implementation. With a more nuanced view on adoption outcomes and adoption process success, success might be reaching the promise of technology. The path to this promise is not necessarily linear. It is not necessarily adoption. However, the path requires negotiation, interaction and understanding of mutual dependency and embeddedness in every unique case. Understanding this is a critical success factor.

6.2.2 Methodological implications

With several years of fieldwork, writing and analysis and frequent contacts with the empirical field regarding the five cases of ICT adoption processes, conclusions in

terms of methodological implications can of course be drawn from a study of this scope. As pointed out by several, a study on inter-organizational ICT is a considerable challenge for the researcher (e.g., Howard and Holweg 2004). With a few specific particularities on how the empirical materials were to be collected, and with a very structured approach on which cases to select and which contacts to make in the field, what then can a study, although it perhaps does not present any unique or new methodological techniques, contribute in terms of lessons learnt on methodology? My methodological implications can be summarized as follows:

- The importance of having key respondents, both to enable deeper understanding of the technology and context under study and to grant access to the empirical setting
- The importance of trust when studying problematic processes – and the problems this participative strategy might imply
- The importance of having follow-up sessions during the course of the process of adoption, including follow-up sessions during and after implementation

The importance of having multiple sources is that one might (and probably will) find diverging and emerging stakes and interests. The phenomenon under study, ICT adoption processes, here conceptualized and approached as processes of embedded interaction, calls for some specific measures in terms of methodology. For example, there are specific implications for studies aiming to identify and track processes with problems or that from a project-participant point of view are considered failures or cases of non-adoption. A lesson learnt from my empirical study has been the important role the key respondents have played in my fieldwork. They have been important in many ways. Firstly, as the technologies under study sometimes have been conceptual and not yet developed, the key respondents have been important in explaining and outlining what the ‘promise of the technology’ carries as well as how the technology works and whom and what it concerns. The by far most complex technology in my study is the product data exchange standard called ENGDAT, described in the case of Volvo Cars and the promise of shared product data. Without the help of a key respondent, in this case an associate working with product data management at Volvo Cars IT, I would not have been able to capture anything of the process. In this particular case, due to conflicting interests and diverging images, I dealt with two respondents for some time, both of whom I considered key respondents. Second, a key respondent usually has good contacts involved in the adoption process and is therefore helpful in linking the researcher to other relevant respondents in the case. In my fieldwork, the key respondents have been project managers or have had direct influence on the

development of the application, but have not necessarily been in a position to make strategic decisions concerning the technology. Third, as the cases in my study have been studied over time, it has been critical to have someone to regularly contact and check the status of the project.

In several of the cases of adoption processes I have studied, I have been placed in situations in which access to the adoption process has been difficult to gain. In some of my cases, it has been difficult to gain access to the adoption process at certain points in time more than at others, depending on the status and events taking place in the process under study. For example, in situations in which the adoption process from some project-participant point of view is considered a failure or a case of non-adoption, the willingness to grant access to an “outsider” is not as high as in situations in which everything is running smoothly and according to plan. In situations in which the firm has something positive to present and talk about, it is often easy to get an appointment or given access to meetings. In situations in which things are not going the way some actor involved in the process expects or strives for, incentives to grant access or share their view on the situation become fewer and fewer. For an outsider trying to understand what is happening, getting access to problematic adoption processes can be a tough challenge. In these situations, with reference to what has already been said about the critical role of the key respondents, the trust of certain people involved has proven to be critical in my fieldwork. In retrospect, my strategy to alter my own participation in the adoption process and sometimes act as consultant/sounding board to gain deeper access has proven to work very well. For example, without my participation in the project group in the case of Volvo Cars and the promise of supply chain visibility, I truly do not imagine I would have gained access to this adoption process.

Taking part in the project as a participant has in some cases given me unique access to situations in which an outsider clearly would have been asked not to participate. A question that can be elevated here is what implications this research strategy has on my research project. In the case of Volvo Cars and the promise of supply chain visibility, I would not have been able to follow the project as closely as I did without access through the SCMo project group I was part of along with colleagues Susanne Hertz and Benedikte Borgström. However, as part of the project group, my conceptual base or conceptual orientation (i.e., to study the interaction between firms within the adoption project) was not explicitly discussed. I did not set the agenda for the research project, as there were several participants from JIBS with a focus on supply management. Concerning SCMo, I was part of the project as a supply management researcher with a specific focus on ICT and not as a technology adoption researcher with a focus on ICT in a supply management context.

This study contributes with an empirical investigation of adoption processes over time. A methodological implication of the processual, qualitative and longitudinal studying organizational level ICT adoption is the importance of holding follow-up sessions during the course of the process, as well as during and after implementation. I made this an explicit part of my research methodology. Other studies have done the same. For those who conduct research that is normally set up as cross-sectional, the dynamics of the adoption process and the possibilities for change in outcomes are especially important. For example, Speier and Venkatesh (2002) applied a research approach by which they collected data across several points in time of the adoption process at two firms, including a user follow-up three months after implementation of the technology in question in their study. Lancioni et al. (2003) also emphasize the necessity to follow up, for example, adoption survey research in order to be able to track adoption trends over time. As my broader understanding of the organizational level ICT adoption process emerged, I realized that following up the status of the adoption process over time enables the researcher to once again open up the interpretation of outcomes – sometimes forcing the researcher to re-evaluate and reconsider previous conclusions. Clearly, a study over time has the potential to provide a more nuanced depiction of the adoption process.

There are several examples of how previous studies have argued for attention to alternative research methods for capturing the complexity and embedded nature of organizational level ICT adoption processes. For example, Kurnia and Johnston (2004) argued that the technology in question naturally introduces the need for the processual approach, claiming that the complexity of some technologies requires specific attention. Some have gone further in their arguments, asserting that the nature of the technologies in some contexts stipulates certain methodological demands and suggesting that the nature of the phenomenon under study calls for an approach that entails a single case study design (e.g., Motwani et al. 2005; Volkoff et al. 1999). On the matter of how to methodologically approach adoption processes, this thesis supports the view that the nature of the phenomenon calls for specific methodological attention. For example, I have approached the technologies from several perspectives, although the technological dimension has been an entry point, and my understanding of the adoption processes would not have been as nuanced and detailed if I had neglected the multiplicity found in perspectives. There are at least two aspects of perspectives that I would like to elevate here. Firstly, in accordance with Wilson (1996), for example, it is important to consider both ends of the relationship in which the technology adoption process evolves. Without input from each end of a focal relationship, it will be difficult to argue for credibility. Secondly, and as shown in my study, it is not only between firms that

one can find diverging perspectives. It is also within firms and across the departments (e.g., purchasing, marketing or production) in which a specific technology is aimed to be implemented that important input for broader understanding of the adoption process can be found.

6.2.3 Implications for future research

By studying the process longitudinally and following through adoption processes over time and specifically pointing at the dynamics of the process, I have found through the five case studies how important it is to understand that adoption is something ongoing, characterized by embedded interaction. In light of the conclusions drawn in my study, especially regarding the interactive nature of adoption, there are a few implications for further research that I would like to discuss. First, an important extension of this study would be to continue with a conceptual development of alternative approaches to adoption outcomes. In the literature, there is a clear tendency to study successful cases seen from the firm that is introducing the technology into a business relationship (e.g., Volvo Cars introducing e-auctions to Nässjötryckeriet). In the existing literature, process status and alternative approaches to adoption outcomes are only briefly discussed (e.g., Bush et al. 2005; Philip and Booth 2001), and how the concept of adoption outcome is conceptually treated in previous studies is exemplified in the theoretical framework of this thesis. The approach to adoption as a process of interaction is certainly a potentially fruitful conceptual platform for such future research. Corresponding with the needs of future research on adoption and diffusion within the domain of industrial marketing as expressed by Woodside and Biemans (2005a) and also by others (e.g., Kurnia and Johnston 2000) that there is a need for a new discourse within the adoption literature, the approach taken on in this study can be seen as a stepping-stone towards such a discourse or an initiative within such a discourse.

Second, as the literature as well as the empirical contributions of this study show, further research will need to study non-adoption and the drivers of non-adoption of ICT applications. Such studies would probably corroborate the assertion that the drivers of non-adoption are not necessarily a mirror image of the drivers of adoption. One interesting critique and extension of the literature on innovation adoption, in this case on the adoption of administrative techniques and not that of technology, are the works by Abrahamson (e.g., 1991), which present an interesting framework trying to determine when and how technically inefficient innovations diffuse, and, perhaps equally intriguing, when and how technically efficient innovations are rejected. Again, the approach to adoption as a process of interaction

is certainly a potentially fruitful conceptual platform for such future research. To further study non-adoption, or problematic adoption processes in the sense that they are negative experiences for some actors, also opens up for interesting methodological advances on how to approach problematic processes with respondents who are unwilling or unable to speak out on the problems they have had or are currently experiencing.

Third, in light of the conclusions drawn in my study, especially on the open and negotiable nature of the object of adoption in the industrial context, the role and development of the promise of technology clearly deserve further investigation. Although present and important in all my cases, the promise of technology is perhaps most strikingly present in the case of Volvo and the promise of supply visibility. I have with great interest observed how a few PowerPoint slides and a technical document presenting a concept have engaged people across Europe and resulted in both what was perceived as significant project failure and fulfilled expectations. Such studies could include the investigation of how such a promise of technology emerges and is communicated, transformed, realized and institutionalized within and across firms over time. In the case of Volvo cars and the promise of supply visibility, the process has just begun. Again, the approach to adoption as a process of interaction is certainly a potentially fruitful conceptual platform for such future research.

Fourth, in light of the discussion on the ongoing and interactive nature of adoption processes, further studies need to explore the overlap between the development, marketing and adoption of ICTs. Once again, the approach to adoption as a process of interaction is certainly a potentially fruitful conceptual platform for such future research. In light of the proposed lack of empirical studies with a processual, qualitative and longitudinal approach studying organizational level ICT adoption as discussed in the theoretical framework, this study contributes to the literature emphasizing the need to follow adoption over time. Infusing the concept of embedded interaction, the study contributes to this literature by bridging industrial marketing and adoption. However, much work is still to be done. The bridging of these two fields of research brings additions to not only the field of adoption but also that of industrial marketing. Through reasoning based on empirical observations, I have aimed to add to the literature that emphasizes the dynamism of industrial markets.

Fifth, continuing the discussion on interaction and adoption, and how adoption decisions emerge in interaction, one could further explore how the growing literature on strategizing and micro-strategy could be used to extend the

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understanding of adoption. Such efforts could further explore how adoption is part of the micro-level development of a marketing strategy or strategizing marketing. Through studying how this marketing in interaction described in the field of industrial marketing in practice involves development, adoption and adaptations of technology would further advance the literature on adoption. The study reported here could function as an empirical argument for such an effort and there are several interesting opportunities for further research in this area. In future research, one could either stay on the organizational level of adoption or study organizational level and individual level adoption simultaneously.

6.3 Epilogue – returning to the empirical cases

To illustrate and ultimately point out that adoption in the industrial context is an ongoing phenomenon we need to understand through a processual approach, I will close this chapter by returning to the empirical sources one last time. I made my last follow-up contact with the key respondents during fall 2006 and spring 2007. In the upcoming section, I present an account of the developments in the adoption processes this thesis builds on.

In the case of Volvo Cars IT and the promise of shared product data, the status is more or less status quo during spring 2007 compared to a year before. The management of process support and product data management at Volvo Cars are still working to migrate to the vision of a global solution for PDM within the Ford Group in terms with C3PNG. Initially, most of this migration has been in terms of usage of user applications that enable the creation and change of CAD models; i.e., in the case of Volvo Cars this concerns Catia V5 and Teamcenter. At Volvo Cars and in the data exchange with suppliers, in spring 2007 Volvo Cars is still using Exter and ENGDAT V2. During 2006 and 2007, a few minor tests have been performed on ENGDAT V3 but no decision has been made to implement this standard. The management of process support and product data management at Volvo Cars are closely monitoring the development in Germany and the development of PDM within the Ford Group. Since 2006, Volvo Cars is no longer represented in the SASIG XMTD task force on product data exchange. In 2007, Computer Sweden reports that the European automotive industry is turning toward changing its network standard for secure file transfer in the future to OFTP2, something that according to Volvo Cars IT could function as a driver in the turnover to ENGDAT V3 for Volvo Cars in the future.

For Tidamek AB, the project aimed at implementing a project platform to support collaboration in the relationship with Sandvik Coromant did not seem to recover from the problems in the pilot stage. Although this was considered a failure, the two firms are still collaborating through their partnership agreement. Despite the problems in the adoption process concerning Tidamek AB, Sandvik Coromant has continued to refine and develop their extranet as well as more general web solutions for customer support. The ideas of customer collaboration originally developed as a dummy version created as an internal demo of what the future e-service package could look like, later trialed at Tidamek, were from 2003 and onward developed further into more sophisticated solutions in a global project on customer web support. Some customers and industries seemed to be more eager to take part in the

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development, with a few customers in Denmark and a few enthusiastic Sandvik Coromant associates at the Danish subsidiary as champions of the project. Some of the visionary ideas on customized global customer collaboration that Sandvik Coromant was developing during the heyday of e-commerce are now slowly being realized.

During the spring of 2007, new momentum emerged in the adoption process concerning SCMo. As described in the case of Volvo Cars and the promise of supply chain visibility, the project came to a full halt in spring 2006 when the MERA application was rejected. In January 2007, Volvo Cars Logistics and Volvo IT arranged a workshop on supply chain management at which SCMo was presented alongside other developments in the field. According to SCMo project management, this spurred new interest and led to a request from Volvo Cars to let Volvo IT put together a project plan on how they, as part of existing EDI services, could handle a solution based on the SCMo software provided by Icon Supply Chain Management. At the seminar, the potential promise of SCMo to cut costs of monitoring critical supply was in focus. The presentation of SCMo as a concept was performed by German business consultants. In Germany, SCMo is in use in several different supply chain constellations. For example, at several conferences representatives of the solution provider Icon Supply Chain Management have reported on projects involving SCMo not only in more permanent operations but perhaps specifically as support in critical ramp-up projects concerning new automobile model information on more than 1,000 components in more than 80 supplier relationships.

The interest in coordination of supply data across firm borders in the business relationships Sapa Profler are engaged in is likely to grow, as Sapa was acquired by Orkla and was delisted from the Stockholm Stock Exchange in 2005. In addition, Sapa is broadening the scope of cross-firm collaboration further with several acquisitions and mergers of other industry actors by Sapa Profler, including Remi Claeys Aluminium (2003) and Alcoa (2007). At Sapa Profler, the application supporting double feeding avoidance was finally implemented in 2006. According to the management of Sapa Profler involved in the adoption process, the project with the co-supplier A-lackering has been problematic but is considered a successful project with the potential to develop further. The project has had several serious setbacks after 2004-2005, when new impetus came in the adoption process. The next step in the development of the application that was initiated as a sub-project under the ETUI project in 2002 is planned to also include automatic translation of packing information, production confirmation and invoicing.

Nässjötryckeriet AB did not win a new deal with Volvo Cars. In fact, Volvo Cars is no longer a customer of Nässjötryckeriet. Since a few years back, the management of Nässjötryckeriet has been active in both developing their product offering concerning digital products. Also, significant recourses have been placed in a project aimed at implementing ERP in the organization. More recently, in 2006, the management at Nässjötryckeriet again received an invitation to participate in e-auctions. This time, the invitation came from a private initiative that has targeted the segment of short series of printed products with short lead times. Like in the case of Nässjötryckeriet and the promise of electronic procurement, the management at Nässjötryckeriet is considering whether it is worth attention, as Nässjötryckeriet is still faithful to their aim to focus on few but close customer relationships with relatively large volumes and mutual long-term orientation.

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Appendix I – Interview guide outline

Each interview is introduced with short personal presentation and presentation of the purpose of the interview. As the interviews were semi-structured, follow-up questions in each interview are not showed in this interview guide. In cases where I met respondents at several times, the second interview would focus more on 3-7.

1. Personal questions:

- What are your responsibilities in firm A?
- How long have you worked for firm A?
- What is your role regarding application X?

2. Questions regarding the subject of adoption

- What is the value proposition (offer) of firm A and how is it offered?
- What are the current challenges that you as management of firm A currently face?
- Who are the key customers/key suppliers and other relationships that firm A do business with?
- Could you elaborate on the IT-systems that currently support your operations and how these are sourced?

3. Questions regarding the object of adoption

- How would you describe the features and benefits of application X?
- How does application X support the value proposition of firm A?
- Could you elaborate on the history/development of application X?
- What are the key hindering factors (technological/organizational/other) in the development of application X?

4. Questions regarding the context of adoption

- Could you elaborate on the setting in which application X and firm A is embedded in (e.g., in terms of important relationships/competitive pressure/power structures/other)?
- What other applications and systems are relevant in the development of application X?

5. Questions regarding the process of adoption

- Can you elaborate and describe the process of adoption/implementation (where are you now, what have you experienced as key events)?
- What does the current time frames look like in the development regarding application X?

6. Questions regarding the outcome of adoption

- Can you elaborate on your expectations on the current project regarding application X?
- When/why do you expect that you have implemented application X?
- Can you elaborate on the reasons for failure or problem (if any)?

7. Final questions:

- Is there any documentation that you think would be relevant for me to have a look at?
- Who else do you think would be relevant to talk to regarding the development of application X?
- Would it be OK with you if I would get back to you on the matter of the development in the implementation of application X and the relationship with firm B?

Appendix II - Empirical sources

Volvo Cars IT and the promise of shared product data

Respondent(s), Firm, Place	Date	Focus and theme of the interview or meeting	Hours
Product development assistant, Volvo Cars IT, Managing directors of Odette Sweden and Scandinavian Automotive Suppliers, Göteborg	2004-05-12	Seminar on new technology and new opportunities in product data management	4
Product development assistant, Volvo Cars IT (Phone interview)	2005-02-08	Interview and introduction to ENGDAT	1
Managing director, Odette Sweden (Phone interview)	2005-02-09	Interview and introduction to ENGDAT	1
Engineer and project manager, IVF (formerly active in the development of the first version of ENGDAT) (Mail questionnaire)	2005-02-16	Interview regarding the early development of ENGDAT	-
Product development assistant, Volvo Cars IT (Phone interview)	2005-08-31	Discussion and interview on potentials and current developments in the deployment of ENGDAT	1
Product development consultants, Volvo Cars Corporation (Phone interview)	2005-09-08	Interview and introduction on the product development process at Volvo Cars	1
Business Analyst Sourcing Relations, Volvo Cars IT, Göteborg	2005-09-26	Field visit and interview regarding PDM processes and tools at Volvo Cars Corporation	1
Commodity buyer for fuel system components, Fuel Volvo Cars Corporation, Göteborg	2005-09-26	Interview regarding PDM and the relationship between Volvo and Siemens	1
Manager Technical EDI, Siemens VDO Automotive, Chairman of VDA workgroup on technical EDI, (Both also European representatives in SASIG), Schwalbach am Taunus, Germany	2005-09-28	Field visit and interviews regarding the implementation of ENGDAT in the German automotive sector and specifically at Siemens VDO	4
Business Analyst Sourcing Relations, Volvo Cars IT, Göteborg (Phone interview)	2006-02-22	Interview and discussion regarding ENGDAT and C3PNG	0,5
Product development assistant, Volvo Cars IT, Jönköping	2006-03-03	Discussion and interview regarding ENGDAT	3

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Product development assistant, Volvo Cars IT	2006-09-27	Discussion and interview regarding the development and implementation of ENGDAT	1
Document name	Issue date	Owner/Issuer	Pages
Application guidelines ENGDAT V1	1994-09-22	Odette International	29
Application guidelines ENGDAT V2	2002-08	Odette International	26
Application guidelines ENGDAT V3	2003-12	SASIG	133
Training material Exter	2002-08	Volvo Cars IT	30
Seminar materials from Göteborg (PowerPoint)	2004-05-12	Odette Sweden/Swedish Automotive Suppliers	126
White Paper for ENGDAT V3 XML Harmonization	n/a	Odette Sweden	14
Exchange Management of Technical Data	n/a	Unpublished research document/Volvo Cars IT and LTH	9
Volvo/Fords new IT-platform (in Swedish)	2004 #3	Verkstadsforum Newsletter	2
ENGDAT – the platform that open new doors for suppliers	2004 #7	Verkstadsforum Newsletter	2

Appendix II - Empirical sources

Tidamek and the promise of shared project space

Respondent(s)/Meeting chair, Firm, Place	Date	Focus and theme of the interview or meeting	Hours
Manager of e-business department and project manager of the extranet project, Sandviken	2001-09-03	Introduction and presentation of project. Meeting attended.	2
Manager of speciality tool construction department, Sandvik Coromant Norden, Kista	2002-01-11	Field visit and interview with focus on customer relationships and IT- support in the order process. Meeting attended	1
Senior project leader, Sandvik Coromant Norden, Kista	2002-01-11	Interview with focus on customer relationships and IT-support in the order process	1,5
Production manager, Production engineers, Purchaser, Tidamek AB and sales officer responsible for the Tidamek account, Sandvik Coromant AB, Tidaholm	2002-01-15	Field visit and interviews with focus on the project and the problems/benefits of the suggested application	4
Production manager, Tidamek AB, Project manager of the extranet project and the sales officer responsible for the Tidamek account, Sandvik Coromant AB, Tidaholm	2002-04-23	Field visit. Launch of the pilot project. Meeting attended	4
Project manager of the extranet project, Sandvik Coromant AB, Jönköping	2002-10-30	Seminar with presentation on how the pilot project had developed and follow up interview on the project evaluation	2
Project manager of the extranet project and the sales officer responsible for the Tidamek account, Sandvik Coromant AB, Sandviken	2004-01-16	Follow up meeting on the developments in the Tidamek/Sandvik relationship	3
Production manager, Tidamek AB, Tidaholm	2004-02-25	Field visit and follow up interview on the developments on the project	1
Project manager of the extranet project, Sandvik Coromant AB, Sandviken (Phone interview)	2004-11-22	Follow up interview on the developments on the project	1
Document name	Issue date	Owner/Issuer	Pages
Pre-study report	2001-10-15	Sandvik Coromant	6

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Project evaluation (PowerPoint)	2002-07-05	Sandvik Coromant	28
User handbook	2002-04-22	Sandvik Cormant	5
Seminar material from Jönköping (PowerPoint)	2002-10-30	Sandvik Cormant	20
Global e-business @ Sandvik Coromant	2000 #1	Metalworking World Business Newsletter	4
Demo version of the extranet solution	n/a	Sandvik Cormant	-

Appendix II - Empirical sources

Volvo Cars and the promise of supply chain visibility²⁹

Respondent(s), Firm, Place	Date	Focus and theme of the interview or meeting	Hours
Managing director, Odette Sweden, Project leader Volvo Cars Corporation, Stockholm	2004-08-23	Meeting with introduction and presentation of the SCMo project	3
Managing director, Odette Sweden, Managing director Odette International, Göteborg	2004-10-07	Seminar for Odette Sweden celebrating 20 year anniversary	3
Project manager SCMo Audi (Phone interview)	2004-10-18	Interview regarding SCMo project at Audi	2
Director logistics, Renault (Phone interview)	2004-10-27	Interview regarding SCMo project at Renault	1,5
Project leader and consultant ERP-systems automotive segment, Intertia (Phone Interview)	2004-11-11	General orientation and interview on ERP-systems and the automotive industry	1
Corporate e-business Director, Faurecia (Phone interview)	2004-11-24	Interview regarding SCMo project	1
Manager Logistics, Novem (Phone Interview)	2004-12-08	Interview regarding SCMo project	1
Project manager SCMo, Trèves (Phone Interview)	2004-12-09	Interview regarding SCMo project	1
Managing director, Odette Sweden, Project leader Volvo Cars Corporation, Gothenburg, JIBS representatives, Supplier representatives, Göteborg	2005-03-09	Meeting with candidate suppliers for pilot project	-
Managing director, Odette Sweden, Project leader Volvo Cars Corporation, Stockholm, JIBS representatives, IT-provider representatives, Göteborg	2005-03-31	Meeting with potential IT-solution providers	-
Managing directors of Odette Sweden and Scandinavian Automotive Suppliers, Project leader Volvo Cars Corporation, JIBS	2005-11-23	Seminar on logistics and supply chain management	1

²⁹ The meetings held on 2005-03-09 and 2005-03-31 were two meetings that I could not participate in although they were critical to the case. Meeting minutes have been studied and my co-researchers in this case have given me more informal summary of the meetings. During the seminar held on 2005-11-23, I only participated during lunch and a coffee break since I was on paternity leave at the time. Seminar documentation has been studied and my co-researchers in this case have given me more informal summary of the seminar discussions.

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representatives, Jönköping			
Managing director, Odette Sweden, Project leader Volvo Cars Corporation, Gothenburg, JIBS representatives, Supplier representatives, Göteborg	2006-02-06	Meeting with candidate suppliers for pilot project and field visit	2
Managing director, Odette Sweden, Project leader Volvo Cars Corporation, JIBS representatives (Phone meeting)	2006-02-10	Meeting regarding the MERA-application	0,5
Managing director, Odette Sweden (Phone interview)	2006-04-07	Interview and discussion on the developments in the SCMo project	1
EDI Team Leader and project leader Volvo Cars Corporation (Phone interview)	2006-04-11	Interview and follow-up the developments in the SCMo project	1

Document name	Issue date	Owner/Issuer	Pages
Background and general Approach of the Odette Supply Chain Management Group	2002-07-02	Odette International work group on SCM	13
Supply Chain Monitoring Industry Recommendation	2003-05-28	Odette International work group on SCM	31
Press release on SCMo recommendations being published	2003-05-28	Odette International	2
Seminar material from Göteborg (PowerPoint)	2004-10-07	Odette Sweden/Volvo Cars Corp.	130
Project plan milestones (PowerPoint)	2004-10-20	Volvo Car Corp.	1
Meeting minutes from meeting with suppliers	2005-03-09	Odette Sweden/JIBS	2
Meeting minutes from meeting with IT-solution providers	2005-03-31	Odette Sweden/JIBS	4
Seminar material from Jönköping (PowerPoint)	2005-11-23	Odette Sweden/JIBS/Swedish Automotive Suppliers	172
MERA-program submission from SCMo project group	2006-01-18	Volvo Car Corp.	9

Appendix II - Empirical sources

Sapa Profiler and the promise of data feed automation

Respondent(s)/Meeting chair, Firm, Place	Date	Focus and theme of the interview or meeting	Hours
Project manager ETUI, Länsteknikcentrum, Jönköping	2002-08-06	Introduction and presentation of the ETUI project	2
Project manager ETUI, Länsteknikcentrum, Jönköping	2002-12-10	Project meeting	2
Logistics manager at Sapa Profiler, Vetlanda	2003-02-12	Field visit and interview regarding Sapa's buyer-supplier relationships and the double feeding problem	1
Consultant, Swedish Institute for Industrial Research and Development Corporation, Göteborg	2003-04-09	Field visit and discussion on technology for supplier relationships	3
Managing director and project manager of ETUI, Länsteknikcentrum and Logistics manager, Sapa Profiler, Jönköping	2003-09-24	Seminar and presentation of the double feeding project within ETUI. Meeting attended	3
Managing director of Stälöv AB, Vetlanda	2003-03-10	Interview regarding double feeding and general on IT-support in supplier/customer relationships	1
Logistics manager of A- lackering AB, Vetlanda	2003-03-10	Interview regarding double feeding and general on IT-support in supplier/customer relationships	1
Project manager ETUI, Länsteknikcentrum, Jönköping	2003-03-12	Project Meeting	3
Logistics manager at Sapa Profiler, Vetlanda	2004-03-31	Field visit and interview regarding Sapa's role in the double feeding project	1
Sales and logistics assistant with a general responsibility for spray-painted products, Sapa Division Systems, Vetlanda	2004-03-31	Interview regarding Sapa's role in the double feeding project	0,5
Technical project coordinator ETUI, Länsteknikcentrum, Jönköping	2004-04-19	Interview regarding the technical solution in ETUI's double feeding project leg	1
Logistics manager at Sapa Profiler, Vetlanda (Phone interview)	2004-11-12	Follow up interview on the developments in the project	1
Market coordinator for Automotive, Sapa Automotive, Vetlanda	2004-11--12	Interview regarding Sapa's automotive segment	0,5
Logistics and sales assistant, Sapa Profiler, Vetlanda and Logistics manager of Sapa Profiler, (Phone interview)	2005-06-09	Follow up interviews on the developments of the project	1

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Project leader ETUI and Technical project coordinator ETUI, Länsteknikcentrum, Jönköping	2005-06-09	Follow up meeting on the development and outcomes of ETUI	2
Logistics manager of A-lackering AB, Vetlanda	2005-08-19	Follow up interview on the development and outcomes of ETUI	0,5

Document name	Issue date	Owner/Issuer	Pages
Project description for ETUI	n/a	LTC	29
Seminar material from Jönköping (PowerPoint)	2002-09-24	Sapa	13
Sub-project description on different technical solutions	n/a	LTC	9
ETUI-project evaluation	2004-02-20	LTC	34
Annual reports Sapa Group	2001-2004	Sapa Group	-

Appendix II - Empirical sources

Nässjötryckeriet and the promise of electronic procurement

Respondent(s), Firm, Place	Date	Focus and theme of the interview or meeting	Hours
Administrative manager and Business area manager, Nässjötryckeriet, Nässjö	2004-01-20	Interview, field visit and presentation of Nässjötryckeriet and discussion on e-auctions	2
Group manager Business Development – Purchasing and Project manager, Volvo Cars Corporation, Göteborg	2004-03-12	Interviews and presentation of eVerest and Volvo's purchasing development, field visit	3
Administrative manager, Nässjötryckeriet, Nässjö	2004-03-25	Interview on e-auctions	2
Managing director, Scandinavian Automotive Suppliers, Göteborg	2004-04-14	Interview on the situation for suppliers and the role of e-auctions	2
Managing director, sales manager and additional associate, Nordemballage, Ystad	2004-06-28	Interview, field visit and discussion on e-auctions in the printing and packaging industry	3
Managing director, Swedish Automotive Suppliers and Managing director, CLEPA, Vice president with responsibility for purchasing, Volvo Cars Corporation, Eskilstuna	2004-08-25	Seminar on the role and situation for suppliers to the automotive industry	4
Associates from Materials Planning and Logistics and visitor center, Volvo Cars Corporation, Göteborg	2004-10-07	Seminar on logistics and materials supply and field visit	3
Administrative manager, Nässjötryckeriet, Nässjö (Phone interview)	2004-10-29	Follow up interview	0,5
Former vice president with responsibility for purchasing, Volvo Cars Corporation (Phone interview)	2004-11-10	Interview on the development of the purchasing policy of Volvo and e-auctions	1
Administrative manager, Nässjötryckeriet, Nässjö	2005-08-26	Follow up interview	1
Group manager Business Development – Purchasing, Volvo Cars Corporation, Göteborg (Phone interview)	2005-09-20	Follow up interview	1
Document name	Issue date	Owner/Issuer	Pages
Concept presentation on eVerest (PowerPoint)	2003-02-05	Volvo Car Corp.	30

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Press release on policy issues on e-auctions	2003-10-23	CLEPA	1
Seminar material from Eskilstuna (PowerPoint)	2004-08-24	CLEPA and Swedish Automotive Suppliers	21
Seminar material from Torslanda (PowerPoint)	2004-10-27	Volvo Car Corp.	28

Appendix III - Acronyms and abbreviations

AIAG - Association of companies involved in the automotive industry in North America

AUTOTAS - Tool management system developed by Sandvik Coromant

C3PNG - CAD-CAE-CAM and PDM, Next Generation of PDM at Ford Motor Company

CAE – Computer Aided Engineering

CAD – Computer Aided Design

CAM – Computer Aided Manufacturing

CATIA – Integrated software solution for CAD-CAE and CAM

CLEPA - European umbrella membership organisation for automotive suppliers

COVISINT – Buyer-oriented Automotive Marketplace

CRM – Customer Relationship Management

ECR – Efficient consumer response

EDI – Electronic Data Interchange

ERP – Enterprise Resource Planning

ETUI – Elektronisk Tekniköverföring av Industriella Tjänster – Research program on information technology in supplier networks administered by LTC and financed by Vinnova

eVerest – Procurement project driven by FMC

EXTER – File transfer application developed by Volvo IT

FMC – Ford Motor Company

FDX – Ford Data Exchange
GALIA - Groupement pour l'Amélioration des Liaisons dans l'Industrie Automobile, French automotive interest organization

ISDN - Integrated Services Digital Network is an international standard for end-to-end digital transmission of voice, data, and signaling

JAMA - Japanese trade association representing car, truck, bus and motorcycle manufacturers

LTC – Länsteknikcentrum

MERA – Research program on automotive engineering administered by Vinnova and representatives from Swedish automotive industry

MRP - Material requirements planning is a methodology and system used to plan and manage manufacturing operations

ODEX – A specific EDI-solution

OEM – Original Equipment Manufacturer

OFTP – Odette File Transfer Protocol

OTS – Original Tool Setup

PAG – Premier Automotive Group, Ford segment including Jaguar, Land Rover, Volvo and Aston Martin

PDM – Product Data Management

Quickplace – Project platform application

RFQ – Request for Quotation

SASIG - Strategic Automotive product data Standards Industry Group

SAP R3 – Enterprise application software

SCMo – Supply Chain Monitoring

SFA – Sales Force Automation

STL – Standard Transport Label

UML – Unified Modeling Language

Vinnova - Swedish governmental agency for research that integrates research and development on innovative systems

VDA - Verband der Automobilindustrie, German Association of the Automotive Industry

XMTD - Exchange & Management of Technical Data

Appendix IV – Example of document requesting formal permission to print the case descriptions

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SE-11111 City

I have read the case “title of the case”.

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