Implementation of information systems as an organisational construction

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Abstract

In this study, the focus is on the implementation process of information systems, which is approached by means of a systems analysis with its strong organisational emphasis. The intent is to create theoretical and conceptual research models as well as practical solutions. The objective is to use various research approaches to show the possibilities of a constructive research and development approach in creating organisational constructions in the planning and implementation of information systems and their practical development solutions, as well as in the formation of new theoretical and conceptual knowledge. In this study, consideration is given to a constructive approach that is close to the pragmatic research and development tradition. The main aim of the study is to determine the new kind of planning and implementation system and its major relations with its organisational constructions, emphasising practical applicability.

In this study, the treatment of the implementation process of information systems in a user organisation is tackled in a new way. The main argument in this study is that it is not only a question of changing the view of renovating information systems in a more user friendly manner. Instead, it is a question of a profound change in the research and development approach for researching and developing information systems. The main point of view is to look at the implementation of information systems as an organisational construction, comprising learning and innovation processes where different actors in the organisation are involved and influence the actions adopted.

In this study, it is emphasised that there is the need to renew knowledge concepts from the premises of positivism and interpretivism towards constructive approaches, with new knowledge concepts based on critical realism approaches. Furthermore, the study develops an organisational construction process-oriented framework for the implementation issue. This means that the implementation of information systems is seen to be a gradual organisational process in which the learning and innovation steps taken by the applying organisation and its different actors play a crucial role for the success of the implementation process.

In this study, it is shown that the implementation of an information system in an organisation is a complicated process, which involves issues involving technical and organisational changes. This forms an innovation design dilemma. From the viewpoint of successful change, technical change should be seen as an organisational construction process. The organisational construction process can become an obstacle to successful implementation and, thus, endanger achievement of the set objectives.

After the strategic and management process, the implementation of information systems consists of three main activities. These are: planning activity, implementation activity, and use and development activity. In the planning, it is normally a question of an activity with the objective of a new solution compared to the former situation. That can be seen as an innovation from the wiewpoint of the user–organisation. The information system applied is the main part of this innovation. Besides, organisational construction processes and new action modes are to be a part of this innovation solution. Through the implementation activity, these innovation elements are tried out in practice. The other dimension is organisational and technical development, which describes the effort to gain the full use of the potential of the innovation steps.

In this study, the planning and implementation steps in four cases are described and analysed. It is shown which method can be used to implement and use information systems. In each case, the following points will be described and analysed: the starting points; the choice and definition of objectives; the analysis; the development work; and the assessment of results.

As the result of the case analysis, an analysis of all the case results is made, and management aspects are assessed. The basis is the life–cycle framework. The path models comprise a strategy and management model, a requirements model, an implementation model, and a development model. There are interdependencies between the path models. These refer to the objectives and hierarchical action trees, change management, organisational changes, and investment models. Furthermore, as the summary, the decision for growth and change was assessed. The points are: the challenges of growing firms, the importance of implementation, the management practices, and competence development, which are analysed and assessed in connection to the implementation of information systems, as well as to strategic and organisational changes.

In this study, there is an implication of how to solve the innovation design dilemma. Different solution models are considered. The study presents solutions for the management of the implementation process of information systems. As the basis, the planning choice of technical change is analysed. As the theoretical result of this study, the organisational construction model for the planning and implementation process is analysed and assessed. The organisational learning approach completes the organisational construction model with learning dimensions.

Preface

In this study, the focus is on the implementation process of information systems, which is approached by means of systems analysis, with its strong organisational emphasis. The intent is to create theoretical and conceptual research models, as well as practical solutions. The objective is to use various research approaches to show the possibilities of a constructive research and development approach in creating organisational constructions in the planning and implementation of information systems and their practical development solutions, as well as in the formation of new theoretical and conceptual knowledge.

This kind of problem setting has interested us for several years, beginning from the second half of the 1980's. We have developed and applied research and development models in the case of enterprise projects. The method developed is called a development cycle method, which is based on case studies and is, by its nature, a constructive research and development method. The main features of the method are a development cycle, teamwork, and modelling. The development of our constructive approach and methodology has been based on developmental research and experiments. Our method aims to construct solutions in practice. We have further developed constructive methods in connection to information systems studies.

I have been continuously engaged in research and development projects concerning enterprises for more than twenty five years. First, my focus was mainly on the planning and implementation process of production and technical changes. We have studied these changes in different environments, based on case studies in which several companies have participated during these years. A lasting theme in our studies has been the question of both research and development activities, and of their relation to the change and development processes going on in companies. That has, to a great extent, labelled our approach. Since the late 1990´s, we have gone to do research and development on the planning and implementation process of information systems.

The case descriptions to be presented in this study are based on a wide-ranging research programme that was carried out from the end of 1999 to the beginning of 2004. The name of the programme was The Developing Management of Technology – Implementation of an Enterprise Resource Planning System as an Organisational Learning Process. The programme and its major topics are related to the Scandinavian tradition, where user- and work-centred approaches

have as strong position, as well as participating approaches in general. The programme itself was implemented in a Finnish business environment. VTT Technical Research Centre of Finland was a major research organisation and was also responsible for the whole programme at the same time. There were two Finnish research partners in the programme. One was the University of Turku and the other was the University of Jyväskylä. Professor Kalle Lyytinen was also actively participating in the formulating of the programme from its very beginning. He was then working at the University of Jyväskylä.

As a preliminary result of the programme, a book was published in Finnish in 2001, based on the collection of different articles. The book then published was called ERP Implementation in Small and Medium-sized Enterprises: From Technology Push to the Management of Knowledge and Expertise (Kettunen and Simons (eds.), 2001). The major topics covered were, for example, the implementation of information systems, enterprise resource planning and its systems, changes of activity and learning at work within an information systems environment, the strength and limits of process thinking, and the methods supporting the development of the information system.

In this study, the treatment of the implementation process of information systems in a user organisation is tackled in a new way. The main argument in this study is that it is not only a question of changing the view of renovating information systems to be more user friendly. Instead, it is a question of a profound change in the research and development approach for researching and developing information systems. The main point of view is to look at the implementation of information systems as an organisational construction comprising learning and innovation processes, where different actors in the organisation are involved and influence the actions adopted.

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Contents

1. Introduction

1.1   Starting points of the study

It is not so easy to distinguish whether it is a question of data, information or knowledge, when we are discussing information systems and their implementation process. Information systems can be approached through a technological or social perspective. The technological perspective emphasises information gathering and analysis functions. The social perspective is rooted in a view of knowledge as a social and organisational construction (Checkland and Holwell, 1998; Prieto and Esterby, 2006; cf. Luhmann, 1995; Berger and Luckmann, 1996).

The main argument in this study is that there is a big difference, in whether we look at information systems and their management from the angle of data, information, or knowledge (Kettinger and Li, 2010). The data perspective is normally connected to data modelling and its methods for advancing information systems. But it is not all clear what is data. As Hirschheim et al. (1995) present, data and data modelling are always tightly linked to historical processes in which different users read and interpret data and meanings. According to them, there is no universal meaning that can be associated with object system representation, which goes beyond these processes bound to different concrete contexts. As they emphasise, there are different conceptual and philosophical foundations, within which data modelling is seen from different angles contrary to each other.In this study, the treatment of the implementation process of information systems in a user organisation is tackled in a new way. The main argument in this study is that it is not only a question of changing the view of renovating information systems to be more user-friendly. Instead, it is a question of a profound change in the research and development approach for researching and developing information systems (Gregor, 2006). The main point of view is to look at the implementation of information systems as an organisational construction comprising learning and innovation processes, where different actors in the organisation are involved and influence the actions adopted (March and Smith, 1995; Nonaka et al., 1996; Lewis et al., 2005).

In this study, it is emphasised that there is a need to renew knowledge concepts, from the premises of positivism and interpretivism towards constructive approaches, with new knowledge concepts, based on critical realism approaches

(cf. Hevner et al., 2004; Gregor, 2006). Furthermore, the study develops an organisational construction process–oriented framework for the implementation issue. This means that the implementation of information systems is seen to be a gradual organisational process, where the learning and innovation steps taken by the applying organisation and its different actors play a crucial role in the success of the implementation process.

The information and knowledge perspective brings into view the special characteristics of information systems. It emphasises the organisational construction processes of applying information systems in an organisation. Checkland and Holwell (1998) discuss organisational transformation processes, based on action research premises. They see that persons in an organisation continuously create and recreate social reality in social interaction. That implies that information systems are wider systems than mere information technologies. Human beings are always directly communicating with others, not only through technological systems. Through these co-operation and organisational action patterns, persons in an organisation also give meanings to information systems (cf. Brown and Duguid, 1991; Weick, 1995; Choo, 1998; Rowlands, 2009). The systems understood in this way are organisational learning and innovation systems, where personal knowledge and know-how have in an important role (Kumar and Van Hillegersberg, 2000; Mao and Palvia, 2008). Organisational networks are, largely, acknowledged to be most important for information and knowledge formation and evolution (Sproull and Kiesler, 1991; Sher and Lee, 2004; Choi et al., 2011). As Macdonald (1998) states, information and knowledge once acquired and used meld with personal skill and experience, which can be exploited to the individual's advantage, but also to create a change in the organisational context of information systems (cf. Sparrow, 1998).

Information and knowledge perspectives together make a clear difference between information systems and information technology. Information and knowledge aspects can be seen to mark the organisational need to manage the use of information technology in relation to an organisation's activities and intentions (Nonaka et al., 1996; Checkland and Holwell, 1998). It could be seen to be a question of information technology and management. In this study, the main question is how information systems can best be organisationally applied and how they should be managed (cf. Markus, 2004).

Besides, it has raised a question of how to research information systems and their implementation process. Mumford et al. (1985) edited the book on *Research Methods in Information Systems*, where different researchers handled questions of how to acquire knowledge of information systems and change processes in this context. Different authors in the book bring forth different aspects of research methodologies and methods to get knowledge concerning information systems and their implementation and use (cf. Russo and Stolterman, 2000; Gregor, 2006).

Based on the treatment above, we can say that there are fundamental sets of assumptions about the nature of the world and how one can obtain knowledge of it. These ontological and epistemological assumptions are of high importance for the planning and implementation process of information systems, as well as for

the use of systems (Hirschheim et al., 1995). In this study, we limit our discussion to the planning, implementation, and use of information systems in an organisation. We mainly speak about the implementation process, but in that connection we touch upon planning and use issues as well.

We share the widely accepted view that information systems are seen to be a factor that extensively and deeply affects business activities and organisational practices (Kearns and Lederer, 2004; Bhatt et al., 2010). As it is normal to suppose, it is seen that information systems can relatively easily be implemented. Business processes and organisational practices will adapt to the demands of new information systems and their technologies. These kinds of approaches have been proposed by many textbooks, such as Edwards et al., (1995), Thorp (1998), Curtis (1998), Cassidy (1998), and Laudon and Laudon (2000). Davenport (1993), earlier, was also in the same line. However, most researchers use other than normal textbooks (e.g. Lee, 1999; O´Donovan and Roode, 2002; Wu et al., 2007; Bhatt et al., 2010). Based on that, we can state that the implementation of information systems within an organisation is a process that is difficult to handle, both in terms of practice and theory. It is widely acknowledged that the implementation of information systems is a sticky organisational problem (cf. von Hippel, 1998; Hyötyläinen, 1998; Baumard, 1999; Irani, 2002; Szulanski, 2003). In practice, companies have great difficulty in implementing information systems, and especially in fully using all the properties inherent in the systems (Barki et al., 2005; Furumoto and Melcher, 2006; Pan, 2008).

In this study, the focus is on the implementation process of information systems, which is approached by means of systems analysis, with its strong organisational emphasis (cf. Arbnor and Bjerke, 1997; Checkland, 1999). The intent is to create theoretical and conceptual research models, as well as practical solutions. The objective is to use various research approaches to show the possibilities of a constructive research and a development approach in creating organisational constructions in the planning and implementation of information systems and their practical development solutions, as well as in the formation of new theoretical and conceptual knowledge. In this study, consideration is given to a constructive approach that is close to the pragmatic research and development tradition (Rescher, 2000; Lukka, 2003; Hyötyläinen, 2005). The main aim of the study is to determine a new kind of planning and implementation system and its major relations with its organisational constructions, emphasising practical applicability.

In this study, the planning and implementation process of information systems will be from use-oriented approach (Dittrich and Lindeberg, 2004; Hyötyläinen, 2005, 78–98). In that, we explicate the meaning of innovation design dilemma in theoretical and practical terms. Furthermore, we will concentrate on the organisational side of the implementation process of information systems. In this case, we looked at the planning and implementation process as an organisational process (cf. Lyytinen, 1986; Kuutti, 1994). We look at the planning and implementation process as an organisational construction comprising learning and innovation processes, where different actors in the organisation are involved and influence actions adopted.

1.2   Focus and aim of the study

In this study, the focus is on the implementation process of information systems. *The basic problem is how to manage organisationally the implementation process of information systems in user organisations, as well as how to research and develop information systems and their implementation process.* The aim is to study how information systems can best be organisationally applied and how they should be managed.

We can assume that there is a tight relations between the practical aspecst of the implementation and the conceptual viewpoints of the implementation (Hyötyläinen, 2005; Lee et al.,1999). Hence, one could say that the conceptual understanding of the implementation process of information systems, with the associated mechanisms of organisational construction, facilitates the application of information systems in an organisation and the fulfilment of the expectation of this implementation, as many researchers have pointed out (e.g. Hong and Kim, 2002; Dalcher and Genus, 2003; Lewis et al., 2005). Later, Davenport (1997) has also come to the conclusion that technology as such is not enough to guarantee success, without mastering organisational and conceptual issues.

Conceptual viewpoints describe and reflect the foundation of practice, which means how practice can be presented through conceptual knowledge, in a consistent and workable form (Meredith, 1993). This can be seen to be, by its nature, the ontological aspect of reality. In the case of the implementation process of information systems, it opens different frameworks, depending on the theoretical and philosophical grounds on which implementation concepts are based (cf. Kuhn, 1970; Bohman, 2003). It is, at the same time, a question of how we get new knowledge about the implementation process of information systems in an organisation. That is a phenomenon concerning the research aspect and how we can get new knowledge, as well as new concepts on implementation processes. There are different research approaches that lead to different interpretations of the conceptual and practical bases of implementation processes (Hirschheim et al., 1985 and 1995).

For this reason, in this study we raise a central question pertaining to the research and development programmes that surround the implementation process of information systems. The question is which perspectives and development dimensions define the implementation process of information systems. We could say that by handling the various perspectives and development dimensions that relate to the implementation process of information systems, we can accumulate more knowledge about these issues. That serves, on the one hand, the needs of business practices, and, on the other hand, supports the creation of concepts pertaining to the application of information systems, the need for which many researchers have brought into view (e.g. Mcdonald, 1998, 9–13; Al-Mashari, 2003; Leem and Kim, 2004; Bozarth, 2006; Currie, 2009).

The basic assumption in this study is that we need new approaches that could set the relationship between information systems research and information sys-

tems practice in a new way. We share the view that the relationship between research activity and information practice is a fixed interactive relationship. The primary message is the function of information research and information acquisition, based mainly on pragmatic viewpoints (cf. Checkland and Holwell, 1998; Rescher, 2000). A close relationship between information systems research and attempts to solve practical information systems problems can also be found in some information systems studies (e.g. Lee, 1999; Klein, 2004).

The assumption in this study is that constructive methods and the analysis based on them provide solutions for a new model of the relationship between the practical implementation of information systems and information systems research. This stance questions the logico-scientific mode, emphasising universal information principles. The logico-scientific way has been seen to construct idealised models of information systems, which are a-contextual and largely universal. An alternative stance to the objectivity of information and knowledge comprehends the subjectivity of an agent acting in information situations as a prerequisite for the construction of the "objective" world in a communicate interaction with others (cf. Checkland and Holwell, 1998; Tsoukas and Hatch, 2001; Norros, 2004).

That kind of consideration is the reason for this study. The objective of the study is to bring into discussion a new interpretation of researching and developing information systems and their implementation process. The application of information systems is viewed from methodological aspects of research and development. The overall mission of this study is to progress our knowledge on the implementation process of information systems, which demands a deep analysis of different organisational facets of the implementation process. Our argument is, however, that this opens a new way to consider management issues of information systems and their implementation process. At the same time, our analysis of the large number of case studies supports the conclusion and progress of practical management viewpoints.

In this study, there are three research questions. They are:

- How are information systems researched, and in particular the implementation process? What frameworks are used, and how can they be applied?
- What are innovation design dilemma and its meaning in the context of the planning and implementation process of information systems? What are its theoretical and practical dimensions?
- How are information systems and action patterns developed constructively and simultaneously with concerted efforts? What are the practical and theoretical implications of these efforts?

In the following, we will handle the research approach and the setting of this study. After that, the research method of the study is considered. Finally, the structure of the study is explained.

1.3 Research approach and setting of the study

The basic premise of this study is that there are different theoretical views of how to research and develop information systems. In this study, it is emphasised that there is a need to renew the research concept of positivism and interpretivism towards constructive approaches, with new knowledge concepts, based on critical realism approaches (see Lukka, 2003; Mingers, 2004a,b; Gregor, 2006; cf. Carlsson, 2010). In this case, it is a paradigmatic change to research information systems and their implementation (cf. Kuhn, 1970; Mumford et al., 1985; Hirschheim et al., 1995). In this relation, Khan et al. (1998) talk about scientific knowledge, which advances domain and context knowledge.

The second premise of the study is that the nature of information is different depending on the theoretical view in question (see Hirschheim et al., 1985, 1995). In this study, an information system, and especially its implementation is seen as an organisational construction (cf. Doherty et al., 2003, 2010). This can be described as knowledge about the domain of information systems (cf. Khan et al., 1998).

The third premise of the study is that the theoretical view selected, together with the nature of the implementation of information systems, will influence information systems development approaches and the proceeding methods (cf. Mathiassen, 2002; Burnes, 2004). In principle, it is a question of knowledge about how to behave, proceed, act in the domain of information systems (cf. Khan et al., 1998). Figure 1 describes the connections and relationships between these premises of the study.
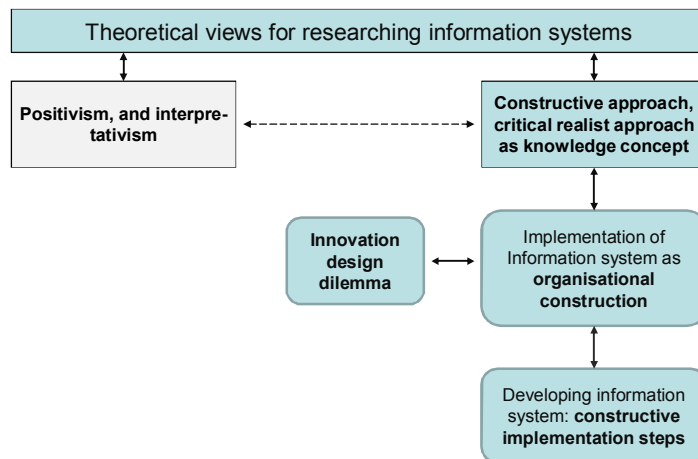
Figure 1. Research setting of the study.

In this study, the constructive approach, with its knowledge concept, is based on theoretical analysis of research and development approaches. Furthermore, the

innovation design dilemma that concerns technical innovation and organisational innovation will be analysed (see Gjerding, 1992; Holbek, 1988). In this study, the innovation design dilemma is connected to the analysis of theoretical aspects for information systems. Furthemore, innovation design dilemma and its dimensions and characteristics will be analysed in this study. The innovation design dilemma and its treatment influence the view of the implementation of information systems as an organisational construction, where innovative and learning steps are an essential part of this construction (cf. Brown and Duguid, 1991; Dixon, 1999; Wenger, 2000; Lewis et al., 2005).

In this, study, developing an information system is based on the model of constructive implementation steps (cf. Lukka, 2000, 2003; Hyötyläinen, 2005). The phases of these steps are analysed. The steps analysed are: the start of collaboration, the analysis, the choice and definition of objectives, development work: planning and testing, and the adoption of solutions (cf. Mathiassen, 2002; Heckscher et al., 2003). This model of the constructive implementation steps creates a basis for analysing the planning and implementation steps in four cases.

1.4   Research method

In this study, the focus is on the implementation process of information systems, which is approached by means of systems analysis, with its strong organisational emphasis (Arbnor and Bjerke, 1997; Checkland, 1999; Stacey and Griffin, 2005; Mason, 2007). The intent is to create theoretical and conceptual research models, as well as practical solutions. The objective is to use various research approaches to show the possibilities of a constructive research and development approach in creating organisational constructions in the planning and implementation of information systems and their practical development solutions, as well as in the formation of new theoretical and conceptual knowledge. In this study, consideration is given to a constructive approach that is close to the pragmatic research and development tradition (Rescher, 2000; Lukka, 2003; Hyötyläinen, 2005; Oyegoke, 2011). The main aim of the study is to determine a new kind of planning and implementation system and its major relations with its organisational construction, emphasising practical applicability.

The starting point for this study is the notion that, when planning and implementing information systems, the user context, the requirements set by users, and the development of the operation models of the user organisation, often go without attention, and they live in the shadow of the requirements definition and the implementation of technical systems (Checkland and Holwell, 1998; Doherty et al., 2003, 2010). This means that technology design and planning generally focus on abstract representations, to the detriment of actual practice. However, practice is central to understanding the research and the development of information systems.

The main argument in this study is that it is not only a question of changing the view of renovating information systems to be more users friendly (cf. Gulliksen et

al., 2003; Dix et al., 2004; Iivari and Iivari, 2006). Instead, it is a question of pro-found change in research and development approach for researching and developing information systems and their implementation process (cf. Kuhn, 1970; Mumford et al., 1985; Hirschheim et al., 1995; Gregor, 2006).

This study emphasises the need to renew knowledge concepts, from the premises of positivism and interpretivism towards constructive approaches, with new realist knowledge concepts (Archer, 1995; Rescher, 2000; von Aken, 2004; Klein, 2004). Second, we touch upon the planning and implementation practices of information systems. We delineate the innovation design dilemma, which concerns the divide between technical change and organisational change (Gjerding, 1992; Hyötyläinen, 1998). With the use of the innovation design dilemma, we make a difference between user-centred planning and an implementation model and a use-oriented model, with their organisational construction, and with their learning innovation processes (cf. Mumford, 1999; Dittrich and Lindeberg, 2004).

In this study, information systems and their implementation are approached by theoretical analysis and by case analysis. The four cases are analysed. It is shown which way can be used to implement and use information systems. In each case, the following points will be described and analysed: the starting points, the start of collaboration, the analysis, the choice and definition of objectives, development work, and the assessment of results (cf. Yin, 1994b; Bruce and Wyman, 1998; Lukka, 2000; van Aken, 2004; Capaldo and Rippa, 2009). An analysis of all the case results is made, and the issues of change management are assessed (Eisenhart, 1989). The case studies lasted from two to three years. In all the cases, new organisational constructions and information systems changes were designed, developed, and used. As a result, a comparative analysis of cases was made (Pettigrew, 1990; Leonard-Barton, 1990).

The materials for all the four cases analysed in this study are based on the programme desribed below. Case materials were collected in connection to the cases, during their execution, by interviewing different persons in each company, and by participating in workshops and other forums in each company.

The basis for this study is a large programme on the implementation process, carried out in 1999–2004. As a preliminary result of the programme, a book was published in Finnish in 2001, based on the collection of different articles. The book then published was called *ERP Implementation in Small and Medium-sized Enterprises: From Technology Push to the Management of Knowledge and Expertise* (Kettunen and Simons (eds.), 2001). The major topics covered were, for example, the implementation of information systems, enterprise resource planning and its systems, changes of activity and learning at work within an information systems environment, the strengths and limits of process thinking, and the methods supporting the development of the information system. Furthermore, a more theoretical publication was published in connection with the programme (Hyötyläinen, 2005).

In this study, the treatment of the implementation process of information systems in a user organisation is tackled in a new way. The main point of view is to look at the implementation as an organisational construction comprising learning

and innovation processes where different actors in the organisation are involved and influence the actions adopted (cf. Brown and Duguid, 1991; Lewis et al., 2005).

The four case studies included in this study concern the strategic planning of an organisation, and the planning, implementation, and use of information systems. The cases included in this study are from the Finnish environment, based on the wide research programme mentioned above. I will also base my premises on our earlier studies and their publications. The following major publications can be mentioned: Hyötyläinen et al., 1990; Hyötyläinen, 1993, 1994; 1998, 2000, 2005, 2007, 2009, 2011; Simons and Hyötyläinen, 1998; Simons et al., 1998 Kettunen and Simons (eds.), 2001; and Simons and Hyötyläinen, 2001.

Furthermore, I have based my thoughts, concepts, and models on many previous studies and books. I can here appreciate some of the most influential books that I have used to further develop my thinking. First, I can mention Mumford al. (eds.) (1985), in a book in which different authors handle research aspects of studying information systems and their implementation. Second, Hirschhein et al. (1995) have profoundly examined the paradigmatic and conceptual issues of information systems and their different aspects. Third, I can mention Checkland and Holwell (1998), who examine the field of information and information systems in a many-sided way. Finally, Currie and Galliers (eds.) (1999) is a book in which many authors handle and examine the several facets of researching, developing, and implementing information systems. Of course, I owe a debt to many other sources, as well. They will be referred to in different chapters of this study.

1.5   Structure of the study

This study addresses the implementation process of information systems in a user organisation. The implementation process will be examined through the constructive research and development model, which is based on the analysis of different research approaches concerning the planning, implementation, and use of information systems. The most important part of the constructive research and development model is the subject of research and development. The main point of view is to look at the implementation process as an organisational construction comprising learning and innovation processes, where different actors in the organisation are involved and influence interaction in the planning, implementation, and use of information systems. The aim is to show how, through the actions of the upper management, middle management, and users, new information systems are planned, implemented, and operated in practice in the user organisation.

The study is divided into eleven chapters. In that way, we emphasise the need for different aspects in the implementation process of information systems, to succeed in the management of theoretical conceptual and practical viewpoints.

In Chapters 2 and 3, we will handle the question of information and knowledge concepts, as well as how to research information systems and their implementa-

tion process, and what approaches are in place for that. Further, we look at new options for researching the implementation process of information systems.

In Chapters 4 and 5, the organisational patterns of the planning and implementation process of information systems will be under examination. A process-oriented approach to the implementation process of information systems is a new emerging framework. This part will concentrate on the process issues concerning information systems and how they have to be seen from different angles. The issue concerns what information systems are and how they can be defined. In these chapters of the study, we will examine and model how the innovation design dilemma defines the possibilities of new implementation solutions. The innovation design dilemma concerns a question of the dual nature of technical change. Two kinds of innovation related to technical change have been identified: technical and organisational innovation. In this study, the innovation design dilemma is determined in a new way. The implementation process of information systems is seen to consist of different phases and activities. These are: planning activity, implementation activity, and use and development activity, and these activities happen at different levels of an organisation. We will discern three levels, which are management, middle, and users. Furthermore, in this part of the study, we examine and model constructive implementation steps for information systems. Two models are considered. The first one is the phase model of the planning and implementation process. Four phases are defined: strategic planning, requirements definition, implementation, and development. The second one is the development cycle method for a constructive approach. This method is based on five stages. Each stage has been assigned by certain tasks and actors.

In Chapters 6 to 9, we will show the planning and implementation steps in the cases. Four cases are analysed. It is shown which way can be used to implement and use information systems. In each case, the following points will be described and analysed: starting points, analysis, the choice and definition of objectives, development work, and the assessment of results. The principal analysis and development method applied in the cases is a constructive approach with a participative dimension. Each case is described, analysed, and developed. New solutions are constructed and tested in practice, and the results are assessed and evaluated. In Cases A–C, it is mainly a question of the planning and implementation of information systems and the development of action modes. In case D, the main focus is on the continual development of an information system.

As a result of the case analysis, an analysis of all the case results is made, and management aspects are assessed in Chapter 10. The path models and their mutual interdependencies are analysed and evaluated.

Chapter 11 will suggest how to solve the innovation design dilemma. The organisational construction model for the planning and implementation process is analysed and modelled. This model is the research result of this study. The further specification covers the organisational learning approach.

Finally, in Chapter 12, the conclusion of the study results is drawn and the future research needs will be assessed.

2. Theoretical aspects of information systems

In this chapter, the research task of the implementation process of information systems will be approached by means of a theoretical analysis, which focuses on the theoretical aspects of information systems, as well as of the need for new knowledge concepts.

2.1 Action research tradition

Traditionally, research activities in management studies and social science, as well as in the case of information systems studies, have been focused on acquiring data regarding changes within enterprises using various "external" methods, which can be considered to be based on the empirical approach (see von Wright, 1971; Rosenberg, 1995). Persons participating in information changes are interviewed, questionnaires are issued, and the researchers review the collected documents, primally based on studying the impacts of technology on reaching universal and generalisable results (Hirschheim et al., 1985; Lau, 1999; Doherty et al., 2006; see Pettigrew, 1990; Smith, 2006). However, this has proven to be insufficient in understanding the complex technical and organisational change processes of the implementation of information systems. Within the framework of action research, new methods of various degrees have been created, meaning that the researchers participate closely in these change processes and also affect them (Checkland and Holwell, 1998, Mumford, 2001; see Reason and Bradbury, 2001).

In recent years in Scandinavian countries, discussion has increased on research-assisted development, based on the tradition of action research (Gustavsen, 1996; Rasmussen, 2004; Alasoini, 1999, 2005; Westlander, 2006; Ramstad and Alasoini (eds.), 2007). By a research-assisted approach, one means development that, on one hand, supports the development of information systems and, at the same time, organisational practices using knowledge based on research data, and also emphasises, on the other hand, the need to create new conceptual knowledge that can be generalised (Alasoini, 2005).

The fundamental problem of the approach is contained in this dual nature of research-assisted development. Action research has repeatedly encountered the

same problem (Baskerville and Wood-Harper, 1996; Gustavsen, 1996; McKay and Marshall, 2001; Lindhult, 2002; Westlander, 2006; Hyötyläinen, 2007; cf. Smith, 2006). It has also been suggested that research may have its own approaches and methods that differ from the logic of practical development. According to Habermas (1974; cf. Weick, 2003), there is no direct connection between theory and practice. The goal of theory is to reflect the truth and to construct interpretations of the relationship between "system" and "real life". Practical development, on the other hand, endeavours to achieve concrete results in the real world. However, even Habermas attempts to bridge the gap between theory and practice by addressing mediating discourses and communication mechanisms (Habermas, 1979; see Lyytinen and Klein, 1985).

In connection with action research and, in part, to counterbalance it, new approaches have emerged. In the background, we have research and development approaches built on the traditions of pragmatism (Rescher, 2000; Smith, 2004, 3–11; cf. Putnam, 1995). Pragmatic ideas have also laid a foundation for the constructive approach that has gained in importance over the past two decades (Hutchel and Molet, 1986; Kasanen et al., 1993; Lukka, 2000, 2003; Hyötyläinen, 2005, 2007; Oyegoke, 2011; see Heckscher et al., 2003; Margolis, 2004). The constructive approach has been used to develop new methods and to examine the relationship between theory and practice.

2.2 Towards new information and knowledge concepts

It is usual to distinguish two different views to see the meaning of information and knowledge concepts in the research and application of information systems. Firstly, practical interests and relevance are, in principle, strongly emphasised and, by the same token, acknowledged as a central issue in connection with information systems studies (Ho et al., 2004; Smith, 2006; cf. van Aken, 2004; Heckscher et al., 2003; Stern, 2003). However, these studies, as well as their data acquisition, have often been seen as a counterpoint to practical activity, based on the view that "scientists should be detached and objective, above the battle" (cf. Rosenberg, 1995). The method used involves the description and analysis of the object, as well as the explanation of "causal relationships" based on it (see von Wright, 1971). The view of information, knowledge, and modelling is that it illustrates or corresponds to something, that it is a conceptual representation of reality and that the theoretical information construct is a mirror image of reality (see Åkerfalk and Eriksson, 2004; cf. Chalmers, 1999; Habermas, 2003, 26–30). In that case, there is a great risk that, in information systems, research beliefs and interpretation made on that basis will be presented as "objective truth situation". In this case, one would mix reality with the interpretative side of information reality (Macdonald, 1998; cf. Foucault, 2003).

Another view is to emphasise activity and action perspectives (Lyytinen, 1986; Kuutti, 1994; Rowlands, 2009). According to the lines of this approach, the principal exclusion of actions completely out of sight in the implementation process of

information systems creates problems for research, as well as practical change processes. In this case, information analysis does not help as much as it should in planning and carrying out actions (Åkerfalk and Erikssen, 2004; cf. van Aken, 2004, 2005; Norros, 2004; von Wright, 1998). Information scientists regularly commit the elementary error of assuming that information analysis and proposals, as well as conceptual modelling based on that analysis, can pass directly to action. However, the implementation of information systems is another task. It demands going about change in the concrete context of the organisation, with the differing interests of actors. It is, by its nature, a social and organisational process, with actors interacting directly, in reality, in a meaningful way (Lyytinen, 1986, 1987; cf. Heckscher et al., 2003).

In this study, we will participate in the discussion on new information and knowledge concepts that are in the formation stage. As a result, we will bring into discussion a third way of looking at the information and knowledge of information systems. In the area of the implementation process of information systems, as well as of information issues in general, there is an increasing debate about the need to renew our knowledge approach to information formation. There was, one or two decades ago, a lively discussion on the new foundations and methods of information systems (e.g. Hirschheim, 1985; Boland, 1985; Klein and Lyytinen, 1985; Lyytinen, 1986, 1987; Kuutti, 1994; Hirschheim et al., 1995; Iivari and Lyytinen, 1998; Checkland and Holwell, 1998; Lee, 1999; Jones, 1999; Russo and Stoltermann, 2000; O'Donovan and Rode, 2002). In this traditions, ome methodological sources can also be discerned (e.g. Abnor and Bjerke, 1997; Sayer, 1992; Archer, 1995).

Recently, a new interest has arisen concerning the research agenda of the implementation process of information systems. Many authors have touched upon the research approches of information and knowledge issues anew (e.g. Al-Mashari, 2003; Hanseth et al., 2004; Klein, 2004; Hyötyläinen, 2005; Smith, 2006; Wu et al., 2007; Currie, 2009; Sharif, 2010; Choi et al., 2011). At the same time, there is a discussion about the new principles of management, and research on organisational change processes and their grounds (e.g. Bohman, 2003; van Aken, 2004, 2005; Henriksen et al., 2004; Tsoukas, 2005; Caldwell, 2006).

In this study, we will delineate information and knowledge concepts and their dividing line in a new way. Figure 2 presents our main approach to the knowledge basis for the implementation issue of information systems.

| Positivism, and interpretativism | ←→ | Need to new knowledge concepts | ←→ | Constructive approach, critical realist approach as knowledge concept |
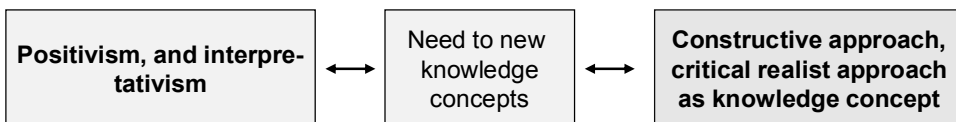
Figure 2. Need for new knowledge concepts of information systems.

The positivistic thoughts have mainly been in the background with the building and application of information systems in an organisation. That has meant that a func-

tional approach has been a normal thinking pattern (see Checkland and Holwell, 1998). The basic premises of the positivistic thoughts resemble the causal correspondence model presented firstly above (cf. Popper, 1992).

New approaches have been based on the tradion of hermeneutics and phenomenology and their basic premises. Interpretivism, which is based on these thoughts, has also got a foothold in the area of information systems and their implementation in recent times (e.g. Lee, 1999; Rose, 2002). In a sense, these approaches have the same kind of views as in the case of the second activity and interaction model presented above.

In this study, constructive approaches will be developed and applied to the implementation process of information systems. Constructive approaches have a debt to the action research tradition, as well as to pragmatistic theoretical suppositions (Kasanen et al., 1993; Rescher, 2000; Lukka 2000, 2003; Oyegoke, 2011). The approach to be applied is based on the proposition that one of the best ways to gain knowledge is to try to change things. To "understand" the information system and its implementation process, it can be claimed that the best way to make sense of social situations is often not to watch them, but to act in them and then reflect on the experiences (cf. Schön, 1983).

A new point in this study is to join the constructive approach and the critical realist approach to each other. The point is that the critical realist theory offers the theoretical base for a constructive research and development approach, which is a new approach to delineate the research and development aspects of information systems. Separately, discussion is also ongoing about the possibilities for critical realism to solve problems of information systems research and development, which concerns the old dividind line between practice and research (e.g. Mingers, 2004a; Klein 2004; cf. Wicks and Freeman, 1998; Weick, 2003).

2.3 Towards use-oriented planning and implementation practices

Correspondingly, the same kind of dividing line, as in the case of the information and knowledge aspects, can also be distinguished in the grounds concerning the organisational side of information systems and their planning and implementation process. The innovation design dilemma depicts these dividing grounds. Figure 3 presents the importance of the innovation design dilemma and its meaning in making a difference between a user-centred and a use-oriented approach, with their learning and innovation patterns differing from each other.
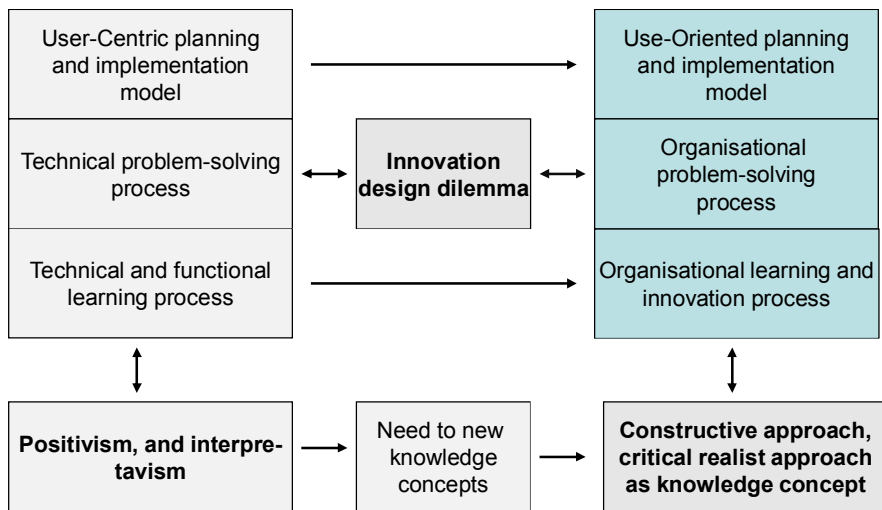
Figure 3. The innovation design dilemma as the dividing line between two opposite knowledge stances.

The innovation design dilemma makes a great difference between the technical and organisational sides of information systems and their planning and implementation process (e.g. Holbek, 1988, Gjerding, 1992; Hyötyläinen, 1998). The implementation of an information system in an organisation is a complicated process, which involves issues involving technical and organisational changes (e.g. Hong and Kim, 2002; Doherty et al., 2003; Cragg et al., 2011). The problem has been that, in implementing information systems, the definitions of the technical system and its requirements have been given more emphasis than the development of the organisation and interaction patterns.

On the one hand, there are technical views and technical problem-solving processes concerning information systems and their development. In that case, the premises of the definition of information systems are mainly based on the static nature of organisational behaviour and practice. The idea is that information systems will solve goal-seeking patterns of the organisation. According to this paradigm, there is a purpose to progress organisational control and problem-solving. The basis is that the information system provides an effective representation of organisational reality (see Hirschheim et al., 1995; cf. Hyötyläinen, 2011, 52–60).

According to the technical view, information systems are primarily viewed from a technical and planning method-centred view. Much attention has been focused on technical choices and planning for information systems, as well as on related planning methods (see Avison and Fitzgerald, 1999; Checkland and Holwell, 1998; Iivari and Lyytinen, 1998). This can also be said to resemble a technology-driven model, which originates within the information systems field with a strong emphasis on computer systems methods (Morton et al., 2003).

For mitigating techno-centric viewpoints of information systems, user-centred approaches have arisen (e.g. Rasmussen, 1986; Hellman, 1989; Rouse and Cody, 1988; Rouse, 1991; Corbett et al., 1991; Beyer and Holzblatt, 1998; Kobsa, 2001; Gulliksen et al., 2003; Dix et al., 2004; Vilpala, 2008). One can state that the user-centred model solves, partly, the limitations of the techno-centric approach. Nowadays, the user-centred model is very popular. However, it is often confined to interface points of information systems, which are otherwise developed in the principles of technical grounds.

Starting points of the user-centred model are in the socio-technical tradition. Socio-technical theory views an activy system as a "socio-technical" system. The view is that the task is the mutual optimisation of these two systems, since the optimisation of each system separately does not lead to optimal solutions from the perspective of the entire "socio-technical" system (Mumford, 1999; cf. Trist, 1981; van Eijnatten, 1993; Burnes, 2004).

Recently, socio-technical concepts are also becoming more comprehensive and systematic (e.g. Mathiassen, 2002; Herrmann et al., 2004; Santosa et al., 2005; Iivari and Iivari, 2006; Kautz, 2011). New approaches are based on system theoretical views, as well as on activity theoretical suppositions. It has been emphasised that this kind of view helps identify appropriate concepts to describe and model the real aspects of socio-technical systems, which are planned, modified, and developed through situated action (Suchman, 1987; Wenger and Snyder, 2000; Lave and Wenger, 2001; Mitev; 2009; Goggins et al., 2011). Modelling methods are also developed for the purposes of planning and developingt socio-technical systems, when activity networks, as well as the differing perspectives of stakeholders, are, at the same time, taken into account in model building (Burgoyne, 1994; Rossi, 1998; Torvinen, 1999; Chin, 2001; Mitev, 2009; Choi and Lee, 2011; cf. Adams and Avison, 2003; Andrade et al., 2004; Zang, et al., 2010).

On the other hand, the use-oriented planning and implementation model is a new approach, which has been conceptualised in recent times (Vicente, 1999; Norros, 2003; Dittrich and Lindeberg, 2004; cf. Beyer and Holzblatt, 1998; Blount, 2011). Major points behind the use-oriented model are views that emphasise the dynamic nature of information systems. They have to be developed as an organisational construction, comprising learning and innovation processes (Lewis et al., 2005). This means that technical change in connection to the adoption of an information system has to be looked at from the viewpoint of an organisational problem-solving process (Hyötyläinen, 1998). This paradigm highlights the role of the information system in the process of social reality construction through sensemaking processes (see Hirschheim et al., 1995; Weick, 1995). This implies that different actors in the organisation have to interact to plan, implement, and use of information systems.

The premise of the use-oriented model is that the implementation process of information systems belongs to, and the question of information systems at large can also be considered to belong to, the area of social science (Hirschheim, 1985). Thus, the implementation and use of information systems involves people in action. This means that the implementation process of information systems is a

social and organisation construction that has some central properties. The features chraracterising the implementation process are: creative goal-formation, multiple and many-level goals, and even contradictory goals are often the case (Nissen, 1985; Regner, 2001; cf. Cyert and March, 1992). This approach is near to a model-driven approach, which is based on solving unstructured and complex problem situations, in which a number of different parties participate, with their different perpectives (Morton et al., 2003). Therefore, there are no easy ways to proceed in the implementation process of information systems.

2.4 Summary: nature of research and development

In this chapter, we presented a new interpretation of research-assisted development and its theoretical bases. The model created is called the constructive approach. This approach crosses the boundaries of action research. Action research tries not to present solutions to its target organisation (Argyris and Schön, 1978; Argyris, 2000). Instead, it seeks to create a change process in which all participants have an equal opportunity to influence solution processes (Bruce and Wyman, 1998; Schein, 1987). Action research consists, however, of objects, premises, theoretical hypotheses, and questions that are different from each other. One may even say that action researchers are somewhat frustrated with the results that can be achieved with their methods (see Rasmussen, 2004; Caldwell, 2006, 33–39). Action research gives the researcher the role of a "healer", whose goal is to promote "democratic" practices in an organisation. On one hand, action researchers are excited to be in the field, influencing new solutions, but at the same time, this is seen as problematic. It is a question of the limits of the researcher's influence and the scientificity of the approach.

The constructive approach is based on the principles of pragmatic philosophy (James, 2004; Rescher, 2000). There, the connection between knowledge generation and practical problem–solving is continuous and immediate. According to that, the concept of practice is an uncertain real world, where the goal is to reduce uncertainty and the prerequisite for action is the generation and utilisation of sufficient knowledge suited to the context. Practice is always uncertain and complex, and new solutions are not ready but have to be discovered and developed (cf. Carver, 1988; Tsoukas, 2005, 1–9). Detecting and defining problems alone can be seen as a challenge.

Action research lacks a proper definition for practice (Lindhult, 2002; cf. Baskerville and Wood-Harper, 1996; Lau, 1999). Its concept of practice might be defined by theory. The task and mission of "theory" in action research is to participate in the change processes in the real world and to support participants in defining solutions. The world of theory is seen as an isolated island to which only the researcher has access.

The constructive model builds on the constructive approach, and its concept of knowledge is based on the hypotheses of the critical realist theory of science (Archer et al., 1998). It divides the world into a real world and a model world. The

phenomena of the real world can be studied only via conceived and conceptualised objects. Our knowledge of the world is imprecise and divided (Sayer, 1992, 103–117; Hyötyläinen, 2005). The central concept in both the constructive approach and the critical realist approach is the accumulation of knowledge, but the essential point is not to find an equivalence of theoretical knowledge in the real world, knowledge is a tool used when acting in the real world. However, the constructive model aims to develop constructs in practical settings in the real world.

Here we have the methodological dual nature of research-assisted development (McKay and Marshall, 2001; Hyötyläinen, 2007). On one hand, we want to increase new information and knowledge, but at the same time we want to apply knowledge in practice (cf. Sayer, 1992; Arbnor and Bjerke, 1997; Recsher, 2000). This dual nature is also visible in the theory concept of the constructive development model. Both the constructive and the critical realist approach see theory guiding practical observation. Observations are tied to theory, which means that theory defines what is seen and observed in practice. On the other hand, research results gained by means of this theory (or "lenses") are applied to produce solutions for certain practical problems and conceptual interpretations (see Laudan, 1977; Habermas, 2003).

By "dual nature" we also mean that the truth criteria for theory and conceptual knowledge are practice and human activity. At the same time, the constructive model supports the generation of new practices that add to the collection of possible actions in an uncertain world. An essential feature of the constructive approach is to seek to create new and innovative solutions for practical needs (Lukka, 2000, 2003; van Aken, 2004, 2005).

In this study, the planning and implementation process of information systems will be considered from the viewpoint of a use-oriented approach. In that, we will explain the meaning of the innovation design dilemma in theoretical and practical terms. Further, we will concentrate on the organisational side of the implementation process of information systems. In this case, we will look at the planning and implementation process as an organisational construction, including learning and innovation processes in which different actors in the organisation are involved and influence the actions adopted.

3. Approaches for researching information systems

In this chapter, the application of information systems is viewed from the methodological aspects of research and information acquisition (Lee, 1999; Al-Mashari, 2003; Hyötyläinen, 2005; Currie, 2009; see Arbnor and Bjerke, 1997; Alvesson and Deetz, 2000). *The main question, in that case, is how do we gather information about planning and implementation processes, and what kind of research approaches and models do we have at our disposal for information acquisition and for formulating new concepts and conceptual knowledge?* This has also been a concern in some information studies (e.g. Mumford et al., 1985; Hirschheim et al., 1995; Checkland and Holwell, 1998).

The main viewpoint in this chapter is the development of the constructive approach as a research and development method (see Lukka, 2000, 2003; van Aken, 2004). For that, we will examine different theoretical approaches that are applicable when researching information systems. The treatment of these research approaches is to point out the meaning of different approaches for gaining practical results, to advance the implementation process of information systems. In this way, we will deal with the first question posed by Lee (1999): What is reasearch and what forms can it have? Furthermore, what forms should research of information systems take in the future?

3.1 Research approaches and model

A fundamental issue in information research work has to do with the conceptual worldview in which its context and approach are anchored. Different research paradigms and the conceptual worldviews they create determine the research (Kuhn, 1996; Rosenberg, 1995, 10–25; Russo and Stolterman, 2000). In social science research, theoretical and methodological issues are especially difficult to manage. In principle, research relates to empirical and factual knowledge on one hand, and to concepts and conceptual knowledge on the other (Sayer, 1992, 45–84; Lukka, 2003; Hyötyläinen, 2005). The relationship between these, especially the role of theory in research, is viewed differently in different research paradigms.

The relationship between theory and practice is also different in different approaches.

From the point of view of the implementation of information systems, the following research and development approaches and conceptual worlds can be discerned: positivism, interpretivism, pragmatism, and action research as well as the constructive and realist approaches (Smith, 2006). Our objective is to use the analysis of these approaches to lay a foundation for a constructive research and development model. For that, three research approaches will be more profoundly considered. These are the constructive approach and the realist approach. Action research approach will be considered in connection with the constructive model. The critical realist approach will be handled, because it lays some theoretical and conceptual ground for the constructive approach and method. The tradition of pragmatism will be also handled because its roots are close to the constructive approach. Instead, the traditions of positivism and interpretivism (hermeneutics and phenomenology) are well known, so they are only handled briefly. Besides, the role of research approaches in the development of information systems will be treated. Table 1 shows a summary of these research approaches.

Table 1. The comparison of research approaches and models (see Hyötyläinen, 2005, 121; Hyötyläinen, 2007; cf. Lindhult, 2002, 62–64).

	Positivism	Interpretativism	Pragmatism	Constructive approach	Realist approach
Scientific roots	Natural science concepts	Hermeneutics, phenomenology	Pragmatism traditions Reflection theories	Action research Constructive theories	Realist approaches Knowledge concepts
Research approach	Empirical approach	Understanding approach	Interaction model of knowledge and practice	Systemic and constructive approach	Approach concerned with foundation of knowledge and truth
View on research	Cool outside observation	Research as social activity	Reflective and operational actor model	Process consulting and research-assisted development	Knowledge generation as social activity
Object viewpoint	Empirical facts	Mental models of actors	Successful tests and practical change processes	Analytical and solution concepts and models	Distinction between thought and real objects
Main objectives of research	Hypotheses	Formulation of theory	Generation of beliefs that are sufficiently certain	Experimentation with new solutions and new knowledge	Development mechanisms
Approach to information gathering	"Catching" of facts	Observation tied to theory and understanding process	Development of concepts and development activities	Change tests and development activities	Review of literature and practice
Research method	Observation	Observation	Participation and experience gathering Observation	Participation methods Constructive methods Observation	Development methods for concepts
Method of analysis	Testing	Reconstruction of situations	Analysis of knowledge and information	Analysis of information and knowledge	Theoretical and practical analysis

	Positivism	Interpretativism	Pragmatism	Constructive approach	Realist approach
Knowledge concept	Generalisations	Context-dependent knowledge	Function of knowledge in practice, empirical knowledge theory	Combination of research and development data	Emphasis on context-dependency of knowledge and practical adequacy
Theoretical model	Construction of theory Causal models	Finalistic interpretation models	Practical theory (praxis)	Models for interpretation and understanding	Theory-dependent conceptualisation of knowledge

The research approaches are described in the table through ten dimensions. The *first* dimension considers the scientific roots of each approach. The *second* dimension describes the research approach on which these various research traditions are based. The *third* dimension shows the view these approaches take on research activity, or how they define the intent of research. The *fourth* dimension is about the objective of each approach. The *fifth* dimension deals with the main object and objective of study, that is, different approaches relate to knowledge and the creation of knowledge. The *sixth* dimension describes the principal methods of gathering information and knowledge of each approach; in other words, what is understood under information acquisition and how to go about it. The *seventh* dimension is about the research methods of each approach, or how these methods are used to acquire data about objects. The *eighth* dimension describes the methods or modes of analysis. The *ninth* dimension examines the concepts of knowledge of the approaches, meaning where the research is expected to lead. The *tenth* dimension describes the theoretical models of the approaches, in other words, what is perceived to be the ideal theory pursued.

3.1.1 The premises of positivism

Positivism holds a strong position in management and social scientific research, as well as in researching information systems (Popper, 1992; Rosenberg, 1995; Checkland and Holwell, 1998; Mingers, 2004a). Its model is the concept of research as applied in the natural sciences, where different hypotheses are formed and tested in various ways (Weber, 2004). Hypotheses that pass the tests are approved. They stay valid until called into question by counter-evidence. Positivism represents the empirical approach. Information studies are seen as based on immediate empirical observations, which accumulate, expand, and become more specific over time. Observations and observation concepts that form their basis are seen as independent of theories and theoretical concepts. Observations are seen as a foundation on which succeeding theories take root (cf. Glaser and Strauss, 1967).

The positivistic thinking is in the background in the building and application of information systems that have primarily been characterised by a functionalistic approach. The subject has been the information systems' hard side, which has meant a focus on the technical planning of systems (Checkland and Holwell, 1998). The dominant thinking has been based on the concept of an organisational goal-seeking system. The most important organisational function has been thought to be decision-making and its connection to objectives and goals. The information system's goal has been seen to be the support of this decision-making (Hirshheim et al., 1995, 102–115; cf. March and Simon, 1958; Cyert and March, 1992). This approach has affected the manner in which research regarding the implementation of an information system has been conceptualised. The basis has been a positivistic approach, where the testing of the hypotheses is the dominant conceptual model and the development of causal analysis (Lee, 1999; Bento and Bento, 2004).

3.1.2 Interpretivism and changed problem formulation

Interpretivism represents the view that research work is social activity and as such socially constructed (Lee, 1999; see Berger and Luckman, 1966). Research may be an individual or group activity, aimed at constructing theories. This implies that theories are viewed as mere theories. Theories are not somewhere "there" in reality waiting to be found. The truth is rather that we invent them.

Next to the positivistic explanation model was added "understanding" – the understanding approach. In the understanding approach, the researcher recreates, or reconstructs, the mental atmosphere, thoughts, sensations and motivations of the actors under study (actors may be individuals, groups, organisations or similar agents) (Fay, 2003). Thus understanding is linked with a finalistic interpretation (Heidegger, 2002; Turner, 2003, see criticism of interpretitism, Smith, 2006, 195–198).

In studies associated with information system application, the interpretative and hermeneutic research approach has started to gain a foothold. During the last decade or so, there have been many studies based on the spirit of interpretivism (Boland, 1985; Klein and Lyytinen, 1985; Hirchheim et al., 1995, 144–154; Lee, 1999). Separately there has been a so-called "soft system" method developed, which approaches, in a new way, the planning and use of information system (Checkland and Scholes, 1990). The starting point is an "understanding" and activity theoretical research analysis framework (Lyytinen, 1987; Kuutti, 1994; Checkland and Holwell, 1998; Torvinen, 1999; Rose, 2002).

3.1.3 The tradition of pragmatism

In the pragmatic philosophical tradition and concept of knowledge, the *relationship between research and practice* is reformulated in a new way (Rescher, 2000; James, 2004; Schmitt, 2004, 3–11). It is assumed that there is a continuous inter-

active relationship between research and practical information gathering. The main message here is the function of research and information acquisition. Mere understanding of matters, disconnected from practice, is not sufficient (von Wright, 1998; Wicks and Freeman, 1998; Kilpinen, 2000; cf. Gimmler, 2004). The question is rather how knowledge helps to deal with different situations. The criteria for knowledge are germane action and utilisation of presented information in successful actions.

In the area of conceptual modelling of information systems, pragmatic emphasis has increased in recent times (Ågerfalk and Eriksson, 2004). Traditionally, according to the descriptive perspective of information systems, the concept model implemented in the information system claims to present reality and the business context as such. This means that the business actors use a computerised model instead of looking directly at the world (Lyytinen, 1987). According to the pragmatic view, people act and communicate within world, as social actors. The question is how action-oriented conceptual modelling can be done and how that will change the idea of the development of information systems. One opportunity is the pragmatic aspect of language and computer use, based on action-oriented conceptual modelling. This means that the system becomes a vehicle used for performing communicative business actions in the dynamic business context, which the system also affects (Ågerfalk and Eriksson, 2004).

3.1.4   The constructive approach and solution models

Constructive approaches were formulated out of the traditions of action research and pragmatism (Hutchel and Molet, 1986; Kasanen et al., 1993; Alasoini, 1999; Lukka, 2000, 2003; Heckscher et al., 2003; Burnes, 2004; van Aken, 2004, 2005; Hyötyläinen, 2005, 2007; Oyegoke, 2011). The constructive approach relies on a model of a stepwise development cycle applied to the needs of the research and development process. A similar model is applied in action research (Bruce and Wyman, 1998, 20–24).

The constructive approach is a research and development model in which the designs of social reality and the research process constantly change, forcing researchers to adopt two roles (Habermas, 2003, 15–17; Lukka, 2003; see Engeström, 1987, 321–337). First, researchers should be able to view the organisational activity systems under study from a "systemic" perspective, which means that researchers construct and model activity systems as if looking at them from above (cf. Schön, 1983; van Aken, 2004). Second, in the intensive phase of the study, the work of the researchers is focused on the organisational construction and change processes within the object organisation (Hyötyläinen, 1998; Lukka, 2003). Researchers must adopt the perspectives of persons and groups active in the organisational activity systems, in order to build and develop new organisational constructions and change processes from the actors' "view", based on their interpretations (Weik, 1995; Ladkin, 2005; Caldwell, 2006). The study of organisational constructions and change processes becomes a collective, multi-voiced

construction and modelling of the past, present, and future of activity systems (Heckscher et al., 2003, 126–127; Hyötyläinen, 2000, 2005). The researchers participate in the planning and implementation processes, as well as in implementing new organisational constructions for activity systems (Hutchel and Molet, 1986; Engeström, 1999, Lukka, 2003; see van Aken, 2004, 2005).

The premise of the constructive approach is that information gained from the development process must be compared to concrete action and action objectives. Emerging knowledge is thus concrete and specific to the operational environment (Lukka, 2000; van Aken, 2004). Consequently, action alternatives and solution models emerge from the "logic" of the situation and from the objectives and solution concepts of the actors. The elements of the situation can be controlled, and it is possible to know what action is needed in the situation to achieve the desired results (cf. pragmatism, Rescher, 2000; James, 2004).

New concepts and unknown technology solutions are not created or adopted in a linear manner within or by an organisation, as new practices are created and developed primarily through trial and error (Ciborra, 1999). New forms (new concepts, information systems, and practices) are at first incomplete and uncertain (James, 2004; Doherty et al., 2006, 2010). Neither can a collision with old practices and their limitations be avoided when initiating new information forms. Using a constructive model, development processes can be started and the organisation can create and try new organisational and technological solutions. The implementation of the information systems solutions within a company is, however, a separate task (Hyötyläinen, 1998; Gupta, 2000; Gosain et al., 2005; cf. Nooteboom, 2000). Often, solutions require complementary organisational and operative process innovations in other systems of the company, and only after creating appropriate conditions is it possible to establish new action models and information systems within the larger organisation (Gould, 1980; Rogers, 1995; Carter et al., 2001; Amoako-Gyampah and Salam, 2004).

3.1.5 The realist approach and its knowledge concept

The question of the nature of truth and the associated concept of knowledge are closely intertwined. It is also a question of research goals and objectives and how they are conceptualised (Tsoukas and Hatch, 2001; Schmitt, 2004). In that sense, constructive research can be labelled "practical theory" (Stern, 2003): it starts with practice and treats it as a fundamental category (cf. pragmatism, James, 2004; Gimmler, 2004, 49–53). Constructions made in practice lead to theoretical conclusions (Lukka, 2000, 2003). Because of this, the realist approach offers a means of conceptualising the foundation of the concept of knowledge pertaining to the constructive approach ("a constructive realism") (Margolis, 2004, 229–230, 234–240; cf. Mizak, 2004, 159–168).

In the scientific tradition, the so-called critical realist science theory and approach evolved, beginning to influence the research in the field of social and behavioural sciences in the 1980s, and later on also in information system research

(Bhaskar, 1997; Sayer, 1992; Archer, 1995; Mingers, 2004a,b; Reed, 2005; Smith, 2006). According to the realist approach, the world exists irrespective of our knowledge of it. Our knowledge of the world is false and dependent on theory. The world is seen as separate and divided, and causality, therefore, appears through multifaceted and multi-level development mechanisms (cf. Manicas, 2006). The world does not consist of mere events, but also of objects and structures that have the power and ability to create events. Generation of knowledge is also a social activity: social relationships, together with conditions in which knowledge is generated, are seen as affecting the content of knowledge (Tsoukas and Hatch, 2001; Norros, 2004).

In the tradition of critical realism, some studies on new subjects have appeared. Smith (2006) argues that information systems research conducted within the normal paradigms of positivism and interpretivism suffers of problems theory-practice inconsistencies. Information systems research has long been dominated by the paradigms of posititism and interpretivism (see Lee, 1999). In any case, due to a large interest in the viewpoints of critical realism', there are not yet functioning methods for practical purposes in the implementation of information systems. In any case, the discussion is ongoing about the possibilities for critical realism to solve some old problems in information systems research (see Mingers, 2004a; Klein, 2004; Carlsson, 2009).

3.2 Summary: a constructive research and development model

The purpose of this analysis of different research approaches is to determine a theoretical and methodological foundation suitable for a research and development model, based on a constructive method. From the perspective of research-aided development and "practical theory" (Stern, 2003), the constructive approach, based on action research and pragmatism, together with the realist approach, offers the best theoretical and methodological premises for the new model (cf. Margolis, 2004, 229–240). The realist approach provides the constructive approach with a credible theoretical concept of knowledge, which is also useful when creating the research and development model for the implementation process of information systems.

The realist approach comes close to the constructive worldview, which makes a clear distinction from the natural scientific method, which positivism strongly favours (Smith, 2006). The relationship between subject and object is seen as closely intertwined. Researchers form a social action and language community that shares certain social meanings. Research focuses on social communities that function in their own environments and that have certain social relationships and meanings. It is essential that both communities share the same meanings (cf. Wittgenstein, 1958; Archer, 1995). It is also central, however, that both the research community and the community under study have a relationship with the material world, that reflects both the research knowledge and the practical

knowledge of the community. Changes in meanings and practices, therefore, usually go hand in hand (Sayer, 1992, 12–44; Choo, 1998).

The constructive approach, on the other hand, is close to the tradition of action research, but its examination of the activity system under study is more systematic (Lukka, 2000, 2003, Hyötyläinen, 1998, 2005). Action research is more involved with process consultation and participation in change processes (Argyris and Schön, 1978; Schein, 1987, 1999). The constructive approach emphasises a research-aided model. Its objective is to analyse and actively create constructions in practice, meaning that a research and development model aims for new solution concepts and practical models, meaning that researchers simultaneously create solutions while presenting them to the target organisation, as well as creating new knowledge about new solution concepts and models (Lukka, 2000; van Aken, 2005; Oyegoke, 2011).

3.3   A basis for hypothesis formation

This chapter discusses and analyses different theoretical models that are suitable for researching and developing the implementation process of information systems. As a result, the constructive research and development model, with its method, was developed. The model attempts a solution to the dilemma existing between theory and practice (Wicks and Freeman, 1998; Weick, 2003; Smith, 2006). Action research has not been able to provide an obvious solution to the problem. Some researchers have emphasised the theoretical premises while treating practice as an application of theory, while others have delved deep into practical development processes, making it hard to arrive at a theoretical examination of the object (Baskerville and Wood-Harper, 1996; Lindhult, 2002; Rasmussen, 2004, Burnes, 2004).

In the constructive research and development model, it is possible to include the hypothesis system, based mainly on the premise of critical realism approaches, aiming to increase knowledge of the development mechanism of the object system under study, as well as to understand organisational construction processes (Sayer, 1992; Archer, 1995). The hypotheses system acts as a tool by which the gap between theory and practice can be bridged (Engeström, 1987; Hyötyläinen, 2005, 2007; cf. Weick, 2003). In the model, the analysis and development of solution models occur in the form of *clafifying hypotheses*, which are used in a research tool in processing research material and case study results, as well as in coming to theoretical conclusions (Engeström, 1987, 321–337; Yin, 1994a, 20–27; Lukka, 2003; Hyötyläinen, 2005, 45–50; cf. Schön, 1983; Khan et al., 1998). The hypothesis system and its hypotheses have two purposes. First, they aid the practical development of an organisation and the creation and implementation of a "theory" that serves the organisational practice of the implementation of information systems and ensuing organisational changes (Lukka, 2003). At the same time, the hypothesis system is "enriched" during the development process and then acts as a foundation for conceptual knowledge and theory. The

result is a context-dependent theory (Arbnor and Bjerke, 1997; Sayer, 1992; cf. Glaser and Strauss, 1967; Strauss and Corbin, 1998) whose universality may be assessed through the "analytical generalisation" of case studies (Robinson, 1951; Yin, 1994a, 3–11; cf. Lincoln and Guba, 2000) and by comparing the results of a number of involved case studies (Eisenhardt, 1989; Pettigrew, 1990; Leonard-Barton, 1990).

4. The innovation design dilemma and its implication

In this chapter, we will go into the constructive process side of the planning and implementation of information systems (cf. Edwards, 2000; Gosain et al., 2005; Hyötyläinen, 2005; Currie, 2009). We will address the issue that concerns the dividing line between technical change and organisational innovation: the innovation design dilemma. For that, the question posed by Lee (1999) of what phenomena pertain to the application of information systems in an organisation is a starting point. In this chapter, the innovation design dilemma is determined in a new way. Factors and their dimensions, as well as mechanisms of the innovation design dilemma, are differentiated and determined.

4.1 Design and adoption of information systems

In this study, the focus is on the implementation process of an information system in the user organisation, which is also considered to be an innovation process (Slaughter, 1993; Hyötyläinen, 1998; Amoako-Gyampah and Salam, 2004). The main focus is on investigating the *adoption* of the innovation in an organisation (cf. Sahal, 1981; Rogers, 1995; Carter et al., 2001; Lorenzo et al., 2012). In this case, the innovation is looked at from the point of view of the adopting unit. This view relates innovation to the stages of the adoption process and the characteristics of the adopting unit (Rogers, 1995, 371–404; Hyötyläinen 1998; Hong and Kim, 2002). In many studies, the adoption of the information system is viewed in the broader context of organisational change (Burns and Stalker, 1994; Dosi, 1988; Edwards, 2000; Doherty et al., 2003). It is usual that information technology is seen as one of the most influential forces providing input into the process innovation (Davenport, 1993; Bagchi et al., 2003; Bhatt et al., 2010). Within this tradition of innovation research, the analysis deals with the planning and implementation of the process innovation (cf. Nadler and Robinson, 1987; Silverberg, 1990; Sabherwal and Robey, 1993; Kuisma, 2007; cf. Johri and Nair, 2011). One of the main goals is to understand how process innovations can be successfully adopted in an organisation. This approach lends a valuable perspective to process innovation (Federici, 2009). First, it lays the main focus on the *implementation process* of an

innovation. Second, it emphasises *mutual adaptation of the organisation and the technical system* for successful implementation (Gjerding, 1992; Burns and Stalker, 1994; Clark and Starkey, 1988; Carter et al., 2001). In this case, it is a question of the innovation dilemma.

4.2   Innovation design dilemma

The implementation of information systems is a major challenge and source of problems in most organisations. The literature about failures and successes in the implementation of new technical systems often refers to three factors that complicate or block the benefits linked to a new system. Various economic difficulties, technical problems, and problems in adjusting organisational arrangements are often mentioned as such factors (Lyytinen and Hirschheim, 1987; Hong and Kim, 2002; Doherty et al., 2003; Mähring et al., 2004; Hyötyläinen, 2005; Snider et al., 2009; Cragg et al., 2011). Less attention has been given to a fourth factor concerning the planning and implementation process.

Here is the point that can be called an *"innovation design dilemma"* (Holbek 1988; Gjerding 1992; Hyötyläinen, 1998, 2005). Two kinds of innovation related to technical change have been identified: *technical and organisational innovation*.

In this study, the innovation design dilemma is considered to concern the *implementation process* of information systems, from the defining of an innovation problem and the planning of the innovation, to the implementation of techno-organisational solutions in the user organisation (cf. Van de Ven, 1986; Sabherwal and Robey, 1993; Hyötyläinen, 1998, 2005). Through that, it is possible to form means of solving the innovation design dilemma.

However, at a practical level, the implementation of information systems is always a question of complicated strategic issues; technical, economic, and organisational problems; and defining the solutions associated with them. In addition, setting goals associated with the planning and implementation process, defining problems and creating solutions, is a kind of organisational process, which progresses in the form of concrete activities and actions (see Engeström, 1987; Blackler, 1993; Hyötyläinen, 1998).

Companies have great difficulty in implementing information systems and, especially, in fully using all the properties inherent in the systems (Sauer, 1999; Wu et al., 2007; Snider et al., 2009). In the implementation of information systems, the starting point is usually that, by using new systems to radically change business activity processes and the conditions on which the activities are based, the modes of operation adapt to new conditions and, thus, the objectives can be reached (Davenport, 1993; Hammer and Champy, 1993; Kobayashi et al., 2003; cf. Furumo and Melcher, 2006; Currie, 2009; Miranda et al., 2011). However, this approach has some apparent problems. Are there any guarantees that the systems can be implemented in a planned manner? The result can be half-baked and, if things go really badly, even worse than the starting situation (Galliers and Swan, 1999; Lyytinen and Robey, 1999; Pan, 2008).

This is affected by the fact that system implementation processes take many years and the process will involve the participation of various parties, with different interests, perspective, and modes of operation. Within the organisation, many people from various parts and organisational levels will participate in the process. In addition, various organisations will participate in the process, such as software suppliers and possibly consultants (Checkland and Holwell, 1998; Hyötyläinen, 1998; Mumford, 1999). Experiences and studies also indicate that extensive information technology projects associated with the renewal of business activity processes often fail. From an international perspective, only approximately one–third of such projects are successful, and the rest do not achieve their hoped-for benefits (Davenport, 1997; MacDonald, 1998; Fichman and Moses, 1999; Marchand et al., 2001, 134–144; Rajagopal, 2002; Doherty et al., 2003; Dalcher and Genus, 2003; Markus, 2004; Barki et al., 2005; Wu et al., 2007; Kuisma, 2007).

4.3   Factors of the innovation design dilemma

Normally, a clear distinction is made between radical and incremental innovations in the implementation of information systems (Tushman and Nadler, 1986; Nord Tucker, 1987; Yin, 1994b; MacDonald, 1998; Benediktsson and Dalcher, 2003; Davis and Hikmet, 2008; Capaldo and Rippa, 2009). Incremental innovations are also called "routine" innovations (Felman, 2000). The central factor determining the category of an innovation is how radical it is. The more an innovation differs from the existing alternatives, the more radical it is said to be. The same applies both to product innovation and to process innovation as to an information system (cf. Schleimer and Shulman, 2011). In the area of a process, a radical alternative is called simply a *process innovation*. An incremental extreme is labelled a *process improvement* (Davenport, 1993; Fichman and Moses, 1999; Leem and Kim, 2004). According to Davenport (1993, 10–15; see Avison and Fitzgerald, 1999), the differences between the process innovation approach and the process improvement approach can be summarised through a dichotomy model. The main dimensions and features of these two forms of process innovation are compared in Table 2.

Davenport (1993, 10–15; cf. Clark and Starkey, 1988; Mustonen-Ollila and Lyytinen, 2004) sees process innovation as the introduction of something new into a process. As such, this brings about a *radical change*. More specifically, with process innovation, Davenport (1993) refers to a radical process change based on two factors: the adoption of a process view in a business activity; and the application of innovation in key processes. Typical key processes are, for example, product development, product design, materials process, manufacturing, and post-sales service. Other names for this are business process redesign and business process reengineering. The application of whatever innovative technologies available, especially information technology, has been seen as the main enabler for process innovation. The advocates for process innovation can be seen to favour

the technology-based approach, because they give preference to technical solutions in facilitating the radical redesign of processes and work practices (cf. Bai and Lee, 2003; Morton et al., 2003).

Table 2. Comparison of process innovation and process improvement approaches (see Davenport 1993, 11; cf. Imai 1986, 23–4; Hyötyläinen, 1998).

Dimension	Process innovation approach	Process improvement approach
Viewpoint to the nature of change	Radical change, a one-time, big step to design new systems	Incremental changes, iterative and evolutionary design of systems
Design concept/planning approach	Clean slate, technology-based concept, Segmentalist planning approach Top-down planning	Build on existing processes and their development, Problem-oriented approach Bottom-up activities
Primary enabler	Information technology, engineering methods	Use-oriented systems, development and problem-solving methods
Change concept	Strong emphasis on the potentials of technical solutions	Strong organisational emphasis

According to Imai (1986, 1–14), contrary to the process innovation defined above, process improvement is an *incremental activity* for making gradual changes to the existing information systems and processes, as well as for developing information systems as an iterative and evolutionary process (Winter, 1996; Fichman and Moses, 1999; Lee and Kim, 2004; Greer and Ruhe, 2004). The starting point for the improvement is the recognition of a problem, the need for improvement. Thus, incremental improvement is based on a *problem-oriented approach as well as use-oriented systems* (Dittrich and. Lindeberg, 2004; Hyötyläinen, 2005, 78–98). In the improvement activity, different kinds of development and problem-solving methods are used to develop processes and to pinpoint problems to be solved (cf. Torvinen, 1999).

These two approaches differ from each other in their planning and implementation models of information systems. The adoption of information technology is the starting point. The adoption and design of radical innovation is seen to be based on specialist-oriented design, and to proceed as a *"top-down"* activity where the role of top and middle management and information specialists is central, due to the large-scale effects of the investment and its complex nature. This limits the

opportunities of some members of the organisation to participate in the design process. It is a question of a *one-time, big step* to innovate the processes, from the starting point of a relatively clean slate, rather than starting from the basis of the existing processes. A *strong emphasis* is laid on the potentials of information technology in striving for dramatic results and renewing the work practices (Davenport, 1993, 10–15; Capaldo and Rippa, 2009).

Improvement is regarded as an incremental, *continuous activity,* which means small improvements are made to the existing information systems as a result of the ongoing efforts, as well as to design information systems, based on new use-oriented approaches (Ehn, 1988; Dittrich and Lindeberg, 2004; van Aken, 2005; Bhatt et al., 2010). The central feature is a *"bottom-up"* approach, where the role of the user is very important. Process improvement activity relies heavily on *the involvement of the whole organisation and the operating teams*. Improvement calls for a great deal of continuous effort to maintain the commitment of the personnel in the organisation (Edwards, 2000; Feeney and Willcocks, 1999; Bai and Lee, 2003).

These two approaches are relevant from the point of view of the innovation design dilemma and its further definition. To conclude this discussion on process innovation, the main topics can be defined through *three factors and their dimensions, characterising the innovation design dilemma.* These factors and dimensions of the innovation design dilemma with regard to technical change are:

1.   The first factor refers to the *nature of technical change*. The point can be interpreted on the one hand as the difference between a radical innovation and incremental innovations, between a one-time big step and continuous, small steps. On the other hand, the point can be seen as a divider between planning and implementation. In particular, the most important viewpoint regards the dependencies between planning and use activity, which means the use activity becoming a central perspective in the design (see Ehn, 1988, 63–69; Vicente, 1999; Pahl, 2004; Hyötyläinen, 2005, 78–98).

2.   The second factor is related to the *design concept/planning approach*. Here, there are three different aspects. First, it is a question of the design concept between a technology-based and a process-based approach (Morton et al., 2003). The second aspect refers to an engineering approach normally based on a segmentalist planning pattern, whereas process improvement is normally grounded on a more problem-oriented approach. The third aspect concerns the difference between "top-down" and "bottom-up" planning. The question is to what extent all members in the organisation have opportunities to participate and co-operate in the planning activity (Boedker and Gronbaek, 1996; Dittrich and Lindeberg, 2004; Iivari and Iivari, 2006; Kautz, 2011).

3.   The third factor refers to the *change concept*. This is related to the question of which viewpoint the implementation of process innovation is considered from. The main dimension can be seen to concern the difference between

the "techno-centric" approach and organisational emphasis (Edwards, 2000; Doherty et al., 2003). The "techno-centric" approach focuses on the technical issues of technical change. The organisational approach emphasises the importance of organisational change in connection with the technical change (Sahal, 1981; Winter, 1996).

The argument here is that the three dimensions of the factors of the innovation design dilemma have to be covered and overcome in the implementation process of information systems. Otherwise, the factors and their dimensions are dysfunctional in the implementation process of information systems (see Kanter 1988, 84–100; Yin 1994b; Brown, 1991; Esteves, 2009; Bhatt et al., 2010). If the technical change is seen merely as a technical issue, "top-down" activity and a one-time big step, the full potential of new technical systems will not be reached (cf. Nelson and Winter, 1982; Nelson, 1987). The three factors and their dimensions are intertwined with the planning and implementation practices adopted by the management and users.

4.4 Development mechanisms of the implementation process of information systems

The study is based on the view that the implementation process of new information systems is an *organisational activity* consisting of concrete actions carried out by different actors in the user organisation for constructing a new activity system, a "socio-technical system" (see Vygotsky, 1978; Engeström, 1987; Kuutti, 1994; Rowlands, 2009). In the study, the implementation process of information systems is considered to consist of the following four activities: (1) defining the innovation problem and goal setting; (2) planning activity; (3) implementation activity; and (4) use and development activity in the "normal" operation phase (Hyötyläinen, 1998, 2005). The central point of view in the study is to consider *the connections and dependencies between the planning and use activity*, which is a focal issue according to the innovation design dilemma (cf. Boedker and Gronbaek, 1996 Dittrich and Lindeberg, 2004; Iivari and Iivari, 2006).

Due to the organisational nature of the techno-organisational change, the realisation method and its success depend on the traditions of the user organisation and its technical level, the organisational culture of the company, the management and planning practices, and the users' professional skill, motivation, and work orientation (Jones, 1989; Corbett et al., 1991, 99–109; Pan et al., 2008).

The shaping of the planning and implementation process of information systems in the user organisation can be seen to be affected by the *development mechanism* proceeding in two ways: (1) the strategic goal setting and the definition of planning and implementation practices performed by the management, as well as by the planners; and (2) the user activity (Hyötyläinen et al., 1990; Norros, 1991 and 1996; Hyötyläinen, 1998, 2005; Kautz, 2011; cf. stakeholder approach, Burgoyne 1994; Hietanen, 1993). Figure 4 summarises these planning and implementation mechanisms.
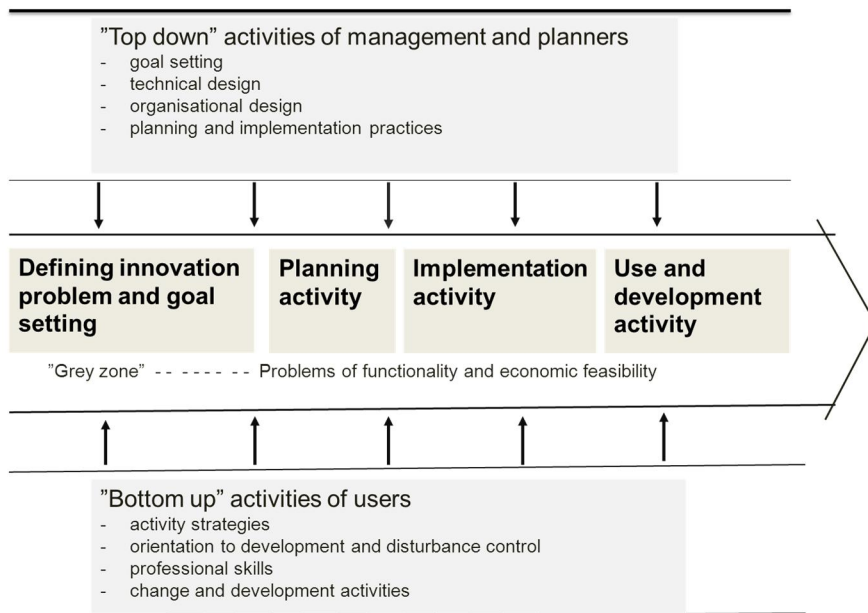
Figure 4. The planning and implementation model of an information system (Hyötyläinen, 1993 and 1998, 24).

The two-way development mechanism of the implementation process of information systems is discussed in the following:

(1) The first one is a manager loop (Gallivan et al., 2003). The company management and planners can be assumed to define, from *"top down",* the goals of the technical change and the framework for planning and implementing information systems by strategic choices and goal setting (Clark and Starkey, 1988, 98–100; Earl, 1999). However, the company and middle management, as well as the planners of the system, encounter pressures on various levels. That is why the management has to act on several strategies simultaneously, and it is not always easy to combine these strategies (see, e.g., Räsänen 1986; Child, 1997; Regner, 2001). The company management has to take into account the market demands and the issues of productivity at the same time. Besides, there are normally conflicting views on strategic changes in the management organisation (Jarzabkowski, 2003). Because of that, the *implementation strategy and practice* adopted by the company and the middle management, as well as by the planners, may evolve along the implementation process when affected by the experiences gained – especially economic pressures and functional problems (see Sitkin 1996; Vicari and Troilo, 1998; Earl, 1999; Galliers and Swan, 1999; Marchand et al., 2001; Jarzabkowski, 2003). Because of this, there are feedback loops between the different phases of the planning and

implementation of information systems, which require co-operation with the users of the system (Gallivan et al., 2003).

(2) The second one is an employee loop (Gallivan et al., 2003). The activity of the users from "bottom up" can affect the development of the implementation process and use activity, as well as the development of information systems and the formation of the organisational arrangements for work (Jones, 1989; Zuboff, 1988; Reijonen and Toivonen, 1996; Hyötyläinen, 1998; Kautz, 2011; cf. Norros, 1996). The professional skills of the users, learning models, and common and individual work orientation play a central role here (Norros, 1991; Engeström, 1987; Khan et al., 1998). The way of working of the users draws, on the one hand, on the organisational structures and conditions and, on the other hand, from personal aims (March and Simon, 1958, 122–135; Gallivan et al., 2003; Doherty et al., 2006; Mao and Palvia, 2008; cf. Sparrow, 1998; Allen et al., 2008). Because the customers' needs and the availability of the company's own resources constantly face new situations, the company has to rely on the users' expertise and skills to co-operate with and adapt to new situations (Rosenberg, 1982; Doherty et al., 2003; Pahl, 2004; Blount, 2011). However, in their development activities, companies might have to face the limitations set by their information systems infrastructure, complicating their adaptation to development needs as determined by activity (Farbey et al., 1999; cf. Bhatt et al., 2010). Thus it can also restrict the potential of the users' activity for continuous development work.

4.5   Summary: implementation as an organisational process

The implementation of an information system is, in fact, an organisational process (Lyytinen, 1986; Kuutti, 1994; Mitev, 2009). The change proceeds through concrete organisational activity and actions where the various actors in the organisation are involved, making interpretations from these implementation activities, through dialogue processes (Isaacs, 1999; Jarzabkowski, 2003; Hsu et al., 2008; Blount, 2011). Thus, the implementation of the technical system is an organisational process in which different actors (management, planners, supervisors, users, the persons of different functions, and external persons) participate in their part in problem-solving processes in different phases of the planning, implementation, and use of information systems (Hyötyläinen, 1998, 2005; Carter et al, 2001; Kautz, 2011). That is activity in which these actors are participating and in which they interact with each other to solve the techno-organisational problems of the change.

At the same time, the implementation process of the information system within an organisation is always a question of organisational learning, where the organisation and its members try to learn new things and to manage many problems occurring in the implementation process of information systems (Argyris, 1992; 2000; Preskill and Torres, 1999; Prange, 1999; Engeström, 2001). The implemen-

tation process is a process during which one can come up against several kinds of troubles and unforeseeable problems, and because of that, one has to seek the ways to solve these problems in an efficient way (Prieto and Easterby, 2006; Barki et al., 2005). Through these organisational problem-solving and learning processes, a new techno-organisational system gradually forms that is, in its nature, an organisational activity system (Engeström, 1987, 2001; Blackler, 1993; Kuutti, 1999). One could justifiably state that the implementation process of the information systems is carried out and defined through organisational activity measures. It is ultimately a question of organisational-learning and innovation processes (Brown and Duguid, 1991; Prange, 1999; Lorenzo et al., 2012). It is only through these processes that the information technology potential can be fully realised.

Organisational issues are of most importance for the success of the implementation process of information systems (Doherty et al, 2003; Chen, 2009). The action mode of the user organisation and the methods in use delineate, to a great extent, how technical change is seen within the organisation. Organisational action modes also have a central meaning for the formation of planning concept (Hyötyläinen, 1998; Avison and Fitzgerald, 1999; Doherty et al., 2010). It can be said that organisational action modes define the quality and success of the organisational problem-solving process occurring in planning and implementation, as well as in the use of information systems (Furumo and Melcher, 2006). As a result of these problem-solving processes technical solutions are created, as well as organisational procedures, through which final results can be achieved.

Understanding the adoption of information systems requires understanding of the whole innovation process, from the conception of an idea to its implementation. The adoption is the process an organisation goes through to reach the decision to adopt a new information system or solution. The process starts with the recognition of a need and the eventual result is the implementation of an innovation (Rogers 1995, 371–404; Amaoko-Gyampah and Salam, 2004).

It is acknowledged that many of the uncertainties cannot be resolved before an innovation becomes operative. Because of this, many decisions made during the design stage need to be adjusted and reworked. This means planning activity to solve and prevent problems from occurring in the implementation phase. During the implementation, the user organisation may be the major agent in changing and modifying the innovation (Gallivan et al., 2003; Leem and Kim, 2004; Capaldo and Rippa, 2009).

5. Constructive implementation steps for information systems

The research and development activity based on constructive approaches is normally conducted through development projects in the concrete real settings of organisations for planning and implementing information systems. In general, a constructive approach is implemented as case studies (Kasanen et al., 1993; Lukka, 2000, 2003; Hyötyläinen, 2005; cf. Yin, 1994a). In research and development, complicated information systems development processes are analysed in real production life. These processes are also considered to be implemented through concrete activity and actions by various actors in an organisation (Lyytinen, 1986; Kuutti, 1994; Lorenzo et al., 2012).

In the following, we will discuss further the constructive research and development model. The phase model of the planning and implementation process is first analysed. After that, special emphasis will be put on the development cycle method to apply in the constructive approach. Here, we will analyse the development cycle method and its significance in practical change and development processes within research and development projects, together with companies (see Toikka et al., 1988; Alasoini et al., 1994; Hyötyläinen, 1998, 2000, 2005, 2007; Hyötyläinen and Simons, 2007). Finally, some concluding remarks on the application of a constructive research and development model in cases will be made. This development cycle method and its phases create the basis for the further consideration of cases in the next chapters of the study.

5.1 Phase model of the planning and implementation process

The planning and implementation process of information systems can be viewed as phases consisting of different stages or cycles (Fichman and Moses, 1999; Gallivan et al., 2003; Bagchi et al., 2003; cf. Markus, 2004; Esteves, 2009). This phase model can be seen as a certain kind of life-cycle model of the implementation process. However, the planning and implementation process does not proceed in straightforward a way as the life-cycle model presents it. There are several feedback loops between the cycles and the importance of different phases can vary according to the question in hand. In any case, the phase model describes

the main phases of the planning and implementation process carried out in a user organisation (Bozarth, 2006; Capaldo and Rippa, 2009; Cragg et al., 2011).

With regard to the end-user enterprise or a similar organisation, the formal phase model for the information system's implementation can be considered to cover cycles from the company's strategic planning to the continual development of the information system and its use. In the phase model, one can view four different cycles, which can be further divided into more detailed levels. In Figure 5, we see the phase model for an end-user enterprise. When proceeding in the phase model into the next stages, the knowledge of the system will be more determined (Lin et al., 2012).
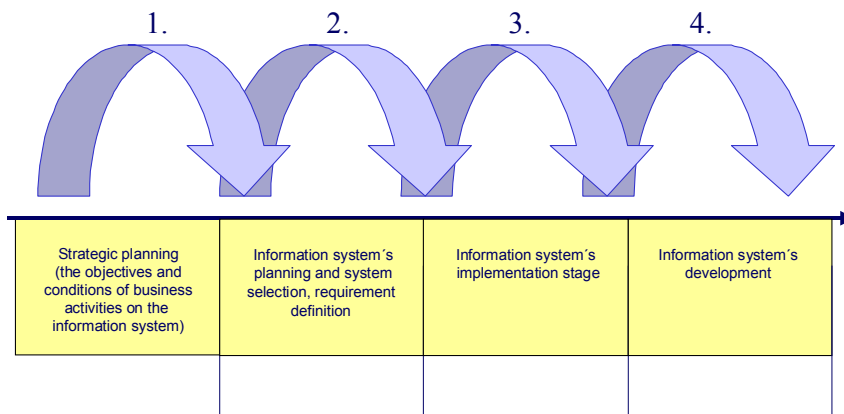
Figure 5. The information system's implementation process phase model for an end-user enterprise or a similar organisation.

Strategic planning and a strategic basis can be considered to be the foundation of a company's business activities, as well as the basis for defining an information system in the company (cf. Mintzberg, 1994; Child, 1997; Jarzabkowski, 2003). Strategic planning and objective setting form the first cycle in the phase model. As far as strategy is concerned, one can differentiate between an actual business strategy and an information management strategy, where one clarifies the role of the company's information technology in the company strategy and one sets goals for the use of information technology (Earl, 1999; Marchand et al., 2001; Amaoko-Gyampah and Salam, 2004; Mason, 2007). However, the strategy can be "market focused" or "operative focused", which affects the company's ability to garnish efficiency versus customer service benefits from its investment in information systems (Beyer and Holzblatt, 1998; Capaldo and Rippa, 2009; Bhatt et al., 2010).

In any case, the creation and implementation of a strategy has been thought to be one of business management's central methods in conducting business and integrating daily activities as part of the company's general objectives and strategic profiling (Ansoff, 1965; Cyert and March, 1992; Jarzabkowski, 2003). The

acquisition of an information system requires significant strategic clarification and consideration of strategic and especially organisational objectives, which clearly influence the quality of the information system (Sarker and Lee, 2003; Spanos et al., 2002; Bai and Lee, 2003, Doherty et al., 2006). The lifespan of information systems like ERP (enterprise resource planning) systems is usually fairly long, for which reason systematic strategic planning and the consideration of strategic and organisational perspectives are essential factors, which enable the selection of an information system that supports the business objectives and the achievement of organisational goals. However, this doctrine of strategic management emphasises development processes that progress top-down in the organisation. It is based on a notion of the omnipotence and primary nature of strategic planning in the direction of the company's operation.

A different kind of perspective on strategic management is introduced by the incremental approach that proceeds in stages (see Quinn, 1980; Earl, 1999, Galliers and Swan, 1999; Benediktsson and Dalcher, 2003). The formation of the strategy is perceived as a stage-by-stage process, in which different parts of the organisation and its management and different actors, with their continuing actions and with opportunities opening up in the activity, have an important position in the management of the company and in the reorientation of activity (Greer and Ruhe, 2004; Miranda et al., 2011; Johri and Nair, 2011). According to this view, strategy emerges from the organisation. The shaping of a definition of business activity starts from considering what the existing skills of the organisation are and in which direction the company wants to develop this expertise (Brödner, 1989; Eriksson and Nurminen, 1991; Feeney and Willcocks, 1999). This emphasises the development processes moving top-down and bottom-up in the organisation (Boedker and Gronbaek, 1996; Lorenzo et al., 2012). The formation and the generalised use of the new activity mode is not seen as a result of systematic planning, but rather it emerges gradually from the pressures of challenges and conflicts, as a result of learning, organisational activity, and the interaction of the actors and groups (Mintzberg, 1994; Bagchi et al., 2003). The formation of the new activity mode is a complex learning and development process, because historically different development states are always represented by strategic layers of assumptions and activity modes (Stacey, 2001; Regner, 2001; Miranda et al., 2011; Lorenzo et al., 2012).

The requirement definitions and the planning of the information system project, as well as the selection of the system, will come during the later stages of the strategic planning process. These measures form the second cycle of the phase model. These measures can be considered to be preplanning for the actual implementation (Beyer and Holzblatt, 1998; Gottschalk 1999; Dalcher, 2003; Blount, 2011). Central measures in the second cycle of the phase model are the requirement definitions, based on business activities and organisational goals and their development, for the system to be selected, the negotiations and bid request round with the software suppliers or system integrators, and the actual selection of the system itself (Browne and Ramesh, 2002; Benediksson and Dalcher, 2003; Xu and Ma, 2008). The company's or organisation's requirement definitions form the

basis for the selection of the system. By means of a thorough requirement definition, which considers different functions and processes, one can ensure that one reaches the required final result (Gupta, 2000; Browne and Ramesh, 2002; Metcalfe, 2002; Kauppinen et al., 2004). Comprehensive requirement specifications have to be based on the current and future needs of the business and organisation (Greer and Ruhe, 2004; Bozarth, 2006; cf. Ikävalko, 2005). Solid requirement definitions also help the company and the vendor conduct discussions and understand each other.

Normally, the requirement definition cycle describes the role of middle management (Nonaka, 1991; Nonaka and Takeuchi, 1995; Ikävalko, 2005). It is seen that the planning of the information system project and the selection of the system, as well as the requirement definitions, will come during the later stages of the strategic planning (Earl, 1999; Al-Mashari and Al-Mudimigh, 2003; Rajagopal, 2003). Middle management, through a systematic development activity, attempts to reach the set goals of information systems and follow them until they are met. Development measures may be focused on the company's production system structures, such as information systems, organisational change and modes of operation, organisation-management methods, business processes, and so on. (Davenport, 1997; Avison and Fitzgerald, 1999; Edwards, 2000; Doherty et al., 2010; cf. Cardoso et al., 2004). The shaping of the structures and processes that form the company's infrastructure often occurs more or less systematically while the projects are being carried out.

By *the implementation of an information system*, we mean the implementation, parameterisation of the selected system and a possible data conversion from the old system to a new one (Boem and Port, 1999; Al-Mashari and Al-Midimigh, 2003). This forms the third cycle of the phase model. The implementation stage also includes any customisation, training, and possible test runs of the information system. From a practical standpoint, it is important to have the entire organisation, including personnel, participate, which will facilitate the implementation (Bai and Lee, 2003; Doherty et al., 2003; Amoako-Gyampah and Salam, 2004; Gosain et al., 2005; Kautz, 2011). The implementation stage also includes the system's introduction into production use, which again means planning and management of the activities using the new information system. Starting up production use is often a critical stage in system projects, and requires much effort from the organisation and the software suppliers to make it smooth and painless (Dalcher and Genus, 2003; Doherty et al., 2003; Capaldo and Rippa, 2009; cf. Gardner and Ash, 2003).

The *continual development* of the information system can be thought to consist of maintaining and developing the readiness of the IT factors, from both an IT and a business perspective. This forms the fourth stage of the phase model. Continuous development can also include the development of the competence of the company or organisation's personnel (Pahl, 2004; Leem and Kim, 2004; Cragg, 2011). The continuous development of the information system means new system updates, as well as increasing the scope of the system used. In addition to the system, the enterprise or organisation may develop its own activity processes, as well as the company's enterprise resource planning, which means that the existing

system can be used more efficiently (Lankton et al., 2010). Continuous development can also be considered to be part of the company's normal system development and as a continuous operational improvement (Imai, 1986, 1997; Felman, 2000; Benediktsson and Dalcher, 2003).

Information systems will be realised only in use (Macdonald, 1988, 32–33). This pertains to the operative level in an organisation, which is illustrated by the continuous change cycle. The practical use of the information system is implemented as operational activity in an organisation (cf. March and Simon, 1958; Zuboff, 1988). The fourth level of the development cycle describes flexible and context-based routines and problem-solving activities, which contribute to adaptation to the operative demands of the activity environment (Eriksson and Nurminen, 1991; Coriat and Dosi, 1998; Felman, 2000; Doherty et al., 2003).

5.2   Development cycle method

The research and development activity based on constructive approaches is normally conducted through development projects in the concrete real settings of organisations for developing and implementing information systems. In general, a constructive approach is implemented as case studies, based on the solution of real problems in practice (Lukka, 2000, 2003 cf. Yin, 1994a). In research and development, complicated information systems development processes are analysed in real production life. Besides, we have studied the development of activity systems, as well as the implementation of information systems, as an organisational change processes. These processes are also considered to implement changes through concrete activity and actions by various actors in an organisation (cf. Lyytinen, 1986; Kuutti, 1994, 1999).

The object of constructive research and development activity is usually the formation of new theoretical concepts and models, and new practical solutions in connection with the implementation of information systems (Peffers et al., 2008; Oyegoke, 2011). This forms the basis for the development project, where the researchers co-operate with the organisation's personnel. The development projects focus on practice, in the analysis and solutions of development problems. When solving practical problems, researchers use theoretical and research-based knowledge, as well as earlier practice-based know-how for advancing innovative new solutions in enterprises (Lukka, 2003; Alasoini, 2005; Hyötyläinen, 2005, 2007).

The construction of research and development methods is an essential part of the formulation process of a new constructive research and development approach (Hyötyläinen, 2005). The methodology of the constructive approach has to have some qualities in order to guarantee successful research results, as well as good innovative results in practice (Kasanen et al., 1993; Lukka, 2000, 2003). Our constructive development research is marked by the following four characteristics: (1) research consists of intensive case studies, (2) it is based on and aims for theoretical generalisations, (3) it is based on test-like development intervention,

and (4) it pursues a methodological discipline. The development process also emphasises the importance of models and tools (Alasoini et al., 1994, 51–73; Hyötyläinen, 1998, 2000, 2005; 2011, 171–173). It can be said that this constructive method is aimed at research-based approaches and knowledge for solving development problems defined in companies (see Alasoini, 2005).

The three corner-stones of the research and development method are the development cycle, development and innovation working, and teamwork and modelling (Hyötyläinen and Simons, 2007; Hyötyläinen, 2011, 171–173). In the business-focused development work of a constructive approach, these are the three central pillars on which the development has been primarily based. First, cyclical development is a tool for analysing development processes and keeping them in circulation (Hyötyläinen, 1998, 2000). The second has been development teamwork. Development teamwork can be seen as the most characteristic feature in constructive development work. In teamwork, researchers solve development problems, outline solutions, and implement them together with business personnel. In this work, researchers often play an important role (cf. Burnes, 2004). The third central feature is the creation and use of models and methods in development work. On one hand, models and methods are used to analyse development targets, and on the other hand, they are used as tools in the development process.

For concrete research and development work, it is ncessary to use suitable methods to manage concrete projects in practice (Hyötyläinen and Simons, 2007). Figure 6 presents a typical development cycle, which can be applied in business projects, as well as in the case of the implementation process of information systems.

Figure 6 shows the five main stages of business-specific analysis and development: 1) the start of collaboration, 2) analysis, 3) the choice and definition of development targets, 4) the planning and testing of development, meaning solutions and their implementation, and 5) the adoption of solutions and practices that have proven workable (Hyötyläinen, 2011, 171–173). Each stage of the development process has been assigned certain tasks and actors, that is, an organisation, and development results. The development process also addresses the need for quick problem–solving, which is specified in the discussion of the stages. Naturally, the progress is not linear from one stage to the next; instead, sometimes it is necessary to return to review the start position or to plan new solutions and methods when those already developed prove unworkable.
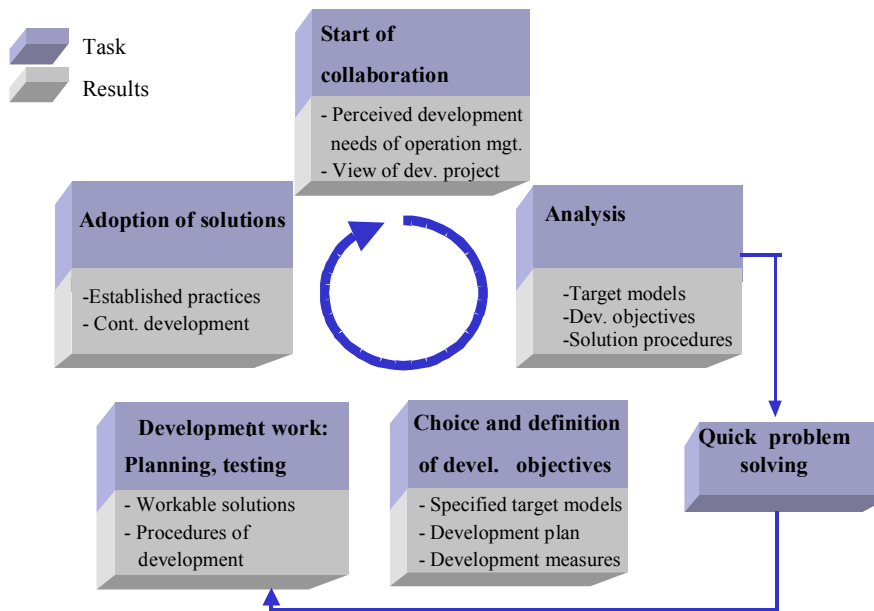
Figure 6. The model of a development cycle.

Below is a more detailed description of the basics of each stage. The stages are not necessarily linear, as the progress of a development project in a company depends on the needs and interests of the company and its personnel. However, when one moves from one phase to later phases, the knowledge of the subject becomes more structured (Lin et al., 2012).

5.2.1   Start of collaboration

The start of collaboration is a critical stage in the development process: it lays the foundation for the development project as a whole and above all for co-operation and trust between the company and the researchers (Lukka, 2003; Hyötyläinen, 2005, 46–50). In the case development projects, the researchers aimed to invest a lot of effort in the first contacts and in establishing a working relationship at the start of the collaboration.

The purpose of the first stage is for the researchers and key employees at the company to engage in discussions and decision-making to establish a shared vision of the company's business, strategic goals, operating processes, and also the current state of problems in, and development needs of operations manage-ment and the information systems supporting it. The shared vision is then used for outlining the development project and its goals, and for agreeing on procedures such as human resources, timetables, communication patterns, and working pro-cedures during the project, binding these into the concrete setting of the organisa-

tion (Engeström, 1987, 321–337; Bruce and Wyman, 1998, 20–24; Lukka, 2000; Peffers et al., 2008).

The first stage results in a shared conception of development needs in operations management and of the development project. In addition, a management group is set up for the development project to monitor project, progress and to convey information between development teams and development sites, that is, to co-ordinate the project overall in the company.

5.2.2 Analysis

The purpose of the analysis stage is to collect data on the target company, its operating practices and information systems, and their development needs (Cassell and Symon, 1994; Fryer and Feather, 1994; Yin, 1994a). The analysis involves charting the current state, business processes, information systems, operations management, future outlook, and goals and key development points of the company (Hyötyläinen, 2005, 45–50; Hyötyläinen and Simons, 2007; cf. Eekels and Roozenburg, 1991). If the company has recently introduced an operations management system and is engaged in operations development, the operations management system implementation project is also analysed, together with the methods used in the information system implementation processes, the roles of various persons and functions, and their tasks and interaction. Data are collected by the project group and through interviews conducted by the researchers.

The interviews focus on key members of the company management, such as the managing director, production manager, supervisors, and information system manager (or the project manager in an information system introduction project). The purpose of the interviews is to gain an overall impression of the company, its current state, its future outlook, and what the company management and key persons feel about operations development and the information system implementation process, problems encountered, and development needs (cf. Gottschalk, 2001).

In addition to management, employees from various user groups in the company (e.g. financial management, production planning, procurement/purchasing, and sales) are interviewed (Burgoyne, 1994; Cassel and Symon, 1994). The purpose of the interview is to get acquainted with and establish relations with personnel in the company and to obtain data on how the implementation process was executed, how users participated, and what problems were encountered in the implementation process from the user groups' perspective. The interviews can also be used to chart user experiences of how the new information system has affected their work and what the general mood regarding development is in the company. User interviews are conducted individually or in groups.

The results of the analysis stage are summarised in an analysis report, containing the researchers' target models for the company's business processes and operations management, and the role of information systems in the company's

business. The report also identifies the company's development points and preliminary solutions to them (cf. Burnes, 2004).

The need for rapid troubleshooting in the company is also taken into account in the development process. This is about addressing minor but acute development needs emerging in the development project, to which clear solutions and development measures can be assigned through troubleshooting techniques (Simons and Hyötyläinen, 1998; Hyötyläinen, 2011, 171–173).

5.2.3 Choice and definition of objectives

The third stage begins with a discussion of the aforementioned analysis report with the project group and key employees in the company. Sufficient time must be allocated to discussing the findings, because the development points for the project are to be selected and defined on the basis of the discussion. In many cases, there are numerous points at various levels to be considered at this stage. The aim here is to prioritise development points and choose the most important among them related to the development of operations management and procedures, and of the information systems supporting them (Lukka, 2003; Tikkanen et al., 2005; Hyötyläinen, 2005, 171–173; Peffers et al., 2008).

Then, internal development teams are set up in the company to address specific development points and development themes. Members of these teams are selected from various functions and include experts in the relevant themes. The purpose of the development teams is to activate company personnel, who are the people actually affected by the problems or development needs identified, to work together to find solutions to address the selected development points. This will utilise employee expertise, provide motivation, and get employees to commit to the improvement of their work and workplace environment while learning new professional and social skills. Another aim is to ensure the establishment of new working practices in day-to-day work. The researchers participate closely in the work of the development teams, offering troubleshooting procedures models and tools, and also guiding the work of the groups (Simons and Hyötyläinen 1998; Hyötyläinen 1998).

In addition to selecting development points and setting up development teams, the purpose of this stage is to organise development efforts in the company (Argyris, 2000). Based on the analysis results and the following discussions, the researchers draw up specified target models for the selected development points and a development plan, besides determining which development measures will need to be carried out in the course of the project (Lukka, 2003).

5.2.4 Development work: planning and testing

The innovation and development work proper in the project is done at this stage, with the development teams addressing their predetermined agenda. The team members seek solutions to the problems, modelling the current state and outlining the target state, and also testing and evaluating how the proposed solutions would work in practice, according to the principles of the constructive model in practice (Weick 2003; Lukka 2003; Hyötyläinen, 2005, 46–50; Peffers et al., 2008). They also, assisted by the researchers, develop procedures and tools suitable for them-selves in particular, and for the company in general, for further development (Hyötyläinen and Karvonen 2000; Ilomäki 2003; cf. Torvinen, 1999).

In this project, focusing on the operations management and procedures of SMEs and the information systems supporting them, all the companies involved in the project identified, as development points, the modelling of business processes and critical information flows, and an analysis of how the current operations man-agement system is used. The usage analysis includes defining current use, en-hancing user operations, and charting features of the system not yet utilised in the company's operating processes. These development points were addressed in the development teams with tools including modelling methods and wall poster tech-niques (cf. Ehn, 1988; Engeström, 1994; Simons and Hyötyläinen, 1998; Torvinen, 1999).

The management team follows the work of the development teams closely and ensures that the company personnel are kept up to date on their progress. The results of the fourth stage are solutions in accordance with the development goals and the development procedures created by the development teams (cf. Bruce and Wyman, 1998; Lankton et al., 2010).

5.2.5 Adoption of solutions

At the adoption stage, workable solutions and new operating practices and devel-opment procedures are established in the companies' operations management and in the use of their operations management systems (Hyötyläinen 2000; Hyötyläinen and Kalliokoski 2001). At this stage at the latest, the results of the work done by the development teams and the project group are published for the personnel groups and employees involved to see. Here, the input of the members of the development teams in instructing other employees in the new procedures and in the use of the equipment and software, and in sharing expertise and knowledge, is vital. Sufficient time must be allowed for the adoption stage, so that employees can learn the new practices and adapt them to their own personal ways of working (Reijonen and Toivonen, 1996; Davis and Hikmet, 2008; Cragg et al., 2011).

The researchers support the companies in the adoption of solutions and in the monitoring and evaluation of how well the solutions work. At the same time, they help the companies to orient their development efforts in accordance with the

development goals set (cf. Peffers et al., 2008). The underlying goal is that, at this point at the latest, the company adopts active and continuous development and acknowledges its importance to the company's success (Eriksson and Nurminen, 1991; Garvin, 1993; Lowendahl and Haanes, 1997; Ilomäki 2003).

5.3   Summary: development points in cases

The company projects were undertaken in close co-operation with the participating companies. There were four participating companies. Table 3 describes the companies and their development trends, and the development points identified in the project.

   This study draws specifically on three case studies, which are extensively reviewed and analysed in detail. The first of these is Case A. In the Case A development project, it is a question, on one hand, of the strategic development in a multi-plant environment, the drafting of a strategic guidance model, and, on the other hand, of the development of production management and operating practices at one plant, including an information system needs assessment.

   The second case is the Case B development project. The focus is on strategic subcontracting issues and operations and production development. The materials are analysed and evaluated with regard to success and difficulties in each development area, and from both the company's and the researchers' perspective. An overall evaluation of the case study is also presented. The third one is Case C. Case C complements, for its part, the points of Case B. In this case, it is a question, on one hand, of the formulation of strategy in the company, and, on the other hand, of the construction and refining of a production management model.

   The fourth development project given focus is Case D, where the further development of an introduced operations management system and the creation of a development organisation and development stages constitute the main content. The creation and use of methods are also important here, and their use is evaluated, as is the development project as a whole, with its outcomes.

Table 3. Companies in the joint project, their features and development points.

Company	Sector and scale	Development trend	Development points
Case A	Door supplier, 5 plants; 300 employees, in operation for more than 40 years	Operating strategy development, production management development, closer co-operation between functions, guidance system development	Strategy definition, production management analysis and development, collaboration development, system surveys
Case B	Hardware and interior decoration, manufacture and imports; 140 employees, founded 1976	Operations growth, starting and expanding contract manufacturing	Subcontracting strategy, development of operations and operations management, operations management system development needs
Case C	Engineering company; 20 employees, founded 1969	Growth orientation, clarification of operations	Growth strategy, guidance model, guidance tools
Case D	Electronics and mechanical equipment supplier, 4 plants of which is1 in Estonia	Operations development, further development of introduced operations management system	Operating process development, run-time development of operations management system

The following is a description of each company, its development situation and function, and measures undertaken in the development project.

6. Case A: development of business strategy and operations management

6.1 Starting points

Case A has changed greatly over the past ten years in terms of structure and operations. Its turnover alone has increased by a factor of 10, and the company acquired another company just before the start of the joint project. The company was originally a family business, but its ownership has subsequently changed.

The company's product range has also changed, with implications for manufacturing practices and technology. Over the past years, the company has engaged in corporate acquisitions and now has four plants. The company has begun exporting its products and is expanding this side of the business, with exports now accounting for about 40% of turnover. The company is the market leader in its field in Finland and also the largest manufacturer of doors in the Nordic countries. In recent years, the company has invested heavily in production automation and information systems.

Rapid expansion, an increasing customer-oriented focus, increased exports, expansion to a multi-plant operation and the related plant profile development, investments, and information system projects have placed a great strain on the company's operations and practices. Development pressures arise from the challenges brought by the company's increasingly complex operations. The company's practices and administrative procedures evolved back when the business was much simpler than it is now. The extent of the company's operations places certain demands on management systems, operations management, production management, and plant co-ordination.

A milestone in the development of the home plant of Case A was the creation of the company's new product line in 1994. A new way of manufacturing doors was created, and the product family idea was developed. At the same time, CNC technology was introduced to the surface pattern process as the basis for planning. In recent years, considerable investments have been made in production automation at the home plant. Today, the home plant produces some 115,000 doors per year, representing a major challenge for production management.

Following the introduction of the new product line, door models and technological solutions have been subject to continuous development. The problem is that as the product line grows, the number of variations and customer-specific solutions is mushrooming beyond the control of production management.

In recent years, the company has invested in information systems. A new operations management system was introduced in 1998. In recent years, considerable investments have been made in production automation and CAD/CNC technology at the home plant. Plant production management has fallen behind this development curve, partly because of the increase in variations and volumes. It is also difficult to manage a highly variable number of orders.

During the research and development project (in 2001–2002), Case A was in the process of clarifying the division of duties between its plants and drawing up a future operating concept for the company. The purpose of this was to utilise the strengths and special expertise of each plant and to reduce unnecessary material and information flows between plants. 'Profiling' the plants is expected to lead to increased capacity, which, in turn, requires increased sales. Exports are seen as a key growth area, and controlled growth is the overall goal (cf. Hyötyläinen, 2009; Miranda, 2011).

This in turn places certain demands on operations development and production management, which must be able to cope with diverse and increasingly complicated jobs. In export markets, customers often require unconventional solutions that require the production management system to have great flexibility.

6.2   Start of collaboration in Case A

The start of collaboration is a critical phase in any development process, because it lays the foundation for the development project, and above all for, co-operation and trust between the company and the researchers (Lukka, 2003).

The joint project with Case A started in August 2001. It took some time to agree on the joint project. The first negotiations were going on in the spring and summer in 2000. The first plan for the joint project was done by the researchers on VTT on 26 April 2001.

The first meeting in the joint project was held on 29 August 2001. The members in the meeting were:

- development manager, home factory
- information manager, home factory
- managing director for two other factories
- information manager for the fourth factory
- two researchers from VTT.

The objective was to start the joint project, revise the project plan, and agree on the following steps in the joint project. It also aimed to specify the development objects and discuss the development objectives set in the joint project. It came out, however, that members coming of the company had no clear or common

image of the development objects and targets for the joint project. For that, it was decided that the researchers would visit all the factories of the company, and interview key persons. Based on that, the researchers would make a proposition for the development objects and follow-on methods in the joint project. These things would be discussed in the following meeting, which was planned to be held on 11 October 2001.

6.3 Analysis

The purpose of the analysis phase is to collect data and to interview key persons in the company. The analysis involves charting the current state, challenges, and future outlook and key development points of the company (Gottschalk, 2001; Hyötyläinen, 2005, 45–50).

The reseachers interviewed 15 persons between 13 and 27 September 2001. The following persons were interviewed:

Home factory
- managing director of the whole company
- development manager
- sales manager
- financial manager
- production planner
- information manager

Second factory
- factory director
- sales manager
- production planner
- supervisor
- information manager

Other two factories
- managing director of two factories
- development manager
- production manager
- other production manager.

In addition, the researchers had access to materials concerning the company, including business plans, and information systems development plan.

After that, the researchers finished the analysis report dated 12 October 2001. In the report, it was emphasised that the company had grown fast. There were more than 300 personnel, and the company had four factories. Furthermore, the company had increased exports to many countries. Production was totally based on customer–orders, varying from one or two pieces per order to thousands of

pieces per order, which made it difficult to manage strategically and also on a more operationally basis.

6.4   Choice and definition of development objectives

The aim is to prioritise development points and to choose the most import things from the point of view of the development targets in the company (Lukka, 2003). It is also the aim to set up development teams and other groups in the company, to address specific development themes.

The analysis report and its propositions were handled in the second meeting on the 15th October 2001, in the company. However, the members in the meeting changed partly from the first meeting. The members were:

- managing director of the whole company
- information manager at the home factory
- information manager at the second factory
- three researchers from VTT.

Not in place were:
- development manager at the home factory
- managing director for two the other factories.

When the analysis report was handled in the second meeting on 15 October 2001, the measures were directed in two directions, based on the propositions in the analysis report. One direction concerned strategic questions between the factories of the company and the management of complex systems, with its market environment, including organisational issues. The other development area was production management in the home factory in the company. The researcher raised these two areas as being important for the future success of the company.

It was decided that the company would choose the members for these groups and communicate this to the researcher, in order to start development steps in the company.

The members in the strategy group were:

- managing director of the whole company
- development manager at the home plant
- sales manager at the home plant
- information manager at the home plant
- information manager at the second plant
- managing director at second plant
- sales manager at the second plant
- two researchers from VTT.

Another question concerned production management at the home factory in the company. The members of the group were:

- information manager at the home plant
- information manager at the second plant
- production manager at the home plant
- two researchers from VTT.

6.5   Development work

The development work proper in the project is done at this stage, with the development teams addressing their predetermined agenda. The team members seek solutions to the problems, modelling the current state and outlining the target state, and also testing and evaluating how the proposed solutions would work in practice (Weick 2003; Lukka 2003; Hyötyläinen, 2005, 46–50). They also, assisted by the researchers, develop models, procedures, and tools suitable for the company and its further development.

Case A identified development pressures in several areas, due to the company's developmental situation and future challenges.

The analysis report made by the researchers, presented, on the one hand, strategic work concerning strategic and organisational questions, and, on the other hand, questions concerning operations management, including procedures, and the development of information system and their use. In the second meeting arranged by the company, these two points were approved.

Figure 7 shows this scheme used as a basis for further analysis and development in two groups in Case A. In this scheme, the connections between different development parts are also outlined. Strategic work and its organisational issues have a direct relationship to how operation management is organised and handled.

STRATEGIC WORK
- market and competitive strategy
- strategic goals
- product strategy
- division between plants
- operations models

ORGANISATION
- organisation structure
- division duties
- actor roles
- contact to partners

PROCEDURE
- job descriptions
- collaboration practices
- professional skills and compentencies
- co-operation and development methods

OPERATIONS MANAGEMENT
- operations processes
- work processes
- information flows
- operations indicators

INFORMATION SYSTEMS
- operations management support
- operations management planning and monitoring
- reporting
- managing inter-plant processes
- system integration

Figure 7. Scheme for development in Case A.

The work consisted of two parts. One part was about further specifying the operations strategy and plant co-operation. Another part of the analysis and development was operations management procedures at the Case A home plant.

The work was divided into two parts. The first part concerned the strategy work of the company. The project was linked to the ongoing strategic groundwork and development in the company. The operations strategy is based on knowledge of the market and the competition situation and on the product strategy. Available resources influence strategic choices (cf. Child, 1997). The strengths and opportunities of the company's plants are used to build for the future. Business models and their development are crucial in this respect (cf. Tikkanen et al., 2005). Co-operation and division of duties between plants is also important for improving the company's operations. In the strategic work, the operations strategy and plant co-operation patterns were further specified. The operations strategy also covers organisational issues and job description development.

Another part was about further specifying the operations strategy and plant co-operation. Analysis and development was undertaken at the Case A home plant with regard to operations management and procedures, this being closely linked to

the operations strategy (cf. Alasoini et al., 1994; Choo, 1998). The principal focus was on production management analysis and development.

Strategic work

The company had developed its businesses and operations in many areas during years before the joint project. However, the problem was that development work happened mainly on the basis of business area and function–specific questions. Because of this, the formation and specification of the strategic plan is of high importance, because it is possible to consider different business areas at the same time, and to deal with development measures from the point of view of the whole company, taking into account the business model and product marketing (cf. Tikkanen et al., 2005). This requires the adoption of strategic thinking and an action plan, as well as to co-ordination of development measures. As part of that, there are new models to manage customers and new services, by which it is possible to achieve an increase in market share, so that the company can open new markets. As a basis, it is the organisation of action, operation, and methods that support these purposes.

It was argued by the researchers that strategic planning is based on the knowledge of markets and competitive situation, as well as on product strategy. The resources in use influence strategic choices (cf. Child, 1997). The strengths and opportunities of the factories are a starting point for constructing the future of the company. In that, the central factors are operations models and their development. The co-operation and distribution of work between the factories are also important in the development of the operations in the company. Strategic planning also covers questions concerning the organisation questions of operations and the development of task descriptions.

The tasks of the strategy work were set (cf. Figure 7):

- defining the business concept and goals
- defining the product strategy
- launching operations planning
- developing an operations model
- planning and developing the division of duties, collaboration, and communication between plants
- outlining the operations strategy
- organising operations and developing job descriptions
- creating a development programme and implementation plan.

The set joint strategy group held its first meeting on 14 January 2002. The group had a total five meetings, the last one being on 2 November 2002.

At the beginning of the strategic work, the researchers outlined how Case A had developed and what were the next steps in this development path. Figure 8 shows the development path of Case A.
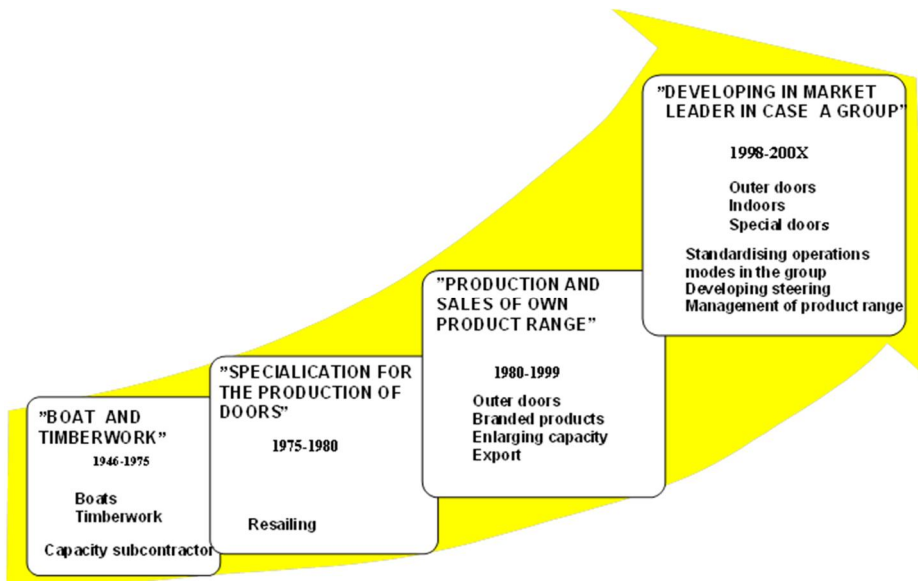
Figure 8. Developing Case A as market leader.

Case A was long a capacity subcontractor. It produced boats and some timber-work. After that, the company specialised in producing doors, but in the beginning it sould them through different retailing organisations. Later, the company developed its own products, and little by little it developed a whole product range. The company has become the owner of many factories. The company created its own sales organisation for selling products. The next phase on the development path is how the company can develop as a market leader in its area, and how the company can increase its export share, including new markets. All this requires the standardisation and development of operation modes in the group of the company. It is also essential to develop steering practices in the group.

During the joint project, a goal-oriented operations planning and budgeting procedure was introduced at the company. A specific market segment sales table was drafted and a competitor analysis conducted in the project. A SWOT analysis of the company was prepared, and the product range and strengths of the plants were analysed. A table was drawn up for drafting the product strategy. Descriptions and flow-charts were drawn up of the processes and workflow in the operations. An information system development map was also drawn up.

There were also discussions on the strategic development stages of the company and how they may be analysed (see Figure 8). There were presentations on the product concept and product definitions and related dimensions. Figure 9 exemplifies the product range concept in the Case A group.
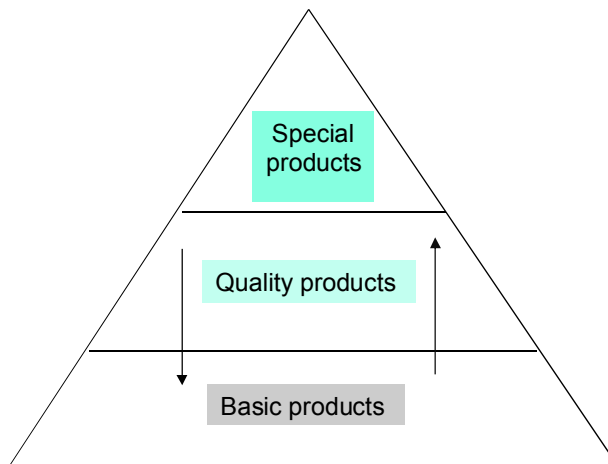
Figure 9. The product and market pyramid in the Case A group.

The question is in which direction the company is moving within the product pyramid. In which segment are different customer groups situated? What is the main competitive advantage in each product group?

In the strategy group, the company's strategic development goals were outlined and discussed, as were the company's products and service concept. The company's business areas were examined and analysed.

The end result of all this was an operating strategy and its implementation plan. This involved analysing the development field in Case A and planning development steps. The ultimate aim is controlled corporate growth, with exports playing a major role in this.

The researchers from VTT made the strategy report for Case A, dated 27 May 2002. The aim of the report was to conclude the work in the strategy group so far, and to present models and views for analysing the development features of the company, as well as for defining strategic planning and product strategy, and the organisation of operations. As part of that, the report included propositions for development measures. The researcher made a proposition for so–called a rolling strategic process (cf. Mintzberg, 1994; Jarzabkowski, 2003). The basic thought is that strategic views and their operational experimenting and implementing overlap each other, and strategic planning is directed and specified continuously, based on the experience achieved. Management and key persons can analyse the situation in the company, and discuss operations and markets. In discussion, new ideas grow, and the follow-on planning can be agreed at the same time. The key persons in the company can experiment with these things, implement them, and follow them up.

In the last meeting, on 2 November 2002, the group assessed the strategic working and its results. In the joint meetings, management was able to start many measures, which made progress on new openings for the company, such as

budget practice and a systematic approach to consider product policy and market-ing activities. New organisational approaches and practices were developed for work duties and co-operation between the plants in Case A. Furthermore, the practice of the management board and its composition was decided. Further, the co-operation between sales persons and the plants was discussed. However, the company and its key persons carried out many measures by themselves, including during the strategic work in the group.

Development of operations management and procedures at the Case A home plant

There were several development projects in progress at Case A in its home plant, so many of the factors included in Figure 7 were in a state of flux. The product policy was being shaped and product structures outlined. The division of duties in the Case A group and its network was being clarified. The plant production process and its automation were subject to continuous development. The order-delivery process was being revised, and customer management and agreements were also being improved. Additional features had been programmed into the information systems for the solution of discovered and anticipated problems. Several factors affected production management and its development at the plant, as presented in Figure 10.
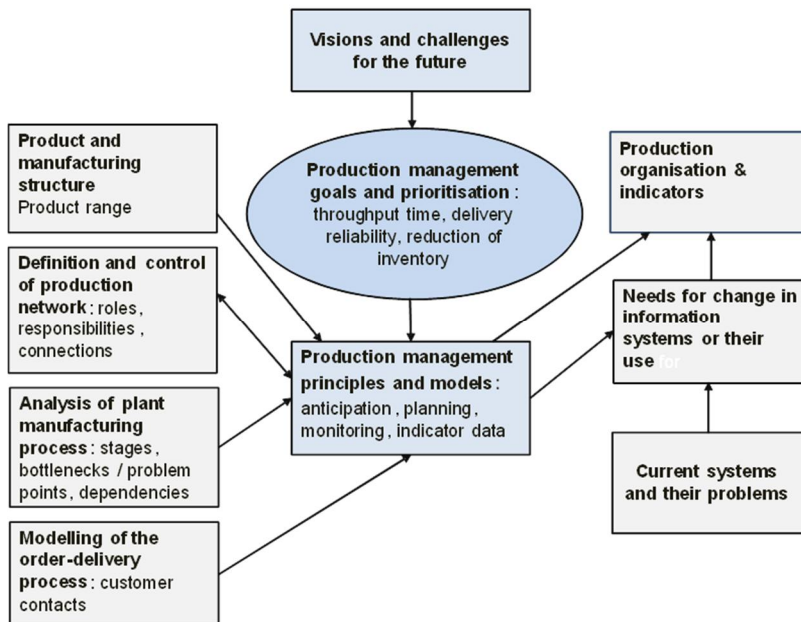
Figure 10. Production management dependencies in Case A, home plant.

The factors affecting production management at the plant are: products and the structure of the product range; contacts between the plant, customers, and partners; and the processes managed (manufacturing and order-delivery). The crucial point is to identify which goals are the most important for the company and its home plant, because the purpose of production management is to influence these goals (cf. Alasoini et al., 1994; Bruce and Wyman, 1998; Choi et al., 2011). Future needs and visions should be taken into account in addition to the current situation. If the aim is not to acquire new systems to support production management, the limitations of the current systems have to be taken into account. On the other hand, the current systems can be made to perform better by analysing how they are currently being used. Production management development often requires changes in procedures, production reorganisation, and possibly the establishment of indicators for monitoring production.

The production management group started its work in December 2001. The group had six meetings. The last meeting was an extended meeting, held on 23 May 2002, in which five supervisors participated besides the normal members of the group. The aim was to introduce the results of the group and involve supervisors in new action modes.

The members of the group were as follows:

– information manager from the home plant
– information manager from second plant

- production manager from the home plant
- supervisor from the home plant
- development manager from the home plant
- two researchers from VTT.

The development group considered it necessary to:

- define the key production management goals
- establish and review the target state of the workflow in the order-delivery process and the roles and responsibilities of its various actors
- identify functions where procedures should be changed
- identify key requirements for successful production management and factors that could inhibit the utilisation of management systems
- aim to eliminate or reduce harmful factors.

The group prepared workflow diagrams for the order-delivery process. Workflow stage flowcharts were also prepared. The workflow processes were tabulated and points and change factors within them that have an impact on the plant's production management were analysed. This led to identification of points requiring development and possible changes therein. There were several points that had to do with other functions, such as sales and production planning. Most of the development measures, however, addressed plant procedures and production management, and also improvement of the usability of the information systems. A table was used to determine persons responsible for development measures.

Moreover, the implementation of production management information systems was investigated in view of the current state and the target state and in several dimensions, including: target models, procedures and roles, basic data determination, training and communications, production use, and maintenance and further development. Persons outside the working group also participated in the analysis of these points, and a discussion with supervisors and other production management personnel was held for the purpose of talking about the measures and how they could be implemented.

6.6 Assessment of results

The end report of the work in the operations management group was dated in 5 June 2002. The preliminary report from the strategy work was dated in 27 May 2002.

As a conclusion, one can state that Case A has to keep up the group working model. It is needed to go through the situation in different areas and co-operation patterns, as well as the development of different areas. In this kind of group, production, sales, material management, information management, and general management can participate. The problems and solutions define who takes part with in each case.

Between the meetings, the determined tasks can be solved using pair work. As more problems can be solved, it is possible to meet less often.

7. Case B: development of subcontracting strategy and information systems needs

7.1 Starting points

Case B is a company that manufactures and sells hardware and interior decoration items. Formerly a family business, the ownership base subsequently changed.

The core competence and image of the company depend on door fittings, in which it is the market leader in Finland. Cheap imports from the Far East constitute a serious threat to the company's own production, as an increasing percentage of door fittings are now imported. The strategic goal of the company is robust growth, particularly through subcontracting. The aim is to become a contract manufacturer (cf. Hyötyläinen et al., 2005). This requires production enhancements, additional personnel, and personnel training, particularly in the area of computer skills, with increased automation in production.

The company began a methodical implementation of the subcontracting development goal defined in its strategy. The growth targets required an expansion of the production facilities and investments in production and warehouse automation over a period of several years.

The development problem in Case B arose from the management and organisation of the growing subcontracting function. Previously, door fittings were mainly manufactured manually, using traditional machinery. By contrast, sub-contracted work and component deliveries should be produced using automation, to ensure competitiveness in a demanding market and to achieve growth. Subcontracted work is completely order-driven. Door fitting production is guided by orders, but the inventory plays an important role here. Subcontracted products and the company's own door fitting production use the same production process, and the same supervisors look after both product groups. This highlights the importance of production organisation and control. Increased subcontracting also places new requirements on the information systems.

The aim in the subcontracting work is to gradually adopt a 'partnership' model, that is, to shift from component deliveries to assembly, and to achieve system supplier status and steady customer relationships (cf. Hyötyläinen et al., 2011). At

the same time, this model will bring increased responsibility for product design and product development.

7.2   Start of collaboration in Case B

The start of collaboration is a critical phase in any development process, because it lays the foundation for the development project, and above all, for co-operation and trust between the company and the researchers (Lukka, 2003).

Before the joint project started, there were two meetings between the persons from Case B and the researchers from VTT. The meetings were held on 20 March 2000 and 19 June 2000. The managing director and the director of finance of the company participated in these two meetings. The aim was to talk through the future joint project, as well as the situation and objectives set by the company for the joint project.

The starting meeting for the joint project was held on 23 August 2000, with a discussion of how to direct and manage the joint project. It was decided that the researchers would make the analysis of the company.

7.3   Analysis

The purpose of the analysis phase is to collect data and to interview key persons in the company. The analysis involves charting the current state, challenges, and future outlook and key development points of the company (Gottschalk, 1999; Hyötyläinen, 2005, 45–50).

The reseachers made, in the analysis phase, eight interviews in the period 14 to 21 September 2000.

The following persons were interviewed:

– managing director
– director of finance
– production manager
– subcontracting manager
– manager for special products
– production planner
– development manager
– a supervisor for hardware and interior decoration items.

Furthermore, the researchers got other materials from Case B, including the strategic plan and quality manual of the company. The analysis report is dated 7 November 2000.

The object of the analysis was to analyse the present state, development objectives, and future visions of the company. The present state comprises the strategic thinking, business areas, and business processes in the company. In the analysis, the aim was to take into account all the business areas that are important for pro-

duction planning and operations models, especially for the development of the subcontracting activity in the Case B.

The business areas in the company are the manufacturing and selling of hardware and interior decoration items and the subcontracting of sheet metal products. There was a total of 146 personnell in the company during the joint project. At the time, the company had only one factory. The company had the objective of doupling its turnover by 2006. The subcontracting formed ten per cent of the total turnover of the company at the time of the joint project. The growth target was 25 per cent per year in the subcontracting area.

The company updated its production resource information system in 1999. It was only aimed at serving the hardware and interior decoration items. The problem was the management of the increasing subcontracting activity. The information systems did not help the management and organisation of the subcontracting function at all.

Another problem was that the manufacturing of hardware and interior decoration items was mainly based on manual work. By contrast, subcontracting activity was done using automation. Besides, the present information systems did not support the subcontracting activity.

The third problem was that all the hardware and interior decoration items were store-controlled, whereas subcontracting is entirely a customer-order activity. Both the basic items and the subcontracting parts were produced through the same processes. The production management and supervisors were taking care of both production lines.

7.4   Choice and definition of objectives

The aim is to prioritise development points and choose the most important things from the point of view of the development targets in the company (Lukka, 2003). It is also to aim to set up development teams and other groups in the company, to address specific development themes.

The first project group meeting was held on 11 October 2000. The project group covered different persons from many functions. The following persons belonged to the group:

– managing director
– director of finance
– production manager
– manager of subcontracting
– development manager
– manager ofr special products
– project manager
– three researchers from VTT.

In the meeting, it was agreed to set the following development objects and development teams:

Subcontracting strategy group: The objective for the group was set to formulate the strategy for subcontracting and the operation plan for achieving the growth objectives set. In this group, the answering person was the manager for subcontracting. The first meeting was on 1 November 2000. The group had five meetings in the period between 1 November 2000 and 10 January 2001.

Subcontracting development group: The objective for the group was determined to formulate the central processes for the subcontracting, and to act as a certain kind of proto group, participating in product and method development. Furthermore, the objective was to act as a certain kind of subcontracting "organisation". In this group, the answering person was the manager for subcontracting. The first production meeting was on 14 November 2000. The group had three meetings in the period between 14 November 2000 and 13 February 2001.

Production meeting group: The objective was to activate the whole management of production, that is, to create the transfer form of knowledge and experience between different production departments. The objective for production meetings was to approach the development needs of each department as well as of the whole production, based on problem–based learning (cf. Coriat and Dosi, 1998; Dixon, 1999). In this group, the answering person was the production manager. The first meeting was on 1 November 2000. There was a total of six meetings in the period between 1 November 2000 and 11 January 2001.

In the spring of 2001, the special group was to **advance indicators for production**. The objective was to consider loading groups, and to determine operative level indicators for these loading groups. In this group, the answering person was the manager of finance. The work started in the spring of 2001.

The group had three meetings in the period between 25 January 2001 and 22 February 2001. The researchers from VTT made the plan for the arrangement of indicators in the production in Case B.

The development and management of know-how: The willingness for training was considered within different groups, based on the inquiry. Besides that, the researchers from VTT carried out an atmosphere mapping in Case B, from which they created a report.

The researchers participated in all these groups and their work. The role of the researchers from VTT was defined as follows:

- to take care of the progress of the joint project according to its planned schedule
- to bring the needed expertise for business, production planning, and information systems
- to offer and develop, together with the groups in the company, development practices and methods for the management of changes
- to conduct and support development group work (models, procedures, tools).

The purpose of the joint project was to develop operations management and operating procedures concurrently, as this was seen as a requirement for the definition and development of information systems on the one hand, and for continuous

development of information systems on the other. Case B clearly highlights how important strategic groundwork and operating procedures are for information systems development. Figure 11 illustrates the development project in Case B.
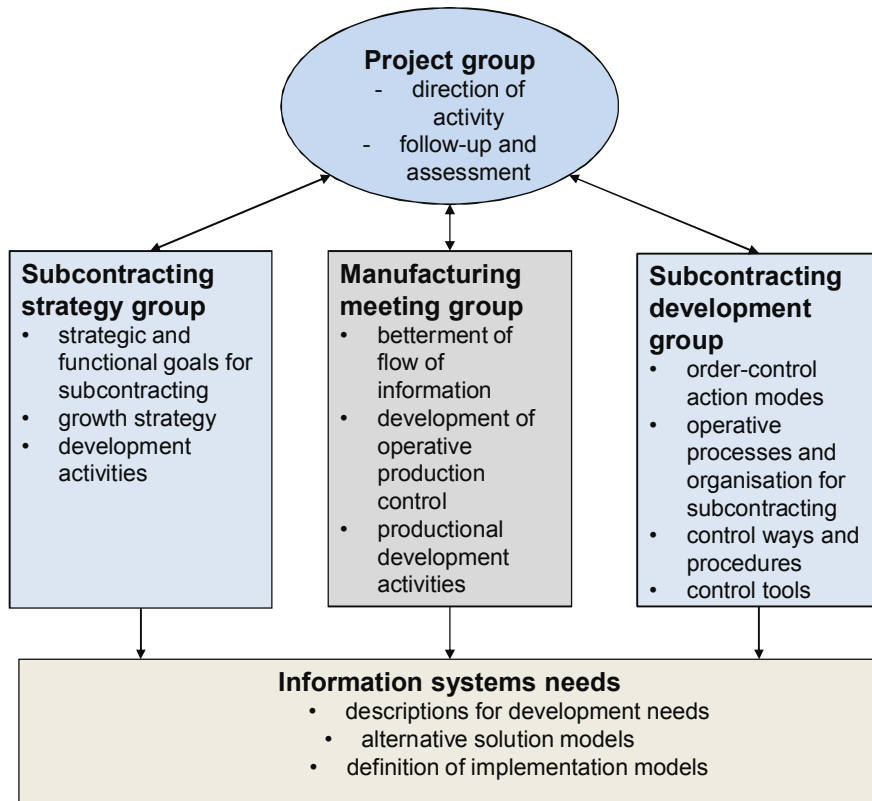
Figure 11. Development map in the Case B development project.

One objective for the project group was to follow–up and manage the development groups. The project group had in the beginning phase, an important role in directing the joint project, but the role changed later as only follow-up activities and operative working happened in development groups. However, many of the members of the project group participated in the work in the development groups at the same time.

The project group had seven meetings in the period between 11 October 2000 and 19 June 2001.

It is vital for SMEs to see operations management development as part of the development of operating procedures and the outlining of future activities (Hyötyläinen and Kalliokoski 2001). In this sense, the joint project outline in Case B highlights the importance of the early stages of the life–cycle model of the intro-

duction process of the operations management system. The definition and development of information systems is crucially dependent on strategic policy setting and operations development.

7.5 Development work

The development work proper in the project is done at this stage, with the development teams addressing their predetermined agenda. The team members seek solutions to the problems, modelling the current state and outlining the target state, and also testing and evaluating how the proposed solutions would work in practice (Weick 2003; Lukka 2003; Hyötyläinen, 2005, 46–50). They also, assisted by the researchers, develop models, procedures, and tools suitable for the company and its further development.

In Case B, a strategic decision to seek growth was made. Growth was to be sought in the company's traditional interior items, production but mainly in subcontracting and contract manufacturing. The analysis and development undertaken in the joint project focused on both functions, specifically with a view to the new requirements imposed by subcontracting.

Figure 12 describes the development phases of Case B. During the time of the joint project, the company was at a turning point, which formed the starting point for the project.

Establisment	Expansion	Specialisation	Turning phase
1976-1984 Creation of prerequisites for activity Production technology and tools acquired (firm purchases) Interior decoration items formed as a ground for activity Other products and some subcontracting Two different firms	1984-1991 Activity grown boom Prequisites for growth were acquired by firm purchases Whole activity was concentrated to one place Development of service concept for interior items Firms were merged as Case B	1992-1999 From interior items as "brand" Creation of service concepts, and the increase of their importance Starting export Sure growth Investing to information systems Reality of import from low countries	1999- The company's own production is engandered Surviving the image and brand of interior items (new product and service concepts?) Changing subcontracting, in order to achieve growth objectives Fitting subcontracting to the environment and culture in Case B Identifying markets for subcontracting activity

Figure 12. Development phases of Case B.

The first phase can be outlined as an establishment phase. The activity of the company is based on the purchasing of other firms, through which the company has bought technology and products. In this phase, the company developed basically into the same form as nowadays.

The second phase was the expansion of activity. The activity of the company enlarged strongly, which was based on the purchase of firms. The firms were merged into the company in Case B.

The third phase can be described as a specialisation phase. The company has developed service concepts for its customers, in which information systems have a central position.

In the new phase, the company is at a turning point. Now it is a question of many decisions, which have a most important role in the future of the company and its growth.

Development work began with the subcontracting strategy working group. The purpose here was to determine the strategic and operational goals of subcontracting, based on the company's strategic decisions. Another aim was to become a contract manufacturer and eventually a system supplier in selected areas (cf. Hyötyläinen et al., 2005). This would support the subcontracting growth strategy. On this basis, certain development measures were outlined, including the organisatio of subcontracting and the launch of product development.

The production meeting group focused on operational production management and its procedures, with the aim of establishing permanent production meetings to discuss information flow between functions and to undertake development actions. This would make production flow more smoothly and help harmonise targets, as the company's own door fittings and subcontracting deliveries go through the same production process.

The subcontracting development group outlined a subcontracting management model based on customer orders, subcontracting operating processes, and organisational practices and procedures to support them. Management tools were also examined.

These actions were co-ordinated by the project, with representatives from the management, the various company functions, and the employees. The project group guided the development efforts and discussed relevant issues.

The analyses and development measures outlined above identified information system development needs. For this purpose, descriptions were drawn up of information systems and particularly the operations management system, and alternative system models were considered. Implementation models and possible solutions were then determined, with particular reference to measuring company operations and to organising information collecting.

Project group

After discussions with the company management and agreement on the targets of the joint project, a project group was appointed, with representatives from the management of the company's business units, financial and information manage-

ment, production, and development. The researchers, guided by the project group, conducted a basic analysis and produced a basic analysis report based on interviews with key employees and document analysis. The main task of the project team was to select and further specify development points, mainly based on what was proposed in the basic analysis report. Another target set for the team was to co-ordinate the development groups to be set up for the selected development points and thereby all the development efforts overall.

Some of the project group members were also members of the development groups, and were therefore able to contribute robustly to the development work itself, while guiding and steering it with their own expertise. Their presence also allowed for co-ordination of the groups' efforts.

Subcontracting strategy group

The task of the subcontracting strategy group was to draw up a growth strategy (business plan) for the subcontracting function, describing in detail the current operations of Case B in the area, development needs for the future, and an outline development path and programme for attaining the targets set. It was also intended that this plan would be appended to the new Case B business plan, with alternative development trends and the development needs related to each of them.

The subcontracting strategy group discussed the company's subcontracting function in view of its current resources. The purpose of the strategic groundwork was to discuss development trends and how they affect the operations of Case B, and to survey the gap between the current state and the target state. On the basis of the discussions and background investigations, the researchers worked with the subcontracting product manager to produce a first version of the growth strategy for further deliberation by the strategy group. This was eventually jointly refined into the growth strategy for Case B contract manufacturing.

Subcontracting development group

In Case B, the clear anomaly in subcontracting was that no operating processes or organisation had been systematically developed for the growing order-driven production, nor were any control means or IT tools developed to support them. Subcontracting growth crucially requires the establishment of procedures and an organisation to support a customer-driven operation and a system supplier role, so that this complex field can be steered and managed.

The purpose of the subcontracting development group was to provide a link between subcontracting sales and production, focusing on product design and production method development, and thereby on the long-term process of establishing the subcontracting procedures and organisation. The aim was for the group to start from a case study in designing and testing procedures and tasks for the group, the idea being that a development team is a learning opportunity, a tool for identifying training needs, and an augmenter of operating models and expertise.

Production meeting group

It was decided to introduce production meetings, as the company had identified needs for improving communications and co-operation across departmental boundaries and for systematically developing production management (cf. Gosain et al., 2005). The two principal functions were identified for production meetings: operational production management and monitoring support and production development.

Production meetings have become a regular event. Meetings are held every few weeks, but also flexibly on the basis of need. Representatives from all departments and key production functions attend the meetings (see Figure 11). The key development points identified at the meetings are quality practices and production indicators, a distribution model being prepared for each production department or function as a basis for this.

Production indicators and operations monitoring

The starting point in indicator development was to build an indicator system and a related reporting system for load planning, capacity factor monitoring, pricing, and payroll. The important point in the development project was to get the process going and to create a procedure for further work on the development point. A major target was to initiate manual monitoring at selected load points and on selected machines.

With indicators, the work began by dividing the production function into departments and machine groups and by determining their capacity one department at a time, the idea being to create department-specific and function-specific indicators. Data needed for creating the indicators, their collection, and the requirements for the reporting system were also determined. Capacity factor monitoring was initiated on key machines and in key departments; this will be reported to the company's management group regularly.

Competence development and workplace development atmosphere

The project group conducted several discussions on personnel competence development in the short and long term (cf. Winter, 1996; Sanchez and Heene, 1997). The issues that surfaced included urgent training needs in certain special competence areas in production. In the course of the development project, co-operation negotiations were conducted with several parties, to explore alternative organisation models for in-house training and labour market policy training.

Survey of willingness for training

The need for a company-wide skills survey emerged during the joint project, especially with regard to the training needs required for the growing subcontracting operation, to serve as a basis for more detailed training planning. A broad-based

training needs survey was not yet implemented, but a start was made with a survey of willingness for training among the entire personnel (94 blue-collar employees and 27 white-collar employees). The survey was drawn up jointly by the management and the researchers, and the researchers compiled the responses, which were then presented to the project group and at a personnel briefing for all employees.

There were 67 blue-collar employee responses to the survey; most of these (82%) were willing to undergo training. Multi-skilling, improving professional skills, and general corporate knowledge were topics of interest. The greatest willingness was for short training periods. There were 23 white-collar employee responses to the survey; nearly all of these were willing to undergo training. Multi-skilling, improving professional skills, and general corporate knowledge were topics of interest. There was willingness for both short and long training periods. The results of the survey show that there is motivation for training and awareness of development needs among personnel. On the other hand, almost one in five blue-collar employees (18%) were not interested in training. According to the project group, the survey results reflected earlier conceptions about training willingness among personnel.

Workplace atmosphere survey

The results of the basic analysis report drawn up as a basis for the development project demonstrated that there is uncertainty among personnel regarding the ongoing change; this prompted discussion in the project group. It was considered important to explore the reasons for the uncertainty and change resistance among the personnell, so as to proceed effectively and with a long-term impact in the development process. A workplace atmosphere survey was conducted to address this matter in January 2001. The survey was conducted by interviews with 18 employees of the company (12 blue-collar and 6 white-collar). The results were then presented to the project group and at a personnel briefing for all employees.

The key points in the survey responses were that the interviewees perceived development needs in the work itself, in the workplace community, and in management. Employees were aware of the new policies at Case B and the development goals with regard to their sectors, but not many could analyse their impact on their specific job or on the company as a whole. There was dissatisfaction with employees' abilities to participate and influence matters in the workplace, but on the other hand, the interviewees were willing and interested in participating in the improvement of their own work and workplace environment, which is a positive sign for the change process. A separate report was drawn up on the survey for the company.

7.6   Assessment of results

The final report on Case B was dated 18 June 2001, and was made by the researchers.

The joint project and its results in the different groups created a central basis for renewing the whole organisation of the company in Case B. During the project, it concentrated on specifing the growth strategy of subcontracting. Within the joint project, the development organisation for the subcontracting was formed. This organisation started work and advanced the acting patterns, and created the practices to develop the productional betterment of products.

During the joint project, the production meeting practice was organised on a general basis. Production meetings are experienced as a useful operations model for the follow-up and development of production, well as for the intensification of information flows between different departments.

The survey of willingness for training and the workplace atmosphere survey were regarded as positive factors that offer knowledge about how the personnell respond to the existing organisational change, and how they are ready for the change situation.

Some problems also were discussed in the project group. It is typical that, in the meetings in the different groups, things are well and good, but the agreed actions do not progress for one reason or another. The project group came to the common conclusion that it is most important to look at the agreed solutions in meetings as an experiment in thinking. When there are problems in implementation, one can consider and assess alternative solutions. Another important factor is the focusing of development work in order for it to be managed.

8.　Case C: development of business strategy and production operations

8.1　Starting points

Case C is a metal engineering company. The company has about 20 employees and was founded in 1979. Case C is a medium–heavy welding engineering workshop that designs and manufactures machines, equipment, and pressure vessels for industry. Its principal customer areas are the mechanical pulp and paper industry, metal and raw material recycling, metal industry subcontracting, and installation, repair, and maintenance work.

The company has operated in much the same way since it was founded. Pressure vessels have always been part of its product range. The operations are based on welding and plate work. The company has also produced conveyors from the start. Many subcontracting customer relationships have remained steady since the early years of the company. In the mid-1990s, the company began to supply plywood production lines, and it has also hired out employees for outside work.

Case C is an engineering company with order-driven operations and a constantly changing work–load. The company serves the varied needs of its customers. There are many different jobs in the manufacturing process, which generates stress on production design and work organisation (cf. Kuitunen et al., 2003).

The principal management problem in the company has to do with order-driven production, since there is a wide range of products. Some jobs are subcontracting jobs (70% of the turnover), while others involve the company's own products. It is complicated to control such a range of operations. The company has developed products of its own after earlier engaging exclusively in subcontracting. The company has a handful of customers whose system supplier it is.

Before the launch of the joint project, the company had introduced a new information system. This initially only covered accounts receivable and payable in financial management and included no production management component. Load calculations were performed manually. The main problem was in planning and organising production and tasks.

The target set at Case C was to revise operations and thereby achieve robust turnover growth, up to twice the current amount. This growth effort involved a focusing of operations, which was perceived as a key factor in further development. Reforming the company's operating model was considered to require an increase in the percentage of the company's own products.

8.2   Start of collaboration in Case C

As has been stated, the start of collaboration is a critical phase in any development process, because it lays the foundation for the development project and, above all, for co-operation and trust between the company and the researchers (Lukka, 2003).

Before launching the joint project in Case C, two meetings (22 March 2000 and 21 June 2000) were held for Case C. In these meetings, the participants included:

- managing director
- production manager
- researchers from VTT.

In fact, this group formed the project group in the joint project. At the same time, the persons in the group also were acting in the strategy group, due to the few resources in Case C.

In these first meetings, discussion covered the coming joint project and the situation in Case C.

Later, the project meeting was held on 30 August 2000 in the same configuration as before. In this meeting, discussion covered the direction and implementation of the joint project. Soon after that, an information event was organised for all the personnell of the company.

8.3   Analysis

The purpose of the analysis phase is to collect data and to interview key persons in the company. The analysis involves charting the current state, challenges, and future outlook and key development points of the company (Gottschalk, 1999; Hyötyläinen, 2005, 45–50).

The researchers interviewed the key persons in the company in the period between 15 August and 12 September 2000. The following persons were interviewed:

- managing director
- development manager
- production manager
- purchase manager
- three production employees.

The researchers got materials from the company, including the business plan, plant layout, and operation processes.

The analysis report is dated 27 September 2000. According to the report, the company has development challenges. These are: the growth of activity and the clarification of activity, as well as a new kind of focusing of activity. Another challenge is to do systematic development work and make the activity of the company more effective, without which it is difficult to be able to be competitive in the long run in the area, so that the company can achieve growth and remain profitable.

8.4 Choice and definition of objectives

The aim is to prioritise development points and choose the most important among them, related to the development of operations management and procedures, and of the information systems supporting them (Lukka, 2003; Hyötyläinen, 2005, 171–173). In addition to the selected development points, the purpose is to organise the development efforts in the company.

Case C set the aim to renew its activity and to increase its turnover. Another point was to develop operations management. The joint project supported these objectives

In the discussion with the managing director and other persons in the company, the development objects became as follows: the specification of strategy, the clarification of operations management, and the development of maintenance.

Development work in the joint project focused on the company's management model and on improving and expanding the usability of the information system. Specification of the strategy was taken up first, from the perspective of finding growth opportunities and creating an operating model supportive of growth. Development of the company's maintenance function was added as a separate item (Figure 13).
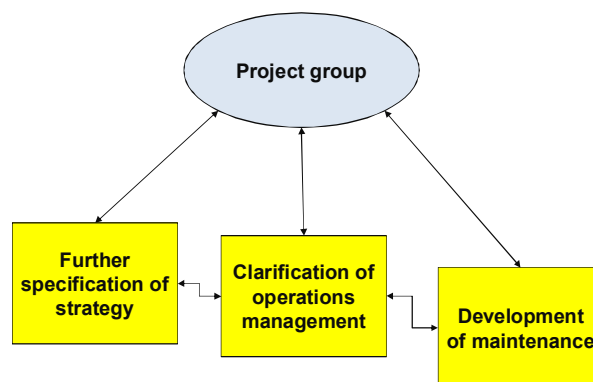
Figure 13. Development targets and organisation in Case C in the joint project.

Three approaches were selected in Case C: strategic groundwork for further specifying the company strategy; operations development to clarify operations management; and development efforts based on complaint lists, focusing on improving maintenance. The project group played an important role in the project, processing the strategy discussions and also being, to a large extent, responsible for the clarification of operations management. The reason for this was that the company, being a small one, did not have the resources to pursue development on many fronts. Shop floor employees and key production personnel were involved in maintenance development.

The project group had three meetings in the period between 3 October and 15 December 2000.

8.5   Development work

The development work proper in the project is done at this stage, with the development teams addressing their predetermined agenda. The team members seek solutions to the problems, modelling the current state and outlining the target state, and also testing and evaluating how the proposed solutions would work in practice (Weick 2003; Lukka 2003; Hyötyläinen, 2005, 46–50). They also, assisted by the researchers, develop models, procedures, and tools suitable for the company and its further development.

The development work in Case C started in October 2000. The strategic groundwork started at the beginning and lasted untill the summer of 2002, holding meetings about once per month, leading the managing director in Case C. The operations development started in November 2000. The development team formed for that, lead by the production manager. This work also included the handling of complaint list and maintenance issues. Special teams were organised around special questions, including the workers in question. This work lasted untill October 2001.

Figure 14 illustrates the three development measure areas chosen for the joint project in Case C.

Strategic groundwork	Operations development	Review of complaint lists and development measures
- Analysis of strategic thinking and development trends - Initiating strategic ground work - Organisation: project group and reseachers - Strategic orientation • diverse subcontracting work • contract manufacturer / system supplier • Networking	- Analysis of order-delivery processes and material flows - Determining job descriptions and work flow - Developing control methods - Creating and establishing a routine of production meetings	- Organising compilation of complaints - Analysis of complaints - Further work on complaints and development measures - Drafting a maintenance programme - Proposal for the organisation of maintenance and continuous development

Figure 14. Development points and development measures in Case C.

The above was based on an analysis on the development and future outlook of the company, as conducted by the researchers and summarised in the basic analysis report. This report also discussed the company's strategic thinking and conceptions about how to proceed. The company's strategic thinking is encapsulated in its growth goals and in the related need to focus and improve the company's operations.

Strategic groundwork

In the strategic groundwork, a target state model for the organisation and operations of Case C was outlined, as shown in Figure 15.
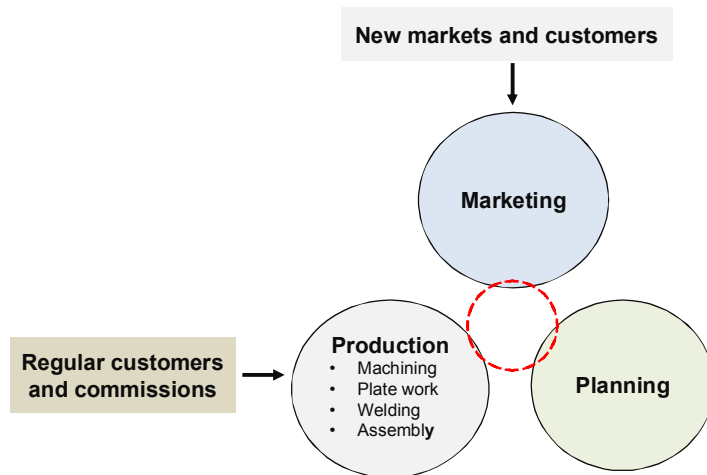
Figure 15. Target state model for Case C.

The objective of Case C is to become a serving and planning machine operator. The objective is to develop whole services and act near customers. The central functions are production, planning, and marketing. It is vital that these functions operate smoothly in co-operation. The new model requires effort in customer service and planning activities. It also requires to the extension of marketing to create new customer contacts. The model also requires much effort in assembly work, so that the company is able to produce and deliver any larger products to its customers. In fact, the company hired a product planner during the joint project. Before that, the company had purchased planning activities from outside.

The purpose of the strategic groundwork was to outline the future strategy of Case C and the strategic focus points and measures for the near future. The resulting strategy document was a proposal for a strategy for the company for the next 3–5 years. The groundwork was undertaken by the strategy group, initially the project team. Later, employee representatives joined the strategy group, and further processing was undertaken by a management group.

Case C confirmed a new operating model aiming to be an engineering company engaged in design and in providing services. The expertise and service concept development was built on the customer knowledge and in-house competence acquired over a period of more than two decades. The operations structure was based on two pillars: diverse subcontracting as a natural continuation of current operations on the one hand, and contract manufacturing on the other, the latter being the focus for future expansion. This required an emphasis on customer-oriented solutions and investments in design inputs (cf. Figure 14).

The purpose of increasing contract manufacturing was to strengthen the role of the company as a system supplier, requiring a focus on the company's core competence in production. It was also considered that the need for assembly capacity would grow as contract manufacturing began to increase. At the same time, there

would be an increased need for networking and network co-operation, as contract manufacturing calls for specialised suppliers.

Figure 16 describes the strategy process and its results in Case C.
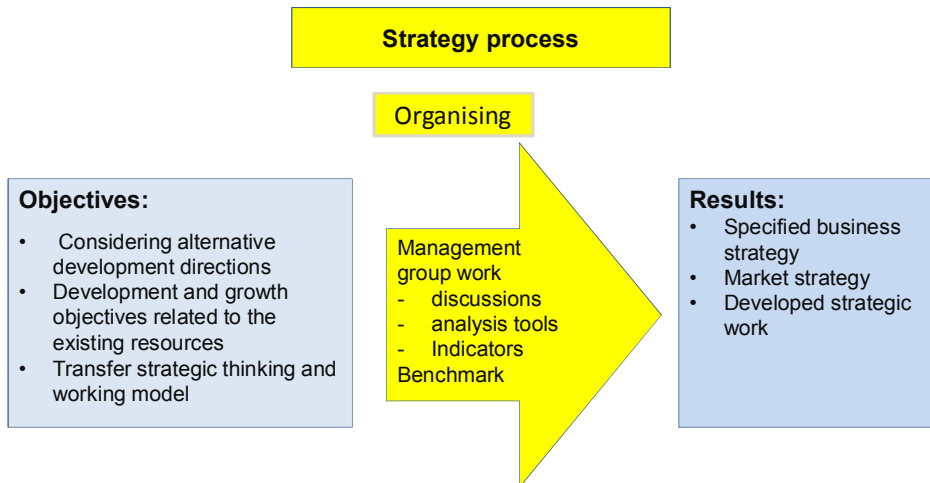
Figure 16. The strategy process in Case C.

The objective was to consider alternative development paths for the company. However, any alternative has to relate to the existing small company. One of the objectives was to transfer strategic thinking and work to the personnell in the company. The strategy group had many meetings during the summer 2000 and the summer 2002.

The strategy process was organised so that the project mainly consisted of the managing director, development manager, production manager, and in some meetings a leading worker in the company. In total, the strategy group had six meetings in the period between 1 March 2001 and 11 September 2002.

The researchers made the first version of the business strategy for the company in Case C. A series of the transparencies was also made. This can be used to market business to new customers and customer groups. The business of the company was defined to comprise two business areas: traditional subcontracting and the developing partner subcontracting. In this business strategy, objectives and development requirements were defined for each business area, taking into account activity, organisation, and competence.

One of the outcomes of the strategic groundwork was the realisation of a need to raise the level of expertise and to acknowledge this process as an integral part of the new operating strategy. Another outcome was the decision to continue the strategy discussion and to set up a management group in the company.

The strategic group had five meetings in the period between 1 March 2001 and 16 July 2002.

Operations development

Job descriptions in Case C were rather vague. Employees performed many different kinds of tasks, and their duties might change according to the situation at hand. The work–load also varied greatly. An organisation model such as this adds flexibility and requires independent actions, but also makes it difficult to focus on development. It is a model typical of SMEs (Kuitunen et al., 2003).

Unclear and overlapping job descriptions may lead to problems in the division of duties, which in turn may be reflected in operations and in operations development. Development needs in operations management and procedures were found at the analysis stage, most urgently in operational production management and materials management.

The order and delivery processes and material flows and the current state of the production management system were charted together with key employees. It was found that a small company has no need for a complicated management system. The solution was to rationalise management methods. Job descriptions and duties were clarified and tabulated. The aim was gradually to reorganise the production so as to strengthen workstation-specific supervision. Materials management and maintenance were also increasingly transferred to workstation-specific and team-specific supervision. The purpose of these organisational changes was to improve production management.

Further management methods were developed, for instance by introducing work folders and work cards for the management of project-based operations. Changes were also made to the workflow and work order, and workplace comfort was improved. A significant outcome was that the company decided to establish regular production meetings. This had been tried out before, but in the absence of an active leader, the practice had subsided. It was now agreed that a meeting would be held every week, led by the production manager. The weekly agenda was agreed to include information on future jobs and work arrangements, a review of the jobs and work arrangements in the coming week, continuous monitoring of operations using selected indicators, and a listing of development points in production and co-ordination of development measures.

Complaint lists and development

The joint project decided to conduct a complaint survey among all employees in Case C. The idea behind this was that the resulting list could provide a quick start for improvements by pointing out small matters to address. The survey yielded a total of almost 80 problems and development points involving a variety of company functions, from tools and machinery to organisation and the division of duties, and to materials control and acquirement.

The handling of the complaint lists led to development measures concerning changes in layout, working posts, and working arrangements.

It was decided to make the complaint list routine a regular development measure in the company's day-to-day operations. On the basis of the complaint lists, the company acquired essential mechanical tools and labour-saving devices.

The complaint lists also revealed a lack of in-house communication and the absence of a common forum for discussing problems in operations management and improvement suggestions. In response to this, Case C introduced a Monday meeting to review the work of the coming week and any feedback received from customers about the work of the previous week. Information on the company's situation was also to be given out as necessary. Another idea is to create practical indicators for the Monday meetings to illustrate matters such as quality level and cost-efficiency for employees in concrete terms.

In the company, it was defined that the joint project would make a maintenance programme for production and for its implementation. Besides specifying the responsibilities and job descriptions for maintenance, production identified the need to create directions and rules for maintenance practices.

The maintenance group was set, including the three researchers from VTT. Other members were the production manager and three workers from the company in Case C. The group made the maintenance programme for production. The researchers made the maintenance file based on the maintenance solutions made in the group. The file included the defined measures for maintenance, based on key machines, including the people responsible. Furthermore, the file included machine and tool lists, as well as machine-centric training and guidance needs and the maintenance measures for each hall in production within Case C. Besides that, directions were made for implementing the maintenance programme, which the production manager wanted to carry through internal measures.

Altogether, there were six meetings on production issues in the period between 5 January and 16 July 2001.

8.6   Assessment of results

The joint project in Case C began in the summer of 2000 and continued until the summer of 2002. The final report from Case C and its project is dated 22 October 2002.

The work of the project group was active in the beginning phase of the joint project. However, the work moved onto the development groups, which were formed around each development object. At the same time, the members of the project participated in the work in the development groups.

The objective of developing the project group into the managing group in Case C was not realised as such. However, through different development groups a strong basis was created for active co-operation between key persons in Case C (cf. Brown and Duguid, 1991).

9. Case D: continuous development of information systems

In this chapter, various aspects of the development of information systems activities are studied and discussed. Special emphasis is placed on the challenges and methods of the continuous development work carried out during the use of information systems. The term refers to the post-implementation phase, when the system is utilised as part of day-to-day operations by its intended end–users. Continuous development refers to all conscious, systematic, and long-term development activities that aim at better alignment of an organisation and its information systems resources.

9.1 Starting points

Case D is a Finnish contract manufacturer of sub-assemblies and box-build products containing electronic and sheet metal components. The services of Case D include production ability assessment, test planning, electronic component assembly, machining sheet steel plates, final assemblies, products integrations, testing, and logistics services.

Nowadays, Case D is an internationally operating contract manufacturer whose comprehensive services cover the entire life-cycle of electromechanical products, from design and manufacture to after-sales services. The customers of Case D include leading equipment suppliers in energy efficiency and well-being technologies, for which the company produces competitiveness as a strategic partner. The Case D Corporation currently employs approximately 730 people. The Case D Corporation also still has some production sites in Finland.

In the autumn of 2000, Case D was facing in the front of many-sided development challenges. Changes were occuring in the branch of Case D. Sub-assemblers felt the need to increase the share of final assembly and especially to increase product integration manufacturing services. Customers also required sub-assemblers to participate in their product and product planning processes. Furthermore, customers were concentrating their procurements to a few firms (cf. Hyötyläinen et al., 2005; Hyötyläinen, 2011).

In 2000, Case D had four production facilities, three in Finland and one in Estonia. At the end of 2000, Case D employed 600 persons. Then, the turnover of Case D grew fast, by as much as a 43 per cent increase in volume in the year of 1999.

At the same time, significant changes were happening in the management of Case D. New management formulated a new strategy for Case D. It decided to direct Case D towards being a value-producing products integrator that offers services from production ability assessment and testing planning to solutions in product up-keep. Furthermore, customer interface activities needed to be harmonised. It was seen that it required the development of joint action processes and the implementation of information systems for integrating different operations.

A profound new step was taken when Case D adopted an enterprise planning system (ERP system) at the beginning of 2001, for the development of the factories' mutual co-operation, information flows, and overall management. Before that, Case D operated based on each factory–solution. Pressures to renew actions also came strongly from outside. Case D had long received feedback from customers and suppliers, highlighting development needs in control processes, procurement operations, and delivery processes.

Case D formulated a new information management strategy for the ERP systems programme. The action processes of the factories were drawn up and described for the definition of the system and for the choice of an ERP system. The invitation phase for tenders and the choice of the ERP system happened between June and autumn 2000. The the system was to be implemented step by step, so that the most important modules were carried out first, among others things concerning purchasing, sales, warehousing, production, and financial administration. The idea was that the system would be expanded later.

The system was implemented technically in January to February 2001. Although the implementation process was largely viewed as a success, the new system was still incomplete during its early months of service. Problems concerned, among other things the reliability of the new system, the unnecessary process capacity of the Case D information machine centre, low information transfer capacity, and communication between Case D and its suppliers. Training and information meetings arranged by an information systems supplier and Case D were also criticised. Users saw that these meetings did not give a good enough idea about the information system as a whole. Training was arranged on a modul basis, the result of which was that users had, among other things, difficulties in perceiving the interfaces and dependencies between different functions. Furthermore, users thought that the amount of training was insufficient.

Some of the problems went away when changes were made to the system, of which a great number were carried. Changes concerned both user interfaces and operational features. As a basis for these problems was the fact that Case D's own operation models were not defined when the system was acquired. Based on the interviews made by the researchers, all users regarded the process models formed in the requirement phase as general quality, without using them later, when choosing a new information system. Besides the implementation of the

information system, all the information management was organised anew. The responsibility and user support for information systems were moved to an outside service provider, which made the various arrangements for business operations.

As a summary of the experiences in the implementation of the system, we can state that the important part of the problem was a question of the new system, of which users had no previous usage experience. From the end-users' point of view, it contained many disturbing features that made its use time-consuming and tedious. Because of this, after the proper technical implementation of the actual system came a consideration of the follow-on to the information system, so that the system could be used more in full-scale supporting action processes (cf. Hyötyläinen, 1998; Doherty et al., 2010).

9.2   Start of collaboration in Case D

One can state that the start of collaboration is a critical phase in any development process, because it lays the foundation for the development project and, above all, for co-operation and trust between the company and the researchers (Lukka, 2003).

At the beginning of 2001, Case D implemented technically an enterprise resource planning system (ERP system) and brought it into service on all of its production sites in a relatively short period of time. However, the use of the system had many deficiencies, as did the practices and processes of the company and its four plants.

Before agreeing the joint project, three meetings were arranged between the management group of the company and the three researchers from VTT. In this phase, the managing director, materials manager, and personnell manager took part in the meetings.

In the first meeting, on 13 October 2000, the question was the whole joint project and how it suited the development situation of Case C. In the next meeting on 15 November 2000, the project plan made by the researchers was discussed and specified. In the third meeting, on 22 November 2000, it was agreed how to proceed in the joint project. It was decided that the researchers would make the analysis and interview key persons in the company, as well as visit different plants in the company.

9.3   Analysis

The project was started with a comprehensive basic analysis, by which the researchers studied the enterprise's operations and its environment's present conditions and development challenges. The purpose of the basic analysis was also to create a strong basis for directing the project and for specifying development targets (cf. Gottschalk, 2001; Hyötyläinen, 2005, 45–50).

The researchers interviewed 11 persons in the company in the period between 19 December 2000 and 22 December 2002. The following persons were interviewed:

- managing director
- materials manager
- sales manager
- information manager
- business controller
- personnell manager
- plant manager, plant 1
- plant manager, plant 2
- quality manager, plant 3
- plant manager, Estonian plant 4
- development manager, Estonian plant 4.

Furthermore, the researchers visited the three of plants from the four plants of Case D between 3 January 2000 and 7 February 2001.

Besides that, the researchers got additional materials from the company, including the strategy of the company, the quality manual, the business processes, the information strategy, and other documents made in connection with the implementation of the new information systems.

The analysis report made by the researchers is dated 25 Febtuary 2001. The object of the analysis was to examine the present situation, the development objectives set in the company, the future vision of the company, and its meaning for different plants in Case D.

In the analysis report, four measure areas were presented. They are:

- the concretisation of the strategy and the making of an implementation plan
- the continuous development of information systems
- the organisation of the development work in the company and its different plants
- the development of an orientation and training system.

Case D was in a transition phase. The history of the company influenced its operation, and operation models and culture habits of the different plants complicated the formation of the common practices in the whole company. The company had just about a year earlier bought two plants and had incorporated them as part of the whole company in Case D.

Case D had created a new strategy that included a strong growth objective. This required the change in the business concept. The strategy described the situation in 2005. The aim was that the share of exports would become more than 50 per cent of production. The objective was to internationalise the company in Case D.

9.4   Choice and definition development objectives

The aim is to prioritise development points and choose the most import things from the point of view of the development targets in the company (Lukka, 2003). It is also to set up development teams and other groups in the company, to address specific development themes.

In the first meeting, on 14 December 2001, the preliminary results of the analysis work were handled in the management group meeting. In the group meeting on 19 February 2001, the results of the analysis report were discussed. Finally, the results of the analysis were handled in the meeting on 28 February 2001. Then it was decided that the joint project would concentrate on the continuous development of the information system implemented. As a result of these discussions, the objectives of the joint project were set as follows:

1) Support for the organisational implementation process of the ERP system
2) More full-scale exploitation of the ERP system as an aid to action processes
3) Development of the action control and action modes in all the factories
4) Creation and stabilisation of systematic development practices and tools.

It was stated, concerning the development of the ERP system, that the congruence of the system had been set in all the factories. This was regarded important from the point of view of the intended integration advantages. Because of this, an extensive management group was established for the joint project, with centrally processing and approving all tailored requests, presented by different teams in each factory of the company in Case D.

It can be stated that the main objective of the joint development project was to unleash the potential of the new system and to ensure that it provided good support for the facilities' order-delivery processes and other key functions, in terms of both efficiency and user satisfaction. Sufficient uniformity of plant-specific installations was also to be maintained. In a multi-factory environment, this was regarded as an essential requirement.

For the continuous development of the system, an action model suitable for the environment of the many plants was created, and this was implemented and developed further in use (see Figure 19).

In the analysis report, it was presented how one can organise the development work in Case D. This was already handled in the steering group of the joint project on 22 December 2000. The idea was to establish the development at the company level, as well as at the plant level, by which it would be possible to help the implementation of the more common operation models and culture in Case D.

At the first level, the steering group was set up as a co-ordination group covering the whole organisation, coordinating development activity concerning the new information systems and action modes, as well as action processes. Furthermore,

the central objective was to manage so–called "development map", by which over-lapping development measures can be avoided, and, for example, development measures made at one plant could be transferred to other plants.

At the second level, there were plant development teams, the central objective of which was to create the continuous development methods and atmosphere at each plant. Furthermore, the central objective was to co-ordinate the development measures in the plants, delegate operative development measures to plant personnell, and support measures using the researchers.

At the third level, there were development groups, which could be established when needed, to solve some special problems.

9.5   Development work

The development work proper in the project is done at this stage, with the development teams addressing their predetermined agenda. The team members seek solutions to the problems, modelling the current state and outlining the target state, and also testing and evaluating how the proposed solutions would work in practice (Weick 2003; Lukka 2003; Hyötyläinen, 2005, 46–50). They also, assisted by the researchers, develop models, procedures, and tools suitable for the company and its further development.

This joint project described an approach to developing ERP utilisation in a multi-factory environment. The approach was developed in close co-operation with Case D and the researchers. During the project, special emphasis was given to the specification, testing, and implementation of useful concepts, methods, and practices to support the development work. The case study concentrated on these methodological issues, including applied theories, approaches, methods, and practical development work. In addition, a summary of the main results of the project, based on extensive end-user interviews conducted by external researchers, is presented.

Basic assumptions and overview of the approach

Spending on information systems and information technology in general is widely regarded as having the potential to enhance firms' competitiveness. However, firms and system vendors in particular place unrealistic expectations on the benefits of new information systems (e.g. Anandarajan and Wen, 1999). It has been shown, for example, that service levels and productivity are likely to decrease after the implementation of a new system (Hyötyläinen, 1998). This phenomenon is largely attributable to the fact that the operating logic of a new system usually (and understandably) differs from that of the firm. This is especially true in the case of so–called pre-configured package solutions (Wu et al., 2007). The implementation of information systems requires organisational changes and competence development (van Nievelt, 1999; Doherty et al., 2003, 2006; Furumo and Melcher, 2006). Attaining and surpassing the previous levels of systems support and opera-

tional efficiency is therefore a real challenge for most organisations, calling for purposeful and well-focused development activities.

The true value of an information system cannot be determined on the basis of its technical and functional features alone (Kearns and Lederer, 2004; Cragg et al., 2011). At the end of the day, everything depends on how and to what extent systems can be utilised as part of day-to-day operations. In general terms, information systems may produce added value by supporting existing processes and practices, and/or by enabling completely new patterns of operation that have not been possible or practical in the past. In such cases, the key word is the process (or set of activities) that is influenced by the implementation of the new system or additional system features. As a result, the business process view of the function and use of information systems became one of the main cornerstones of our approach.

Another issue, however, is how to successfully develop information systems and their use in practice. In this respect, our approach was based on two major hypotheses. Firstly, we assumed that systems and operations should be developed together as an entity. Development can be regarded as a change process incorporating various technical, organisational, and social dimensions. Secondly, it was assumed that the development process should be organised according to the principles of the so-called participative and constructive development model (Mumford, 2001; Lukka, 2003; Hyötyläinen, 2005).

The development work in Case D consisted of two main phases: utilisation analysis and further development. The utilisation analysis phase aimed to identify and document the major IS-related problems and development needs in relation to the organisation's key processes and activities. The further development phase aimed to remove the identified problems and enhanced IS utilisation in general, by means of systematic development practices. The focus may be on information systems or operating practices, depending on the case-specific factors.

Utilisation analysis

The development work was started unit by unit during 2001 with the utilisation analysis. The first step was a characterisation of Case D order-delivery process. This was done separately at each facility. The facilities' processes appeared to differ from each other because their products and clients were different, too. The preliminary descriptions were gradually transformed into more detailed ones, including process phases, tasks, and responsibilities, as well as problems and development needs regarding the use and functioning of information systems in each particular process phase and task. The necessary information was acquired by means of interviews and workshops. The development team was responsible for the practical arrangements on each site, while the researchers chaired the sessions and provided the necessary tools. The accumulated data was electronically documented in tables and workflow diagrams to allow flexible iteration.

Process modelling was usually started by compiling a written description of the process, because plant employees preferred to reflect on their work in terms of daily routines and episodes, rather than task sequences or control mechanisms. On each site, this data was documented in a plant-specific process table (Figure 17). Workflow diagrams were produced afterwards based on the process table and refined in the following meetings and workshops. This arrangement appeared to work fairly well, although it required quite a lot of time and resources. The two methods are also complementary to each other, because workflow diagrams alone do not support extensive documentation in text format, while tables cannot properly present parallel tasks and processes.

I CASE D, one factory			I ORDER-DELIVERY PROCESS		17(27)
PHASE	TASK	RESP.	SYSTEM	IS RELATED PROBLEMS	OTHER REMARKS
...	...	..	...	...	..
Preparation	Print working documents = collection list and work order	Collector	XXX	Items on the collection list cannot be sorted according to their storage depots. Collection is therefore time-consuming.	-
...	...	..	...	...	..

Figure 17. The process table made at plant level in Case D.

Further development

The development teams in the plants of Case D assumed responsibility for the further development process. They started from the problems that were identified during the utilisation analysis and drafted proposals for their removal or mitigation. The proposals related to desired changes in the system, as well as in the organisation and its functioning. All the proposals for a system modification had to be submitted to the corporate-level steering group for approval. With regard to other development initiatives, the plants were allowed to proceed spontaneously. The problems and corresponding proposals were also assigned an order of priority, to make sure that the most important ones received the necessary attention in the future.

PHASE	TASK	RESP.	SYSTEM	IS RELATED PROBLEMS	OTHER REMARKS

CASE D, one factory   **| PENDING ACTIVITIES**   14(33)

PHASE	TASK	IS RELATED PROBLEMS	PRIORITY	ACTION PROP.	STATUS
...	...	...	..	...	...
Preparation	Print working documents = collection and work order	Items on the collection list cannot be sorted according to their storage depots. Collection is therefore time-consuming.	Class 1	The comment line of each BOM will be converted to a grouping line. Then items can be sorted within each group.	5.2.2002: A task force established. JKF in charge. Design in progress.
...	...	...			

Figure 18. From the process table to the table of pending activities in Case D.

Because the development activities produced massive amounts of information, an efficient data management system was needed. Therefore, problem descriptions, priorities, action proposals, decisions, and corresponding follow-up information were documented in so-called tables of pending activities. On each site, the first version of the table was prepared on the basis of the corresponding process table, produced as part of the utilisation analysis (Figure 18). Problems and development initiatives raised after the completion of the utilisation analysis were also documented in these tables. New concerns were usually voiced during project meetings or submitted directly to the head of the team. Tables were saved and updated on the company intranet to inform all end-users.

The steering group was established at the very beginning of the project to coordinate the development of Case D's new ERP system. During the further development phase, it assumed responsibility for the processing of new modification proposals. New proposals were addressed in their order of priority, as determined by the facilities. The group also processed other IS-related concerns that were brought to its attention. Once an efficient processing routine was established, meetings were carried out by means of video-conferencing. All the decisions, as well as the current processing status of each proposal, were documented in the steering group's table of pending activities stored on the company intranet. An overview of further development arrangements is given in Figure 19.
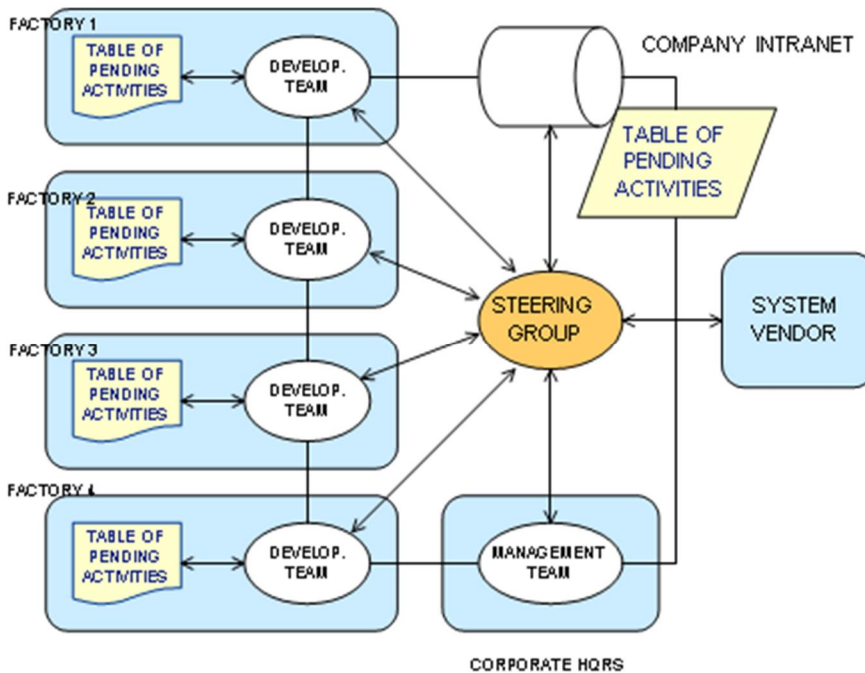
Figure 19. Further development arrangements in Case D (development model).

The steering group also played an important role in allocating resources for the specification of modification requests and in supervising their testing and implementation. The system vendor carried out the actual modifications to the system. Members of the steering group reported to their facilities the processed proposals and the current status of the system.

During the development process, both the members of the development team and the main users had the main responsibility to request the end–users to test and implement the improvements concerning practices or the system. In addition, at the end of the project, the researchers conducted a survey concerning training needs for the system. The target group was all end–users in four facilities. From the basis of the survey, the training concept was made in co-operation with the steering group and development groups. The main objectives of the training were to improve the process view and system thinking, communicate new modifications and improvements in practice, and give guidance on plant-specific problems or end–users` needs as mentioned in the survey. At the same time, end–users were to be informed of the so–called development model: in other words, how to get further guidance related to the system and how development work had been organised. The implementation of further training was delegated to the facilities (development groups and main users), according to plant-specific needs.

Main results

Overview of the project

The utilisation analysis was started at one of the Case D factories in May 2001. The other plants joined the process one at a time, so that when the process was finally kicked-off at the last Case D plant in December, the others had already proceeded to the next phase. During the spring of 2002 researchers gradually reduced their work contribution and Case D assumed overall responsibility for running the process. The development project was formally completed in August 2002.

By August 2002, a total of 170 problems or modification proposals relating to the functioning or use of Case D's information systems had been documented in the plant-specific tables of pending activities, of which 48 had been submitted to the steering group for consideration or approval. The facilities had managed to complete 41% of the local development initiatives, while 73% were either completed or in progress. During the same period of time, the steering group had managed to complete 19% of the measures it had formally approved, while 59% were either completed or in progress. About 70% of all the measures approved by the steering group were system modifications. The others concerned new applications or tools, improvements in practices or responsibilities, IS–raining or guidance, or further examination.

End-user views on the applied development approach and its results

In April 2002, researchers interviewed a total of 11 project team members from two sites and asked them to express their views on the goals, organisation, and results of the applied development approach and the development project as a whole. Three of the interviewees were also members of the steering group. The interviews were conducted on location in two Case D factories. The facilities were selected on the grounds that they were the first to join the process and therefore possessed a large body of experience, both from the utilisation analysis and the further development phase (see Ilomäki, 2003). A summary of the results of the interviews is presented below. The results have been classified into the following three classes: 1) development organisation, 2) tools and communication, and 3) results and continuation.

Development organisation. The interviewees were generally quite satisfied with the development project and the work done in the development teams. They saw that the researchers organised the work efficiently and that the researchers' role in the project was important. All the interviewees were also satisfied with their opportunities to influence the decision-making process in their own development teams.

Many interviewees considered, however, that the system vendor's participation in at least one project team meeting could have made the work more effective. A lot of time was devoted to wondering whether a particular problem could be eliminated by a system modification and/or how much it would possibly cost. This gen-

erated numerous inquiries and therefore more items on the development teams' tables of pending activities.

Some interviewees thought that the end-user perspective was inadequately represented in the steering group. This may relate to the fact that the steering group did not always manage to justify their decisions in a comprehensible way, such as by informing a project team about why their modification proposal had been rejected or postponed. Among project team members, this may have created an impression that there was a lack of understanding of shop-floor activities in the steering group.

Because the project team members had a heavy workload during the development project, they felt that they could not contribute to the project as much as they wished. They thought, for example, that they should have carried out their development tasks more efficiently and that they should also have worked more closely together between the official project meetings. This is a clear indication of scarce development resources and partly explains why the researchers' role was conceived as being so important.

Tools and communication. The table of pending activities was regarded as an explicit and useful tool for the processing of information systems-related concerns. However, as the tables grew larger in the course of the project, some interviewees became confused about the status of the problems and proposals documented in those tables. This suggests that special attention should be paid to keeping the tables clear and free of excessive data.

The interviewees were not satisfied with communication between the steering group and the development teams. They saw that the only way of getting information on the processing status of submitted modification proposals was the company intranet, where the steering group's table of pending activities was stored. The project team members had expected a more efficient exchange of information between the steering group and the development teams.

Video-conferencing was looked upon as a rather limited communication method, but nevertheless maybe the only possible way of organising regular steering group meetings in this particular case, due to the facilities' geographical locations (the long distances made travelling both time-consuming and expensive). However, once people became familiar with video-conferencing, the meetings ran smoothly without any major difficulties.

Results and continuation. The development team members thought that small technical improvements in the new ERP system had been accomplished. Some interviewees found those improvements insufficient, while others regarded them as "a very positive thing". In addition, the awareness of operative processes, information flows, function of the system, and the others tasks in processes increased during process modelling and co-operative problem solving. The need for further development activities was widely acknowledged. The interviewees noted that teamwork combined with the use of the table of pending activities could form a good basis for future development work, as anticipated by the researchers at the outset of the project. They also concluded that the continuation of the development process necessitates that there is a well-defined framework for the work,

including a clear definition of responsibilities at each plant. In addition, the managers should be expected to express their support for the work and to allocate sufficient resources for it.

9.6   Assessment of results

Maybe the most important result of the development project was the concept of further development itself. The concept is in use and its importance has been widely acknowledged. The applied practices and tools were considered useful, too. Therefore, the case experiences suggest that the applied approach is suitable for developing ERP utilisation in a multi-factory context.

At Case D, the practical benefits of applying the approach mostly related to an enhanced understanding of plant-specific needs at corporate level, and to a more systematic and transparent decision-making process. As a result, the plant-specific installations of the new ERP system ceased to "grow apart". It may be assumed, too, that, as a result of the project, Case D's ability to plan and implement complex development initiatives in general has been significantly improved.

A number of development activities were formulated, approved, and implemented. The development activities relating to the facilities' internal working practices were the most successful. It may therefore be concluded that the plant-specific development teams functioned fairly efficiently, which reflects the importance of finding practical solutions to prevailing problems.

With regard to the ERP system, small improvements were introduced during the project. In retrospect, those improvements were not as significant as expected at the outset of the project: many modification proposals were rejected or stuck somewhere in the handling process. It seems apparent that many of these delays related – in one way or another – to the workings of the steering group. For instance, many steering group meetings were not as efficient as they could or should have been, because of absenteeism and apparent breaks in the flow of information. As a consequence, many problems were addressed again and again in the steering group meetings without notable progress.

The role of the researchers was great throughout the joint project in the different plants and in the direction of the plant teams. The joint working lasted about a year in each plant. The researchers had eight work days on two factory sites and five working days on other two factory sites.

The final report of the joint project in Case D is dated 8 October 2002. The joint project lasted almost two years, beginning in December 2000 and ending in September 2002.

The first meeting of the steering group was on 18 April 2002. The first task of the group was the definition of the key action processes of Case D. As the result of that, plant-specific process modelling was use to focus on order-delivery action patterns, including material procurement and the forecasting process. Between the first meeting and the final meeting, the steering group had twelve meetings.

The final meeting of the steering group was held on 3 September 2002. Then the whole joint project and its work were assessed. The plant teams and other groups had raised many problems for development activity. Nearly all the presented problems were handled in plant teams. The teams decided to solve more than one third of the presented problems. Of these problems, one third were processing requests for the steering group and the other two thirds were development measures that could be solved at factory level. All the problems and processing requests brought for handling in the steering group were taken into consideration. Of all these, about half led to development measures. However, many development actions were in progress.

The results of the development project were, of course, influenced by several interacting factors. For example, the system vendor who was responsible for the implementation of approved modifications got into significant delivery problems at one stage of the project. In addition, the specification of modification requests and the testing of new system features proceeded slowly due to the fact that plant personnel had a heavy workload at the time of the project. Because so much depended on effective co-operation and exchange of information between different parties, the above-mentioned difficulties had a significant negative impact on the throughput ratio of the whole system.

Since the project, Case D has invested in its IS development procedures and practices with a view to making them clearer and more efficient. Special emphasis has been placed on the flow of information both within each plant and between the plants and the steering group. Case D and the system vendor have also managed to agree on improvements with regard to the process of delivering system modifications. These initiatives have certainly been motivated by the departure of the researchers, who were mostly in charge of running "the show" during the project. As a result, practices and procedures that appeared to be too heavy or impractical have been gradually replaced by more efficient ones; these may be used to analyse how work practices diverge between communities (cf. Wenger and Snider, 2000).

10. Analysis of the case study results and change management

In research and development, there is a need to make a distinction between the model world and the real world (Habermas, 1974, 2003; Weick, 2003; Hyötyläinen, 2005). The central concepts in the model world are theoretical concepts and models, and their relationships. The central purpose of the model world and its concepts and terms is, by definition, to emphasise such factors, which, based on the selected research approach method, are able to discern the object's essential characteristics and relationships, as well as the development mechanisms (Laudan, 1977; Sayer, 1992; Archer, 1995). The object in this study is the information systems' planning and implementation process and its context. That is studied both from theoretical and practical points of view. In the cases, new constructs and development steps are created, tested and applied in use, based on a constructive approach (Lukka, 2003; van Aken, 2004; Hyötyläinen, 2005; Kautz, 2011).

The development of information systems' planning and implementation requires organisational change and the adaptation of team-related and network-related structures (Doherty, 2003; Chen, 2009; Choi et al., 2011). It is not enough to just make the separate functions more efficient. The need for co-operative work is emphasised even more in organisational processes and actor networks, which implement these, and where the processes cross the functional lines (Gosain et al., 2005; Doherty et al., 2010).

In the following, the main assessment and evaluation of the case results is made. At the same time, management issues are handled. First, the life-cycle framework is assessed. Based on this framework, development and path models are considered, with reference to the case study results. Second, the mutual interdependencies of path models are assessed. As a summary of the analysis of the case study results, a decision on growth and change is presented.

10.1 Life-cycle framework

The case studies have helped to sketch a multi-dimensional image of the parallel development of operations management and procedures, and of information systems in SMEs (Esteves, 2009; Cragg et al., 2011). The results clearly demonstrate

that operations management development in an SME is linked in many ways to its strategy, operations, and practices. Several case studies highlight the importance of strategic issues and a strategic management model for operations development. In addition, strategic groundwork lays the foundation for the determination of specifications for operations management and information systems. As the results show, determining the specifications for operations management and information systems is neither simple nor straightforward (cf. Browne and Ramesh, 2002; Kauppinen et al., 2004). The specifications may also reveal surprises. It is not always necessary to proceed directly to information system procurement; sometimes operations management and procedures development should be continued instead. Even when an information system is implemented, development does not end with the introduction of the system (Hyötyläinen, 1998; Fichman and Moses, 1999; Leem and Kim, 2004). The results of the case studies confirm that there are many unresolved issues that have to be resolved as the system is used and further developed.

The summaries and results of the case studies may be analysed by using the phase model of the planning implementation process developed in section 5.1 (see Figure 5). It was noted above about the phase model that the stages do not progress in a linear fashion; there are interactions and recursions between stages (Bozarth, 2006; Capaldo and Rippa, 2009).

Analysis of the case studies and the rich material gained enables new interpretations of the life–cycle model and its parameters. The results enable an evaluation of the development models and paths emerging at the various stages. Interesting questions that arise include: *How do the development models and paths at the various stages differ from one another and in which dimensions? What are the original features of each development model? Which features occur in all models? What should we learn from earlier stages?*

10.2 Path models

Table 4 shows the model classification outlined on the basis of the case study results. This is analysed as development models and paths (cf. Bagchi et al., 2003). Development models reflect the stages of the life-cycle model. The development models are further separated into several development paths, as dimensions that further illustrate the content and function of the development models.

Table 4. Development models and development paths.

	Strategy and management model	Requirements model	Implementation model	Development model
Operations basics	Customer demands Growth and development goals Change goals	Operations development goals Operations management development goals	Operations goals Information management goals	Goal models Usability goals Development goals
Development and implementation organisation	Project group Several development teams	Function teams Joint teams Development teams	Joint team User teams	Steering group Development teams
Basis for information acquisition	Experience Documents Materials and analyses Analysis reports	Descriptions and analyses Analysis reports Data on information systems vendors	Experience Descriptions and analyses System descriptions	Experience Descriptions and analyses Monitoring data Analysis reports
Development and evaluation methods	Strategy analysis Listing and defining development points Complaint lists Development maps Atmosphere and training surveys Indicators	Strategy matrix Process descriptions Workflow analyses Collaboration models	Goal models Implementation stage models Actor role definitions	Development models Process modelling Usage analysis Problem lists Development methods
Role and operations of researchers	Outlining, leading, and maintaining the development process, presenting potential solutions	Analysis and modelling, leading working teams	Analysis and modelling, implementation evaluation	Outlining, leading and maintaining the development process, method development
Strategic changes	Further specification of strategy Strategic operating models	Strategy review Strategy development points Further specification and deployment of strategy	Operations strategy Information management strategy	Development strategy

	Strategy and management model	Requirements model	Implementation model	Development model
Organisation changes	Reorganisation Work organisational changes	Collaboration procedures and their specifications	Organisation role specifications	Development organisation
Steering process changes	Operations and production steering models Organising manual monitoring Development of reporting	Clarification of steering	Steering architecture	Process definitions and process changes
Changes in operations processes	Operations process specifications Process changes	Harmonisation of operating practices	Operations models and procedures	Operations process specifications and changes
Competence development	Training plans Training measures	Competence requirements	Communication Training	Further training needs and training measures
New meeting practices	Meeting practices, e.g. management group, production meetings, joint operation groups	Work meeting practices	Implementation teams	Team meetings
Investments	Tool and equipment procurement Facilities	Determining specifications Information system tenders and selection process	Information system acquisition and implementation	Information system further specifications and development
Case classification	**Case A** *Case B* *Case C*	**Case B** *Case A* *Case C*	**Case C** *Case A* *Case D*	**Case D** *Case C* *Case A*

The table shows four different development models and development paths: the strategy and management model, the requirements model, the implementation model, and the development model. These are analysed through 12 dimensions. In the seven shadowed rows, the results of the models and paths are presented in the table. Furthermore, case examples belonging to each development path are classified in the table. Each development model forms its own development path.

The following is a more detailed analysis of the development models and the development paths formed by them.

10.2.1 Strategy and management model

The strategy and management model is at the core of business development. It is based on customer demands and the challenges that they pose to the company. SMEs are dependent in many ways on the operations of their principals and the trends therein (Beyer and Holzblatt, 1998; Choi et al., 2011). How an SME responds to the challenges and demands of its operating environment depends on its own developmental situation and attitude (cf. Hyötyläinen et al., 2005; Cragg et al., 2011; cf. Mason, 2007).

Growth-oriented companies can identify new opportunities in their operating environment and are prepared to set new growth goals. However, growth can by no means be taken for granted, but instead requires conscious development efforts (cf. March, 1991). Firstly, the company must be able to set growth and development goals that it can attain with the available resources and expertise. On the other hand, development goals serve to orient competence and operations development (Hyötyläinen et al., 2005; Shiau et al., 2009).

All the four companies participating in this development project had set growth goals for themselves. However, they had no detailed operating plans for achieving that growth. At the strategic level, growth was seen as a desirable thing, but there were many unresolved issues in the operations plan. Change goals and means for attaining goals were an important development point (cf. Capaldo and Rippa, 2006; Doherty et al., 2010).

This was the baseline scenario for the development project in the companies involved. Creating an operating strategy and a related management model is always a demanding process with multiple possibilities. Moreover, an operating strategy and operations decisions affect nearly all functions and personnel groups in the company, which makes it difficult to put new solutions into practice (Gosain et al., 2005; Upadhyay et al., 2011). It is therefore only natural that the researchers play a major role in the strategy and management model (cf. Hyötyläinen et al., 2005; Hyötyläinen, 2005). The researchers were instrumental in outlining the stages in the development process and also participated in leading the development project. They also presented solution models and made concrete suggestions for solutions, according to the constructive model (cf. Lukka, 2003).

Drawing up an operating strategy and an operations management model is a process that requires profound expertise. It is crucial that the best expertise in the company is engaged from the very beginning of the development project and that the experts are willing to invest their time and to commit to the development project. This will guarantee a successful outcome (Hyötyläinen, 2005; Choi et al., 2011).

The strategy and management model is integrally linked to the company's strategy and operations development, and corporate management therefore plays

a key role (Earl, 1999; Spanos et al., 2002; Hyötyläinen, 2005). Management participation is easiest to achieve in the project group, which is responsible for the development project. The majority of the actual development work, however, is done in the several development teams appointed for the purpose. Experience and expertise play an important part in opening up new pathways (Hyötyläinen, 2005). Earlier documentation and separate materials analyses, such as a competitor analysis or corporate SWOT analysis also support the development process, and basic analysis reports and operations reports compiled by the researchers and other parties are likewise important.

In addition to expertise, the development and evaluation methods used in outlining the operating strategy and solutions are vital. On the one hand, they enable access to new topics. On the other hand, they make discussions of matters between functions easier (Engeström, 1994; Chin, 2001; Hyötyläinen, 2005). Typical methods used in the strategy and management model include strategic analysis, listing and specifying development points, complaints lists, development maps, and atmosphere and training surveys. Operations indicators and monitoring methods are also used. The researchers play a key role in the development and application of several of these methods (cf. Fryer and Feather, 1994; Lukka, 2003).

The strategy and management model typically involves analysis and development of the company's core functions. This naturally provides a basis for easy implementation of development and change measures in the company, affecting the foundation of the company's operations in many ways (cf. Bai and Lee, 2003). This may involve drafting or further specifying a strategy, outlining organisational operating solutions, changing management practices, or clarifying operating processes. It is common for new meeting practices to be introduced alongside these solutions (steering group, production meeting, and various collaboration procedures) (Alasoini et al., 1994; Simons and Hyötyläinen, 1998). Competence development is also important, and this requires training activities. Attaining growth goals and pursuing operations development may also require investments in machinery, equipment, and facilities.

The clearest example of the strategy and management model here is Case A, where strategic issues and strategic management and operating practices in various functions are highlighted. Case B and Case C also come close to the strategy and management model: in both cases, drafting a strategy and strategic management models were key elements.

10.2.2 Requirements model

The requirements model is linked in many ways to the development of a company's operations and operations management. Its goals may be steering goals, operational goals, operational practices development goals, job function goals, or collaboration models (Browne and Ramesh, 2002; Hyötyläinen, 2005; Doherty et al., 2010).

The requirements model is important, because without a properly and thoroughly prepared requirements specification, operations management cannot be developed (Browne and Ramesh, 2002; Wang and Tai, 2003; Johri and Nair, 2011; cf. McBride, 2003; Zang et al., 2010). The implementation of an operations management system may be based on existing processes, in which case the features and functional specifications of the information system are paramount (Tsai et al., 2012; Vitharana et al., 2012; cf Ramdani et al., 2009). Requirements specification is seen as one of the key tasks in building an information system (Zoryk-Schalla et al., 2004; Kauppinen et al., 2004). Because the later stages of the system's life cycle will build on the foundation laid by the requirements specification, it is obvious that any initial shortcomings will accumulate later in the implementation model and the development model.

The requirements model is closely related to the operating strategy and its implementation (Hyötyläinen, 2005; O'Connor and Martinsons, 2006). Therefore, the corporate management and the company's various functions are very important in the application of the requirements model. Cross-functional joint operation teams can discuss control and operations processes that cut across boundaries (Gosain et al., 2005; Rowlands, 2009). Detailed process analysis can be undertaken by development teams with representatives from several personnel groups.

The requirements model and its implementation call for a great deal of knowledge about the organisation and how it works (Vitharana et al., 2012) This may be derived from various descriptions, analyses, and analysis reports, either existing or specifically drawn up for the purpose with the researchers participating. Data acquired from information system providers may also constitute a significant source of information (Tsai et al., 2012). Successful application of the requirements model needs information to be presented in a specific format, which makes it easier to discuss matters with information system providers and to outline the implementation model and the development model smoothly (Gosain et al., 2005; Capaldo and Rippa, 2009).

Although the organisation management and its functions play a key role in the requirements model, the researchers may also be vital in analysing operations and in leading the development teams addressing the various requirements specifications. The researchers may also play an important role in information acquisition and the development of methods used for that purpose (Hyötyläinen, 2005, Hyötyläinen et al., 2005). The methods used may include the strategy matrix, process descriptions, workflow analyses, and collaboration models.

The requirements model and the development path that it outlines may cause development and change measures. A natural consequence of this is a strategy review, which may lead to the further specification and amendment of the strategy. Changes often involve steering and operations processes. Steering processes often need to be simplified and clarified, while operations processes need consistent procedures (Pahl, 2004). Organisational development points and a need to increase the level of competence may also emerge. All in all, this represents a major investment on the part of the company, and specifically an investment in human capital (Wickramasigne and Weliwitigoda, 2011).

An example of the requirements model can be seen in Case B, which focuses on the drawing up of a requirements specification for a subcontracting strategy and operations model, and on preparing for the development of information systems. Case A also shows features of the requirements model, as it involves examining the requirements and further development needs for information systems and other systems. Case C also has requirements for strategic work, a production meeting, and maintenance programme.

10.2.3 Implementation model

The implementation model builds on the strategy and management model, and on the requirements model. The implementation model is about information system acquisition and implementation, based on functional goals and information management goals. System descriptions and implementation practices are key features in the model (Gottchalk, 2001; Hyötyläinen, 2005; Capaldo and Rippa, 2009).

Generally, the information system supplier plays a vital role in the implementation model, which involves adapting the selected system to the company's operating environment and practices. In this, the supplier's project models, stage models, divisions of duties, models and methods are applied (Hyötyläinen and Kalliokoski, 2001; Hyötyläinen, 2005; Maditinos et al., 2012). The extent to which the user organisation can utilisate its own organisation models and methods in the transition depends on the organisation's own capabilities (Furumo and Melcher, 2006). It is possible that the information system supplier's procedures alone are used as the basis for the transition process (Bozarth, 2006).

Nevertheless, the implementation model requires information as the basis for all operations (cf. Dalcher and Genus, 2003; Bhatt et al., 2010). Experience is very important in implementation, and the information system supplier is naturally in a strong position here. Existing and new descriptions and analyses contribute to the information system implementation. System descriptions are the bedrock of the implementation of a new information system, along with the entry of existing data into the new system (Hyötyläinen and Kalliokoski, 2001; Bendoly and Schoenherr, 2005; Doherty et al., 2010).

In the implementation model, responsibility rests with the joint operation teams, with representatives from corporate management and middle management in various functions. In addition, user groups are involved at this stage at the latest (cf. DiBella et al., 1996; Hyötyläinen, 2005). The role of the researchers may be to support the user organisation on the one hand, and to function as a bridge between the user organisation and the information system supplier on the other. In the implementation model, the natural role for the researchers is to conduct analyses and modelling to support the ongoing transition processes, which may also be supported with a variety of methods. Models and methods employed may include goal models, implementation stage models, and actor role definitions (cf.

Simons Hyötyläinen, 1988; Torvinen, 1999). The researchers may play a vital role in developing and applying these methods.

Generally, the acquisition of an information system is a major investment (Anandarajan and Wen, 1999; Benediksson and Dalcher, 2003). It is normal that changes not anticipated at the planning stage have to be carried out at the implementation stage. This may increase costs considerably. Personnel training and getting used to the new system may also take time and cost money.

Case C provides an example of the implementation model in which the researchers participated in drawing up production meeting practice, complaint list practice, and operations management practices. The Case A also presents an implementation model in which operations management practices are implemented. In Case, strategic work, and production meeting practice were implemented, and production changes were made. In Case D the new information system was implemented, but the researchers did not participate in that phase at all.

10.2.4 Development model

The development model involves the development of an already implemented information system. This is a stage that is difficult to avoid (Hyötyläinen, 1998, 2005; Xu and Ma, 2008; cf. Saeed and Abdinnour-Helm, 2008; Federici, 2009). The basis here consists of the goal models adopted, the usability goals set for the system, and the resulting development needs. In any case, it is hard to achieve the goals set without continuous development of operations and of the system (Coriat and Dosi, 1998; Felman, 2000; Benediktsson and Dalcher, 2003; cf. O'Connor and Martinsons, 2006).

At this point, the strategic level of operations must be revisited. Senior and middle management have to take responsibility for consistent development of operations and of the system, and for deciding which development measures to undertake and in what order (cf. Hyötyläinen and Kalliokoski, 2001; Nokaka and Takeuchi, 1995; Blount, 2011). The steering group is a natural forum for engaging in this, although the actual specifications are outlined and development efforts addressed in the various development teams representing middle management and the company's functions.

The development model is based on experiences of using the system, descriptions and analyses prepared, and analysis reports to which the researchers contribute (Feeney and Willcocks, 1999; Gallivan et al., 2003). The researchers' role may be quite prominent in the development model. Companies do not always have existing organisational models and procedures to address continuous development of the system and how this connects to the company's strategic development (Irani, 2002; Zhong and Majchrzak, 2004; Hyötyläinen, 2005; cf. Shih and Huang, 2010). The researchers may be required to undertake outlining, leading, and maintaining the development process and method development. Methods may include development models, process modelling, usage analysis, problem lists, and development methods.

Operations and system development may result in numerous changes to operating practices and to the system itself. In the best cases, the organisation may evolve development actions of its own, establishing a development organisation and permanent procedures (Hyötyläinen 2005). Process definitions and process changes in both steering and operating processes are natural consequences of this. Development efforts may turn out to be relatively costly; changes to information systems in particular require labour input not only from the company's organisation, but also from the information system provider.

An example of the development model may be found in Case D, where the focus was solely on runtime development of operations and the information system. Case A has features of runtime analysis and specification. Case C also has some development features, including maintenance and complaint list development.

10.3 Mutual interdependencies of path models

10.3.1 Objectives and hierarchical action trees

The descriptions and analysis of the different path models clearly illustrate that there are the interdependencies between development and path models. This is already apparent in the operations basics of the various models. The strategy and management model focuses on customer requirements and the company's growth and development goals. Change goals are the most concrete manifestation of these goals. In the requirements model, change goals are expressed as operations development goals and operations management development needs (Baghi et al., 2003). The implementation model focuses on operations goals and information management goals that lay the foundation for the information system to be selected. In the development model, the goal models again take centre stage. Usability goals for the system, reflecting the goal models, are naturally involved here. Development goals arise from shortcomings and needs in operations.

The objectives and action trees are hierarchical in the sense that the goals of one model are included in the previous model, while those in the next model are more concrete (Edwards, 2000; Greer and Ruhe, 2004; Esteves, 2009). However, a closer look at the objectives and action trees shows that the goals are not fixed; instead, following changes in experiences and operations, the goals themselves evolve and change, necessitating a review of earlier matters or a revisiting of the same issues from different perspectives. This is true for strategic changes as well as for steering and operating processes. Competence development, too, requires a repeated revisiting of issues in the various models.

10.3.2 Change management

For the development and management organisation of systems, the role of corporate management is, of course, crucial in the strategy and management model.

This role diminishes in moving to the requirements model and in some respects further in the implementation model. At this point, the role of middle management is heightened, and in the implementation model, user groups join in, too (cf. Kanter, 1983; Ikävalko, 2005; Davis and Hikmet, 2008; Blount, 2011). However, what is surprising is that corporate management again acquires a key role in the development model (cf. Hyötyläinen, 2005; Doherty et al., 2010). It would seem that the evolution of goals may change the meanings of things irrespective of the development model, and management has to be ready to invest time in implementing development and change.

Information acquisition is largely similar in all development models; the differences are in the details. The development and evaluation methods applied are also unexpectedly similar in all models. While certain methods are better in one given development model, than in another, the same methods may be used (or may have to be used) at several different stages. It is a noteworthy point that all models incorporate methods addressing the company strategy and its outlining, which highlights the importance of strategic issues in the models (cf. Jarzabkowski, 2003).

It seems evident that the role of an outside party is fundamental for the successful application of the development models and their development paths. At least for SMEs, this seems to be true (Hyötyläinen and Kalliokoski, 2001; Bagchi et al., 2003; Burnes, 2004). Method development and the application of new methods is also quite naturally something for an outside party to undertake, as companies generally do not have resources for such development efforts.

10.3.3 Organisational changes

In the strategy and management model, companies are willing to undertake organisational change and workplace organisation development, which is only natural (Edmondson and Moingeon, 1999; Doherty et al., 2003; Cragg et al., 2011). What is surprising, by contrast, is that organisational issues are included in the other development models, too. Evidently, issues of organisation and procedure cannot be resolved in one stage. Perhaps the work done in the various models brings up new issues that require a further specification of organisational procedures. As an analysis of the development model shows, setting up a development organisation is not an easy task for companies (Ilomäki 2003; Hyötyläinen, 2005; Doherty et al., 2010). A development model inevitably raises the issue of development work. However, creating a development system is only possible once the fundamentals of the company's operations have been reassessed and a dedicated organisational and procedural framework built. A development system reflects the logic and operating model that the company follows in its change and development activities (Winter, 1996; Sitkin, 1996; Felman, 2000).

Meeting practices and changes therein are closely related to organisational changes (cf. Simons and Hyötyläinen, 1998; Goggins et al., 2011). Many new needs for meetings emerge in connection with the strategy and management

model. The meeting practices established may be strategic in nature, concerning the company's steering group, or practices supporting strategic goals, such as production meetings. Surprisingly, the need for establishing new meeting practices emerges in each development model. Every model highlights forms of co-operation that each requires in its own meeting practices. The diversity of meeting needs is a manifestation of the need for information exchange and discussion, That is, dialogue processes in companies (cf. Nonaka and Takeuchi, 1995; Isaac, 1999; Engeström, 2001). Meeting practices promote organisational learning and knowledge and thus may contribute to the foundations of the company's success.

10.3.4 Investment models

In terms of investments, a clear focus is detectable in the development models. For instance, the tools and equipment acquisitions and facilities solutions included in the strategy and management model are simple enough in themselves (Farbey et al., 1999; Anandarajan and Wen, 1999; cf. Yang and Su, 2009). The organisational changes and training investments in the model, however, are significant measures. Investments in training and organisational practices are investments of a completely different kind compared to traditional investments in equipment. They might be described as human capital investments (cf. Hyötyläinen, 1998; Choo, 1998; Wickramasigne and Weliwitigoda, 2011). These human capital investments play a major role in the other development models, too. Even in the implementation model, where technical investments in information systems are central, training costs and the learning and work inputs involved in the implementation of a new system are considerable (Bhatt et al., 2010; Cragg et al., 2011). Runtime development ties down considerable resources within the company. At the same time, however, the company acquires new expertise, which can subsequently become a competitive advantage, as shown especially in Case D.

10.4 Summary: decision for growth and change

10.4.1 Challenges of growing firms

SMEs capable of growth and development are of great importance to the national economy and to employment (Hyötyläinen et al., 2005; Simons and Hyötyläinen, 2009; Hyötyläinen, 2009, 2011, 116–131; Snider et al., 2009). Growth-oriented companies are required to have the will and the ability to develop. Development is the product of numerous intertwined strategic tweaks, management model evolution and changes in operating practices (cf. McGahan, 2004).

Growth-oriented SMEs seek operating strategies and steering solutions with which to attain their goals. In this, they encounter many difficulties and unexpected situations (Kuitunen et al., 2003; Hyötyläinen, 2009; Cragg et al., 2011). Because of this, many things that seem clear and feasible in strategic decision-making start

to look very different once they are translated into concrete operations, as the steering groups in the cases stated (Gottschalk, 1999; Shiau et al., 2009). Progressing along the development paths outlined in the development models constantly brings up new strategic requirements and needs for specifying operating practices. This implies that when an organisation implements a strategy, its various functions bring up new innovations and suggestions that have to do with strategy, organisation, and operating practices, and that require the attention of and new decisions from the management (cf. Mintzberg, 1994; Child, 1997; Doherty et al., 2010).

Company-specific development projects and the analysis of their results demonstrate that companies are obliged to balance many factors in revising their operations management practices and in aiming to implement information systems to support those practices (Esteves, 2009; Bhatt et al., 2010). The organisational context model presented here covers the essential points while also describing the field of development in the companies discussed. We have the strategic goals and change motives on the one hand, and the operations management model and its development goals on the other. This is not enough, however. It is equally important to address issues of organisation and the division of duties and procedures related to operating practices (Hong and Kim, 2002; Doherty et al., 2003, 2006). The case studies specified this angle.

Operations basics are fundamental factors in this process, and operations are based on the characteristics of the operating environment (Baumard, 1999; Argyris, 2000; Chin, 2001). Customer needs and the way the company interprets them are governing factors in all operations and development. Nevertheless, analysis shows that the demands of the operating environment are not directly translated into company goals. The company has to set change goals for itself and to examine how to attain its change and development goals (Hyötyläinen et al., 2005; Bhatt et al., 2010). Goals are transformed into different shapes in the various development models, as changes in the operating environment are taken into account along with the company's capabilities and development resources.

10.4.2 Importance of implementation

The importance of the development and implementation organisation was clearly shown in the case studies. Change goals cannot be attained without conscious organisation and resourcing of change and development activities (Clark and Starkey, 1988; Edmondson and Moingeon, 1999; Henriksen et al., 2004). On the whole, companies seem to proceed quite methodically in their change and development efforts, so that the various groups in the organisation take a leading role in the orientation and implementation of development measures as the change and development efforts progress in the development and implementation organisation. However, it was also clear that strategically significant issues requiring management input may unexpectedly emerge at most stages in the process and in most development models.

It is essential to obtain sufficient information and knowledge in order to be able to progress in change and development efforts and to make successful decisions (Blackler, 1993; Metaxiotis, 2009; Choi and Lee, 2011). Information acquisition and analyses have to be carried out as required in the course of the change and development work. Information acquisition methods and development process maintenance methods are required, as confirmed in the case studies. Here, an outside party is crucial. In the case studies, the researchers oriented and led the development process and also contributed to method creation and application, and to analyses.

Analysis of the results of the case studies profiled the importance of the various development models and development paths in change and development aiming at improving operations management and implementing new information systems (cf. Bagchi et al., 2003; Federici, 2009). Discussion of the development models revealed how the models and development paths differ from one another, which factors they share, and which points recur in different forms in the models. The results of the case studies also show that it is not always clear to companies where the focus lies in change and development in each development model. The analysis resulted in the outlining of four development models: the strategy and management model, the requirements model, the implementation model, and the development model. These were examined through a number of dimensions. The development models and their development paths can help similar companies in their change and development efforts in the future.

10.4.3 Management practices

The case studies and the analysis of their results highlight the importance of steering and operating processes in change and development (cf. Spathis and Constantinides, 2003). Steering process changes are featured in all development models. The requirements for specifying and changing steering processes are different at different stages. Similarly, changes in operating processes appear in a number of guises. Changes in both steering processes and operating processes reflect changes in goals and operating models, which in turn are directly governed by new interpretations of the demands of the operating environment, and the company's change and development goals.

New meeting practices were established at the companies. This can be seen as being closely connected with the organisation changes undertaken. There were needs for several different types of meetings, demonstrating the need for information exchange and discussion between functions and personnel groups. This could be construed as an information system, with both informal and formal forms of co-operation being highly relevant (Isaacs, 1999; Hyötyläinen, 2000, 57–64; Lin et al., 2012).

In the case studies, change and development efforts were aimed at specific issues that required solutions. In the case studies, measures and development actions were undertaken to solve problems. A development model emerged high-

lighting the issue of organising development efforts and creating suitable procedures. This issue can be framed as a question of a development system reflecting the logic and operating model on which the company's development efforts are based. In that case, development will be focused not on troubleshooting individual problems, but on the development system (see Alasoini et al., 2005).

10.4.4 Competence development

Competence development measures are also closely linked to change and development, as the case studies showed (Feeney and Wilcocks, 1999; Sher and Lee, 2004; Cragg et al., 2011). Competence development focuses on training, communication, and further training needs. Investments were also made, although most of the investments could be considered to be 'human capital investments' aimed at developing operations and operating practices. Considered as a whole, all development measures are such investments in the case studies (cf. DiBella et al., 1996; Fujimoto, 1998; Hyötyläinen, 1998; Doherty et al., 2010). All competence development, organisational and procedural improvements, operations management development and establishment of collaboration procedures generate unique expertise in the company. This enhances the company's emerging development system and its competence base, which researchers emphasised in the case studies for steering groups.

Capital bound up in competence, operating models, and a development system may prove to be a crucial competitiveness factor for the company. The company can then explore its strategic operating model in depth, build up new kinds of organisation, and successfully introduce new technology, thereby acquiring further competitive advantages (Davis and Hikmet, 2008; Metaxiotis, 2009; Wickramasighe and Weliwitigoda, 2011). This model also enables relatively rapid adaptation in situations of change and provides capacity for utilising emerging opportunities. This is important, because the operating environment is changing all the time, and changes may happen within the company itself – such as organisational changes or ownership changes, examples of which were seen in the case studies (cf. Chun and Montealegre, 2007).

11. Solutions for innovation the design dilemma

In this chapter, solutions for the innovation design dilemma will be considered. New models will be examined. That will be based on the analysis of the case study results and the assessment of change management. The starting point is the planning choice of technical change. Next, a constructive model for planning in the implementation process of information systems is presented and evaluated, forming the main theoretical model in this study. This model is completed by the organisational learning approach. As the summary, the implementation is viewed as organisational processes.

11.1 Planning choice of technical change

The purpose of the implementation of an information system is to support the company's business and its goals. The conceptual design and system specifications of the information system are crucial for success. However, it is not until the implementation that the information system becomes a tangible entity. The implementation of an information system may be seen as happening 'at a single blow' or as a continuous process of developing procedures and leveraging the features of the system. Research indicates that realisation of the potential inherent in any system requires organisational development (Lyytinen, 1986; Checkland and Holwell, 1998; Hyötyläinen, 1998, 2005; Doherty et al., 2010).
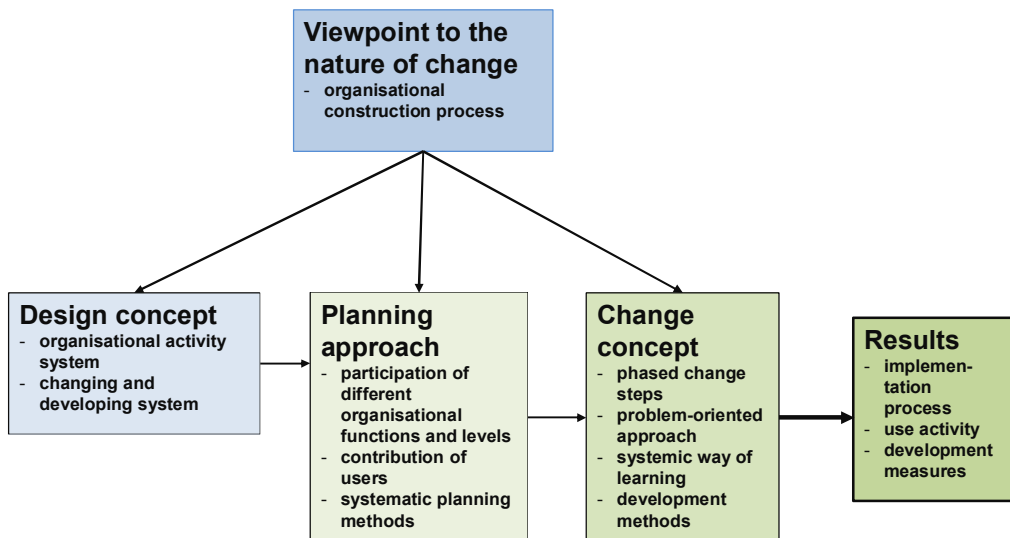
The implementation of an information system in an organisation is a complex process involving both technical change and organisational change (Feeney and Willcocks, 1999; Hong and Kim, 2002). This may be described as the 'innovation design dilemma' involved in technical change or innovation (Holbek, 1988; Gjerding, 1992; Ehn, 1988; Hyötyläinen, 1998).

In order to resolve the 'innovation design dilemma' in technical change, we need to examine the design, implementation, and use of an information system as an organisational process (Lyytinen, 1986; Engeström, 1987; Kuutti, 1994, 1999; cf. Blackler, 1993). The implementation of an information system is, after all, a process of organisational change. The change manifests itself in concrete operations and actions. To put it another way, the implementation of any technical sys-

tem is a process where various actors (management, designers, supervisors, employees, personnel in other functions, supplier representatives, and consultants) participate in troubleshooting functions at various points in the implementation and introduction phases, an operation where actors in the organisation participate and interact in resolving the technical and organisational problems involved in the change. Through these processes, a new technical system forming part of the operating system, eventually emerges (Hyötyläinen, 1998, 2005).

11.2 Organisational construction model for the planning and implementation process

According to the innovation design dilemma, the most important factors from the point of view of the success of the results of the implementation process of information systems are the following elements: (1) viewpoint of the nature of change; (2) design concept; (3) planning approach; and (4) change concept (see Table 2). The most important intervening factors are organisational patterns (cf. Hyötyläinen, 1998; Doherty and King, 1998; Bai and Lee, 2003). The relations of these elements are described by the organisational construction model of the planning and implementation process of information systems. The model is presented in Figure 20.

Figure 20. Organisational construction model of planning and implementation process of information systems.

According to the model of the planning and implementation process, the viewpoint of the nature of change defines mainly the design concept, and also partly the

planning approach and change concept. The viewpoint to the nature of change is the organisational construction process. The design concept determines correspondingly the planning approach and its organisation. The change concept is closely connected the planning approach, as well as to the viewpoint to change. All of this influences the results of the change. The results concern the success of the implementation process, use activity, and development measures. As is seen in the figure, organisational learning and change activity are in a central role in the organisational construction model for the achievement of the goals of the planning and implementation process (Davis and Hikmet, 2008; Doherty et al., 2010; Lorenzo et al., 2012). The most important factor for all the following phases is the viewpoint to the nature of change. This has to seen as a great organisational construction process, which helps to direct the later phases of the planning and change successfully (cf. Lewis et al., 2005; Lin et al. 2012).

In the following, the features of the organisational construction model are considered. The next analysis specifies further the model of the implementation process of information systems:

(1) The realism of the viewpoint of the nature of change is one of the most important factors influencing the whole planning and implementation process of information systems. It is realistic to consider the change as an organisational construction process (cf. Ramdani et al., 2009; Doherty et al., 2010).

(2) Another important factor is the design concept, which had a crucial role for the formation of the planning organisation and practice, and for the technical solutions made in the planning phase. Thus, the design concept is an important means for the designers and planners in directing their work (Wang and Tai, 2003). The design concept has two dimensions. First, the object of design has to cover the organisational activity system, not only the technical system and process design (cf. Hyötyläinen, 1998). Second, the object of the design has to be seen as the constantly changing and developing organisational activity system. Furthermore, when the changing and developing organisational activity system is an object of design, it has profound implications for the technical and organisational practices to be chosen (cf. Corbett et al., 1991; Dittrich and Lindeberg, 2004; Doherty et al., 2010; Bhatt et al., 2010).

(3) The third factor of the organisational construction model is connected to the planning approach, culminating in the division between "top-down" and "bottom-up" planning, which is the central line in overcoming the border between planning and use (cf. Currie, 2009; Blount, 2011). There are especially two basic elements for solving this dilemma: the planning organisation and the systematic planning methods.

The first one is the *planning organisation*. The change in the planning organisation means that the different organisational functions and levels participate in planning activities and contribute the solutions formed in the planning phase (Gosain et al, 2005). Especially, the role of the users in the planning has to be emphasised. The users can become involved in the

planning process earlier and more deeply than usual (Kanter 1988, 241–277; Jones, 1989; Hyötyläinen et al., 1991; Boedker and Gronbaek 1996; Feeney and Willcocks, 1999). The participation of the users in the planning has a double effect (Sohn and Doane, 2002; Santosa et al., 2005; Hsu et al., 2008):

– by being involved in the planning process, the future operators of the system can adopt and transfer the planning knowledge to the operation, which may also shorten the implementation period of the system
– the users of the system can participate in the processing and solving of the planning problems and, thus, bring operational knowledge into the plans, which may reduce problems and disturbances in the realisation of the plans in the implementation and use phase.

However, at best, these changes only lead to so-called "participative" planning, in accordance with the "user-centred" model (Mumford, 1999; Gulliksen et al., 2003 Dix et al., 2004). The integration of the planning and use activities depends crucially on the constructive approach (Lukka, 2003, Hyötyläinen, 2005), as well as on the use of the systematic planning methods and tools (Ehn, 1998; Boedker and Gronbaek 1996; Dittrich and Lindeberg, 2004; Kautz, 2011). Models and methods are needed, by which the planners, users, and user organisation as a whole can manage the techno-organisational system under design, in co-operation through the principles of simultaneous working.

(4) The change concept is a crucial factor for the implementation, use, and development of an information system in the organisational construction model (Leem and Kim, 2004). It could be assumed that the change is suitable to carry out by step by step, according to a phased steps model (Fichman Moses, 1999; Avison and Fitzgerald, 1999; Benediktsson and Dalcher, 2003; Greer and Ruhe, 2004; Ruhe, 2004). The problem-oriented approach emphasises organisational problem-solving activity, which has a central role in the implementation process. At best, this can result in a systematic way of learning activity (Chen, 2009). This requires the use of the suitable development methods, in order to advance organisational learning and innovation activities in the implementation process of an information system.

As a summary of the above treatment, one can state that the planning and implementation process progresses as an organisational constructional process. The planning and implementation process can be seen to form an "experimental field", where the experienced difficulties, set-backs, and good results may act as a basis for learning and seeking new planning practices, implementation models, and management approaches (cf. Edmondson and Moingeon, 1999; Bhatt et al., 2010; Doherty et al., 2010; Choi et al., 2011). As March and Simon (1958, 117–131) already argued, when an organisation meets a new and complex situation of decision–making, the past experience gathered in the organisation is not necessarily

valid for choosing the "right" actions. Especially in the conditions of developing new "performance programmes", the search for new organisational patterns occurs rather according to a step-by-step principle than by the "rational" planning of ready solutions, due to "limited aspirations" and "bounded rationality" (March and Simon, 1958, 172–210; Cyert and March, 1992, 214–215; cf. Child, 1997).

11.3 Organisational learning approach

The application of information systems occurs through the co-operation and interaction of many parties in the organisation and between the organisations (Pan et al., 2008; Iveroth, 2010). Viewing the planning and implementation process of information systems from the perspective of organisational learning brings into view the fact that organisations learn and create new practices and supporting methods as the processes progress (Lave and Wenger, 1991; Lowendahl and Haanes, 1997; Dalcher, 2003). However, both innovation based on information systems and learning are about creating new systems, which means changing established ways of thinking and acting. Interaction and learning are organisational activities and always take place in certain contexts (Kearns and Lederer, 2004).

It is generally understood that open and thematic network structures are a central prerequisite for the emergence of innovative new solutions and operational models (Isaacs, 1999; Chesbrough, 2003). However, traditionally, learning theories are based on individual learning, while learning models are usually extended to describe organisation-wide learning (Argyris and Schön, 1978; Argyris, 1990, 1992).

To conceptualise and manage learning networks, new approaches and models of learning are needed (DiBella et al., 1996; Bagchi et al., 2003; Furumo and Melcher, 2006). The basic view is that learning and the production of knowledge by an organisation are never simple or without problems (cf. Leontjev, 1978; Engeström, 2001; Jarzabkowski, 2003). They may be based on individual learning, but the internal dynamics and conditions of an organisation always add new dimensions to the process (Gallivan et al., 1999; Jarzabkowski, 2003; Henriksen et al., 2004; Iveroth, 2010). Furthermore, we should bear in mind that learning and production of knowledge by an organisational setting is linked to future action, which is realised when flows of knowledge and control mechanisms become more focused. It is an interactive process striving to analyse a complex and uncertain future, also in the case of information systems (Stacey and Griffin, 2005; Doherty et al., 2006). This means that learning has a future dimension.

Thus, learning does not only mean the processing of knowledge in an organisation, but also the formulation of hypotheses, which requires reflection on thought and action (Engeström, 1987; 321–337, 2001; Weick, 1995). We believe that information and knowledge are not sufficient to promote learning. It is also a matter of interpretation. We know that with the same information and knowledge we can come to quite different conclusions and measures, also within information systems (March and Simon, 1958; Doherty et al., 2006). The only way to study

issues in learning networks and to define new hypotheses is to create common learning forums and to process the interpretations constructed in them interactively. Here, communicative action and dialogue processes take a key position (Isaacs, 1999; Henriksen et al., 2004). They assign interpretations and meanings to issues and information, which helps to pose new questions on the information system and to create new knowledge.

Generally, learning and the production of knowledge are not unconnected learning events. Learning is always situation-specific and linked to a certain context and to the processes surrounding the creation of new knowledge in that context (Lave and Wenger, 1991). In addition, in a dynamic organisational environment, the information results and structures that unfold from learning are not final or complete. Learning and the production of knowledge can be seen as having a systemic nature (Senge, 1990, 68–73). Systemic thinking emphasises wholes, the understanding of interactive relationships of sub-systems, with attention paid to incremental changes, based on learning by doing (Rosenberg, 1982; Erikssen and Nurminen, 1991). Systemic thinking also helps to free us from the linear model of learning processes, and to see reality as circles formed in interaction, where we influence the course of events (see Nonaka, 1991; Stacey, 2001).

11.4 Summary: organisational prosesses

One could justifiably state that the implementation process of information systems is carried out and defined through organisational processes. It is ultimately a question of organisational-learning and knowledge-creation processes (Hyötyläinen, 1998; Prange, 1999; Iveroth, 2010; Choi and Lee, 2011). It is only through these processes that the information technology potential can be fully realised. Many different parties participate in the implementation process, and all have different interests, objectives, and methods, which can facilitate the learning processes. However, the presence of the viewpoints of actors does not, as such, guarantee the start of the learning and knowledge-creating processes within the organisations (the end-user organisation and its functions and different actors, and a vendor) and their co-operation with each other. The learning process requires conscious organisational practices, co-operation methods, and communication tools (Engeström, 1994; Nonaka and Takeuchi, 1995; Preskill and Torres, 1999 Hyötyläinen, 2000, 2005).

The problem lies in the fact that the learning processes do not occur automatically (Lyytinen and Robey, 1999; Vartiainen, 2010). Although organisations encounter problems and difficulties, this does not necessarily lead to conscious learning, even within individual companies – not to mention learning processes occurring across organisational boundaries (Argyris 1992; Nonaka and Takeuchi 1995; Reijonen and Toivonen 1996; Dixon 1999, 2000; Preskill and Torres 1999; Zhong and Majchrzak 2004).

Often an organisation's actors and functions are not used to presenting issues clearly, based on model thinking. Accounts of issues are often recounted verbose-

ly and disjointedly (Hyötyläinen 1998; Checkland and Holwell 1998; Preskill and Torres 1999; see Iveroth, 2010). Thus, it is understandable that the very actors and functions involved have difficulty in learning each other's activity logic and in starting to build a new activity model together. The idea is that there is much knowledge within an organisation, though it is primarily connected to individuals and their various views, as well as their functional routines (Polanyi, 1983; Felman, 2000; Prieto and Easterby, 2006).

It can be stated that the implementation process of information systems is realised and defined through organisational construction. It is ultimately a question of organisational-learning and knowledge-creation processes (Grant, 1996; Hyötyläinen, 1998; Prange, 1999; Miranda et al., 2011). It is only through these processes that the information technology potential can be fully realised. Many different parties participate in the implementation process and all have different interests, objectives, and methods, which can facilitate the learning processes. However, the presence of the viewpoints of actors does not, as such, guarantee the start of the learning and knowledge-creating processes within the organisations (the end-user organisation and software firm) and their co-operation with each other. The learning process requires conscious analyses of the cases shown, which need organisational practices, co-operation methods, and communication tools (cf. Engeström, 1994; Nonaka and Takeuchi, 1995; Preskill and Torres, 1999; Hyötyläinen, 2000; Iveroth, 2010).

12. Conclusions

In the conclusion chapter of this study, we will summarise the study and evaluate the study results. The basic problem addresses how to manage the implementation process of information systems in user organisations, as well as how to research information systems and their planning and implementation process. We discerned three research questions, all of which have theoretical dimensions. The third research question was also approached by case study analysis. First, the summary of the study and its results will be presented. Second, the study results will be evaluated. Finally, we discuss the need for further research.

12.1 Summary of the study

In this study, the focus is on the implementation process of information systems, which is approached by means of systems analysis, with its strong organisational emphasis (Blackler, 1993; Arbnor and Bjerke, 1997; Doherty et al., 2010). The intent is to create theoretical, methodological, and conceptual research models. The objective was to use various research approaches to show the possibilities of the constructive research approach in the planning and implementation of practical development solutions, as well as in the formation of new theoretical and conceptual knowledge. In this study, consideration is given to a constructive approach that is close to the pragmatic research and development tradition (Rescher, 2000; Lukka, 2003; Hyötyläinen, 2005). The main aim of the study is to determine the new kind of planning and implementation system and its major relations to its constituent parts, with the emphasis on practical applicability.

A new point in this study is to join the constructive approach and the critical realist approach to each other. The point is that the critical realist theory offers the theoretical base for constructive research and a development approach, which is a new approach to delineate the research and development aspects of information systems, and which has the possibilities to solve problems of information systems research and development concerning the old dividing line between research and practice (e.g. Mingers, 2004a; Klein 2004; cf. Wicks and Freeman, 1998; Weick, 2003).

The study developed an organisational constructive process–oriented framework for the implementation issue. The study considered the organisational side of the planning and implementation of information systems. The viewpoint is the examination of the innovation dilemma. The dividing line concerns the distinction between technical innovation and organisational innovation. The dimensions and factors of the innovation dilemma were defined and assessed. Further, the social process model of the implementation process of information systems was discussed. This means that the implementation of information systems is seen to be a construction process in which the learning and innovation steps taken by the applying organisation and its different actors play a crucial role in the success of the implementation process.

The study touched upon the constructive implementation steps of information systems, based on the organisational construction framework. The implementation process of information systems was handled through different phases of planning, implementation, and use and development. After the strategic and management process, the implementation of information systems can be seen to consist of three main activities. These are: planning, implementation, and use and development. In planning it is normally a question of an activity aims for a new solution compared to the former situation. That can be seen as an innovation from the point of view of the user–organisation. The information system applied is a main part of this innovation. Besides, new activity processes, organisational models, and action modes can be a part of this innovation solution. Through implementation, these innovation elements are tried out into practice. Another dimension is development, which describes the effort for realising the full potential of the innovation steps.

The constructive implementation steps represent the concrete method of the constructive research and development model. The development cycle method is a constructive approach to managing concrete projects in practice. At the same time, the objective of the constructive research and development activity is the formation of new theoretical concepts and models, and new practical solutions in connection with the implementation of information systems (Lukka, 2003; Oyegoke, 2011). The development cycle method has five main stages for serving a business-specific analysis and development. These stages are: the start of collaboration; the analysis; the choice and definition of development objectives; the development work; and the adoption of solutions that have proven workable (Hyötyläinen, 2011, 171–173). Each stage of the development process is assigned certain tasks and actors, that is, an organisation and development results. The development process also addresses the need for quick problem solving.

This method creates the basis for the consideration of cases in this study. This study draws on four case studies, which are extensively reviewed and analysed in detail. The first of these is Case A. In the Case A development project, it is a question, on one hand, of the strategic development in a multi-plant environment, the drafting of a strategic guidance model, and, on the other hand, of the development of production management and operating practices at one plant, including an information system needs assessment. The second case is Case B development

project. The focus is on strategic subcontracting issues, and operations and production development. The materials are analysed and evaluated with regard to success and difficulties in each development area, and from both the company's and the researchers' perspective. An overall evaluation of the case study is also presented. Case C complements, for its part, the points of Case B. In this case, it is a question, on one hand, of the formulation of strategy in the company, and, on the other hand, of the construction and refining of the production management model. The fourth development project given focus is Case D, where the further development of an introduced operations management system and the creation of a development organisation and development stages constitute the main content. The creation and use of methods are also important here, and their use is evaluated, as is the development project as a whole, with its outcomes.

In all the case studies, the same procedure was applied. They are: the starting points, the analysis, the choice and definition of objectives, the analysis, development work, and the assessment of results.

All the case study results are analysed, and change management issues are evaluated. The life-cycle framework is a basis for analysing the path models of the development phases. The path models are: strategy and management; requirements; implementation and development. Each of these models is analysed and evaluated. Furthermore, the mutual interdependencies of the path models are analysed. The following points are discussed: objectives and hieararchical action trees; change management; organisational change; and the investment model. As a summary, the challenges of growing firms, the importance of implementation, management practices, and competence development are handled and assessed.

Solution models for the innovation design dilemma are considered and analysed. First, the planning choice of technical change is analysed. The organisational construction model for the implementation process is presented and evaluated. This model forms the major theoretical contribution of this study. This model is completed with the organisational learning approach.

12.2 Research questions and results

In this study, the focus is on the implementation process of information systems, which is approached by means of systems analysis, with its strong organisational emphasis. The objective was to use various research approaches to show the possibilities of the constructive research approach in the planning and implementation of practical development solutions, as well as in the formation of new theoretical and conceptual knowledge.

In this study, there are three research questions. They are:

- How are information systems researched and in particular the implementation process? What frameworks are used and how they can be applied?

- What are the innovation design dilemma and its meaning in the context of the planning and implementation process of information systems? What are its theoretical and practical dimensions?
- How are information systems and action patterns developed constructively and simultaneously with concerted efforts? What are the practical and theoretical implications of these efforts?

In the following, these research questions and the results of this study are analysed and evaluated.

12.2.1 Research frameworks in information systems development

The first research question is answered through the theoretical analysis approaches and models developed and assessed in this study. The first research question in this study is:

How are information systems researched, and in particular the implementation process? What frameworks are used and how can they be applied?

There are six research approaches and models for researching information systems and their implementation issues. The first one is the action research tradition. The others are: positivism, interpretivism, pragmatism, the constructive approach, and the realist approach. The main point in this study is the development of the constructive research and development method for the application of information systems.

In the framework of action research, there are emerging new approaches. Traditionally, action research is based on the socio-technical tradition, emphasising user-centred information systems (Mumford, 1999; Gulliksen et al., 2003; Vilpala, 2008). Recently, socio-technical concepts are also becoming more comprehensive and systematic (e.g. Herrmann et al., 2004; Santosa et al., 2005; Iivari and Iivari, 2006; Kautz, 2011). New approaches are based on system theoretical views, as well as on activity theoretical suppositions. It has been emphasised that this kind of view helps identify appropriate concepts to describe and model the real aspects of socio-technical systems.

Positivistic thinking is often in the background in the building and application of information systems, which have primarily been characterised by a functionalist approach. The subject has been the information systems' hard side, which has meant a focus on the technical planning of systems (Checkland and Holwell, 1998). The dominant thinking has been based on the concept of organisational goal-seeking and decision-making systems (Hirschheim et al., 1995, 102–115; cf. Cyert and March, 1992).

Interpretivism, based on hermeneutics and phenomenology, has got a foothold in the area of information systems and their implementation in recent times (Klein and Lyytinen, 1985; Lee, 1999; Rose, 2002). The explanation model is based on "understanding": that is, the understanding approach. In the understanding approach, the researcher recreates, or reconstructs, the mental atmosphere, thoughts, sensations, and motivations of the actors under study.

Pragmatism asks how knowledge helps to deal with situations. The criterion for knowledge is the utilisation of presented information in successful actions. In the area of conceptual modelling of information systems, pragmatic emphasis has increased in recent times (Ågerfalk and Eriksson, 2004). According to the pragmatic view, people act and communicate within the world as social actors. One opportunity is the pragmatic aspect of language and computer use, based on action-oriented conceptual modelling. This means that the system becomes a vehicle used for performing communicative business actions in the dynamic business context, which the system also affects.

Constructive approaches are developed and applied in the case studies in this study. Constructive approaches owe a debt to the action research tradition, as well as to pragmatic theoretical suppositions (Kasanen et al., 1993; Lukka, 2003; Oyegoke, 2011). New information solutions are not created or adopted in a linear manner within or by an organisation, as new practices are created and developed primarily through trial and error (Ciborra, 1999). Neither can a collision with old practices and their limitations be avoided when initiating new information forms. Using the constructive model, development processes can be started and the organisation can create and try new organisational and technological solutions.

A new point in this study is to join *the constructive approach and the critical realist approach to each other*. The point is that the critical realist theory offers the theoretical base for the constructive research and development approach, which is a new approach to delineate the research and development aspects of information systems (e.g. Mingers, 2004a; Klein 2004; cf. Wicks and Freeman, 1998; Weick, 2003). The constructive research can be labelled "practical theory": it starts with practice and treats it as a fundamental category. Constructions made in practice lead to theoretical conclusions (Lukka, 2000, 2003). Because of this, the realist approach offers a means of conceptualising the foundation of the concept of knowledge pertaining to the constructive approach ("a constructive realism") (Margolis, 2004, 229–230, 234–240; cf. Mizak, 2004, 159–168).

The use-oriented planning and implementation model is developed and analysed in this study. The model describes a new knowledge and learning concept. The model is developed and analysed in this study. This concept represents constructive approaches and the starting points of critical realism. According to that, the implementation and use of information systems involves people in action. This means that the implementation process of information systems is organisational process that has some central properties. The features that characterise the implementation process are: creative goal-formation, multiple and many-level goals and even contradictory goals are often the case (Nissen, 1985; Regner, 2001). This approach is close to the model-driven approach, which is based on solving an unstructured and complex problem situation, in which a number of different parties participate, with their different perspectives (Morton et al., 2003).

12.2.2 Innovation design dilemma and its solutions

The second research question is based on the theoretical views developed and assessed in this study, and partly on the case analysis results. The second research question in this study is:

What are the innovation design dilemma and its meaning in the context of the planning and implementation process of information systems? What are its theoretical and practical dimensions?

The innovation design dilemma is defined and analysed in this study. It makes a great difference between the technical and organisational sides of information systems and their planning and implementation process (e.g. Holbek, 1988; Gjerding, 1992; Hyötyläinen, 1998). The implementation of an information system in an organisation is a complicated process, which involves issues involving technical and organisational changes (e.g. Hong and Kim, 2002; Doherty et al., 2003; Cragg et al., 2011). The problem has been that, in implementing information systems, the definitions of the technical system and its requirements have been given more emphasis than the development of the organisation and interaction patterns.

The models of process innovation and process improvement are delineated and analysed. These models differ from each other in their planning and implementation approaches. They are different according to the viewpoint to the nature of change, the design concept/planning approach, and the change concept. The major phases describing the innovation design dilemma are: defining the innovation problem and goal setting, the planning activity, the implementation activity, and the use and development activity.

Solution models for the innovation design dilemma are defined and analysed in this study. The basis is the planning choice of technical choice. *The organisational construction model of the implementation process is* defined and analysed. According to the model of the planning and implementation process, the viewpoint of the nature of change defines mainly the design concept. The design concept determines correspondingly the planning approach and organisation. The change concept is closely connected to the planning approach, as well as to the viewpoint to change. All of this influences the results of the change. The results concern the success of the implementation process, use activity, and development measures. Organisational learning and organisational problem-solving activities have a central role in the development model for the achievement of the goals of the planning and implementation process. The most important factor for all the following phases is the viewpoint to the nature of change. This has to be seen as a great organisational development process, which helps in directing the later phases of the planning and change successfully.

This organisational construction model is a major theoretical contribution of this study. Organisational learning approaches are defined and analysed. This learning approach completes and brings further points to the organisational construction.

12.2.3 Constructive research and development

The third research question is based on the theoretical views developed and assessed in this study, and also on the case analysis results. The third research question in this study is:

How are information systems and action patterns developed constructively and simultaneously with concerted efforts? What are the practical and theoretical implications of these efforts?

When discussing the constructive research and development model*, the phase model of the planning and implementation process* is presented and analysed in this study. The model comprises the following stages: strategic planning, requirements definition, implementation, and continual development.

The development cycle method is developed and analysed, which is, by its nature. a constructive approach. The three corner-stones of the method are case study, teamwork, and modelling. The five main stages in the method are discerned. They are: 1) the start of collaboration, 2) analysis, 3) the choice and definition of objectives, 4) innovation steps: planning and testing, that is, solutions and their implementation, and 5) the adoption of solutions and practices that have proven workable. Each stage of the development process has been assigned certain tasks and actors, that is, an organisation and development results. The development process also addresses the need for quick problem solving, which is specified in the discussion of the stages. Naturally, the progress is not linear from one stage to the next; instead, sometimes it is necessary to return to review the start position or to plan new solutions and methods, when those already developed prove unworkable.

Four case analyses are made. Each of the cases is extensively reviewed and analysed. The first of these is Case A. In the Case A development project, it is a question, on one hand, of strategic development in a multi-plant environment, the drafting of a strategic guidance model, and, on the other hand, on the development of production management and operating practices at one plant, including an information system needs assessment. The second case the Case B development project. The focus is on strategic subcontracting issues, and operations and production development. The materials are analysed and evaluated with regard to success and difficulties in each development area, and from both the company's and the researchers' perspective. An overall evaluation of the case study is also presented. The third one, Case C, complements, for its part, the points of Case B. In this case, it is question, on one hand, of the formulation of strategy in the company, and, on the other hand, of the construction and refining of the production management model. The fourth development project given focus is Case D, where the further development of an introduced operations management system and the creation of a development organisation and development stages constitute the main content. The creation and use of methods are also important here, and their use is evaluated, as is the development project as a whole, with its outcomes.

An analysis of the case results is made and issues of change management are assessed. The basis is the life-cycle framework. *Four path models* are analysed. They are: strategy and managementl, requirements, implementation, and development. *The mutual interdepencies of the models* are analysed. The following points are discerned: an objectives and action tree, change management, organisational change, and investment models. In summary, *five factors* are emphasised. They are: the challenges of growing firms, the importance of implementation models, management practices, and competence development.

12.3 Evaluation of the study results

Studies of information systems and their implementation as well as the organisational side of implementation, have been the subject of extensive interest (see, e.g., Boedker and Gronbaek, 1996; Avison and Fitzgerald, 1999; Al-Mashari and al-Midimigh, 2003; Bai and Lee, 2003; Bozarth, 2006; Capaldo and Rippa, 2009; Bhatt et al., 2010; Doherty et al., 2010; Choi et al., 2011).

However, few research efforts and studies have examined researching information systems and especially theoretical grounds for researching systems (cf. Boland, 1985 Hirschheim, 1985; Checkland and Scholes, 1990; Hirschheim et al., 1995; Iivari and Lyytinen, 1998; Checkland, 1999; Al-Mashari, 2003; Hanseth et al., 2004; Klein, 2004; Hyötyläinen, 2005, 2007). This study constructed a new theoretical approach to a constructive research and development model (cf. Kasanen et al., 1993; Lukka, 2000, 2003). In this study, the constructive approach and the critical realist approach are joined to each other (cf. Carlsson, 2010). The point is that the critical realist theory offers the theoretical base for a constructive research and development approach, which is a new approach to delinate the research and development aspects of information systems.

A use-oriented planning and implementation model (cf. Vicente, 1999; Norros, 2003; Dittrich and Lindeberg, 2004) is developed and analysed, which is anchored in the constructive approach by the critical realist approach, as a knowledge concept (cf. Mingers, 2004a,b; Klein, 2004). According to the use-oriented model, the implementation and use of information systems involves people in action. This means that the implementation process of information systems is organisational process that has some central properties. The features that characterise the implementation process are: creative goal-formation, multiple and many-level goals, and even contradictory goals are often the case (Nissen, 1985; Regner, 2001). This approach is close to a model-driven approach, which is based on solving an unstructured and complex problem situation in which a number of different parties participate, with their different perspectives (Morton et al., 2003).

Defining the innovation design dilemma in this study is a new approach. The innovation design dilemma separates two different theoretical stances from each others. On one hand, it is a question of user-centric planning and implementation model, with its technical problem-solving and learning process, based mainly on positivism and interprevism. On the other hand, there is the use-oriented planning

and implementation model with its social and organisational learning and innovation processes, based on the constructive approach, with critical realism as a knowledge concept.

The constructive method is developed in this study, and is called the development cycle method for the planning and implementation process of information systems (cf. Lukka, 2003; Aken, 2004, 2005; Peffers et al., 2008). The object of the constructive research and development activity is the formation of new theoretical concepts and models, and new practical solutions in connection with the implementation of information systems (Oyegoke, 2011). This forms the basis for the development project, where the researchers co-operate with the organisation's personnel. The development projects focus on the practice, analysis, and solutions of development problems. When solving practical problems, researchers use theoretical and research-based knowledge, as well as earlier practice-based know-how for advancing innovative new solutions in enterprises.

For concrete research and development in practice, it is necessary to use concrete constructive steps. In this study, the stages of the constructive steps are explicated for the implementation process of information systems. Five stages are discerned. These stages are analysed and evaluated in this study.

In this study, the main argument is that it is not only a question of changing the view of renovating planning and implementation of information systems to be more user-friendly. Instead, it is a question of a profound change in the research and development approach for researching and developing the implementation process of information systems. Another argument is that the treatment of the implementation process of information systems in a user organisation is tackled in a new way. The main point of view is to look at the implementation as an organisational construction, comprising a learning and innovation process where different actors in the organisation are involved and influence the actions adopted.

Through the analysis and research of the implementation of information systems, this study has enhanced further research by formulating new theoretical knowledge concepts on researching information systems, as well as explicating the organisational side of the planning and implementation of information systems.

Finally, there is a reason to note, in this study, that the three aspects and factors could be connected to each other. *The first* is the analysis of theoretical research approaches and the creation of the constructive research and development model, for which the knowledge concept is based on the principles of critical realism. Furthermore, this constructive approach is applied in the concrete method for analysing and developing case studies. *Another part* is the conceptualising of the innovation design dilemma, basing it on theoretical knowledge concepts. Furthermore, the characteristics and dimensions of the innovation dilemma are defined. Solution models decide solutions for the innovation dilemma. *The third* consists of the practical case studies, their analysis and development. Each case study is analysed and assessed. Furthermore, all the cases are analysed as a whole, emphasising path models and their interdepencies.

When evaluating and assessing the study results, one can state that this study is based on a constructive approach and case study. There is discussion about

this role in research methodology (Hartley, 1994; Cassell and Symon., 1994; Hammersley et al., 2000; Borda, 2001; Lukka, 2003; Cassell et al., 2006; Shah and Corley, 2006; Denyer and Tranfield, 2006; Oeygoke, 2011). However, in this study, all the approaches were based on the profound theoretical analysis of the research and development of information systems and production management (March and Smith, 1995; Hevner et al., 2004; Peffers et al., 2008). Based on these design theoretical points, the constructive approaches and methods were defined. These methods were applied to analyse and develop solutions in the cases. The study is based on the analysis of the four cases. Through the profound theoretical approaches, the analysis of the case study results can be drawn, based on "theoretical and analytical generalisation" (Eisenhart, 1989; Pettigrew, 1990; Leonard-Barton, 1990; Yin, 1994a).

12.4 Future research needs

The study delineates the need for further research and present management challenges to manage the implementation process of information systems. The first issue is the need for a deeper and more extensive theoretical analysis of the application of information systems within different research approaches and models reviewed in this study (Gregor, 2006) In particular, there is a need for a thorough analysis of the constructive approach, as well as the critical realism approaches. The second need is the deeper study of the use-oriented planning and implementation model and its theoretical roots and solutions (Dittrich and Lindeberg, 2004). The third issue is the model of the innovation design dilemma and its dimensions in the different environments of IT systems. The fourth issue is the further analysis of constructive approaches and the application of their methods in the different case study environments (Peffers et al, 2008). Finally, further research is needed on the path models and their mutual interdependencies. By means of these models, one can manage and direct development efforts for the implementation of information systems, as well as proceeding to achieving the aimed goals. Further, these models aid the growth of a firm, as well as the development of competencies in the firm.

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Implementation of information systems as an organisational construction

In this study, the focus is on the implementation process of information systems, which is approached by means of a systems analysis with its strong organisational emphasis. The intent is to create theoretical and conceptual research models as well as practical solutions. The objective is to use various research approaches to show the possibilities of a constructive research and development approach in creating organisational constructions in the planning and implementation of information systems and their practical development solutions, as well as in the formation of new theoretical and conceptual knowledge. In this study, consideration is given to a constructive approach that is close to the pragmatic research and development tradition. The main aim of the study is to determine the new kind of planning and implementation system and its major relations with its organisational constructions, emphasising practical applicability.