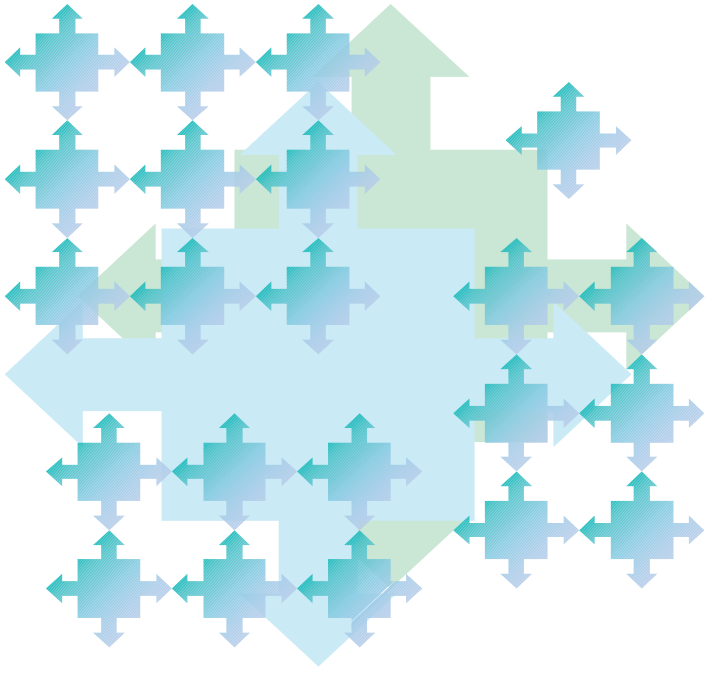
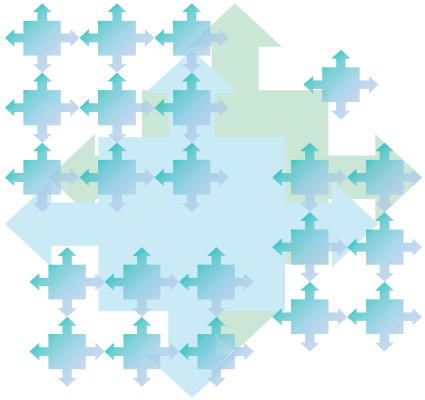
DOMINIQUE J.E. DELPORTE-VERMEIREN

Improving the flexibility and profitability of ICT-enabled business network:

an assessment method and tool





Improving the flexibility and profitability of ICT-enabled business networks: an assessment method and tool.

'Het verbeteren van de flexibiliteit en de winstgevendheid van ICT ondersteunde bedrijfsnetwerken: een inschattingsmethode en werkinstrument'

THESIS

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In 1998, I started to work on the research project described in this dissertation. Together with my academic and business colleagues, I began to investigate how and if the incorporation of digital technologies in a business network is a key strategy for efficiently improving the performance of a business network in the face of changing customer demand. The result of this research is contained in this dissertation, entitled 'Improving the flexibility and profitability of ICT-enabled business networks: an assessment method and tool.'

During the process of working on this dissertation, there have been many people from many companies and universities, as well as many authors in the professional literature who have inspired me and supplied me with ideas. It is not possible to thank all those who have helped me; however, there are some people to whom I want to express my thanks.

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Rijswijk, March 2003 Dominique Delporte-Vermeiren

CONTENTS

1 INTRODUCTION

1.1 Introduction to the research problem and managerial and scientific relevance

This dissertation is the result of a research project that started at PTT Post in 1998. As Marketing Manager for key accounts at the PTT Post BU letters, I had practical experience with building value-added partnerships (VAPs) with the PTT Post's key business customers. VAPs are defined by Johnston & Lawrence (1988) as 'a set of independent companies that work closely together to manage the flow of goods and services along the entire value-added chain.' Within PTT Post, the observation was made that both key business customers *and* PTT Post could benefit from forward and backward integration in the supply network when serving the business-to-business and business-to-consumer market; moreover, that the use of information and communication technology (ICT) is a key enabler in doing this. At that time, only a few business managers from PTT Post and a few key business customers were convinced of the benefits coming from adopting ICT in the supply network. We started a partnership with Erasmus University Rotterdam to help 'get the message through' the internal organization as well as to key business customers. To this end, a client solutions marketing program was set up to work closely with key business customers in specific areas to demonstrate the potential benefits of using ICT in the supply network. Some examples of this include the following:

- ABN/AMRO: important cost savings were realized in the transport and logistical processing of physical documents by enabling an earlier exchange of more detailed order data between ABN/AMRO, the regional transport company and PTT Post (PTT Post, Multi Media Skills, 1998a).
- Aegon: significant savings in costs and throughput time were realized by changing from physical to electronic documents early in the distribution network (PTT Post, Multi Media Skills, 1998b).
- Eastman Kodak: an international business network solution was developed for the processing and delivery of business documents on a pan-European scale by integrating inter-organizational service and production processes with the use of ICT. As Eastman Kodak was beginning the implementation of SAP (Systems, Applications and Products in Data Processing) software, they realized it could be much more efficient if their information integration could be extended to their critical business partners. By extending their organizational system, they were able to get the same responsiveness from their 'virtual factory' as they could from a wholly owned one (Delporte & Hearly, 1999).

In this context, the method of modeling and assessing the impact of ICT-enabled supply networks was recognized. This method – called modular network design (MND) (Hoogeweegen, 1997) – had been empirically validated at KLM, one of PTT Post's key

customers. The advantage of this method lies in its ability to modularize products and services into specific service elements, which can be mapped onto modularly designed processes. It also allows the benefits of ICT-enabled modularity to be assessed when alternative products and services and customer-fulfillment processes are redesigned.

1.1.1 Managerial relevance

The MND method was initially designed to assess reductions in cost and throughput time that can be attributed to ICT (i.e., electronic data interchange [EDI]) adoption. However, this puts too much emphasis on cost reduction and does not take the effect of ICT adoption on revenue into account. In assessing the effect of investments in information technology (IT) on the business performance of an organization, Parker & Benson (1988, p.3) argue that it should be evaluated on both reducing costs and producing revenue. Therefore, when an ICT initiative is being considered as a means to improve business performance, i.e., margin, both sides of the coin should be considered. The margin of an organization is the value created by the activities of the organization minus the costs of executing them (Porter, 1985).

Based on our business experience, it is important to make an accurate assessment of the effect of ICT adoption on margin – prior to the redesign of an inter-organizational (i.e., business) network. Margin is one of the most common measures of organizational performance and can be related to ICT initiatives in terms of cost and revenue. Ellram & Cooper (1993) support this emphasis on margin when stating: 'Most companies simply don't know how much the fulfillment processes of their products and services cost to operate, let alone how much margin they contribute to ultimately drive shareholder value. Companies need to know the true cost of doing business in the traditional paper-intensive manner compared with the potential costs/savings of being seamlessly electronic.'

The problem is that the concept of the 'margin of a business network,' as such, is neither well-known nor accepted within PTT Post or among its key business customers. This means that assessing the redistribution of margin that can be attributed to the adoption of ICT among the organizations in a business network is not an easy task. To solve this problem, we want to find out 'how' and 'to what extent' one could accurately make an ex ante assessment of the margin effect of adopting ICT in a business network. We are particularly interested in three aspects of the business network: (1) revenue production, (2) margin and (3) the distribution of margin among the organizations in the business network. This is based on an 'offensive' (i.e., creating and seizing business opportunities) and 'ex ante' mode (i.e., preparing for some future transformation in advance) (Evans, 1991, p.75). When analyzing opportunities and changes in a business model, it is easy to look back and observe the results of shifts that have occurred ex post (i.e., after the fact). But the real

challenge is to proactively generate business networks and assess results prior to the redesign.

1.1.2 Scientific relevance

Although the justification for carrying out this research originated from the need for solving a business problem, it also stems from the desire to contribute to business science, and more specifically, to ICT-enabled business network reengineering (BNR). In the BNR literature of the mid-90s, only a few examples can be found of methods and frameworks that support the assessment of ICT adoption in business networks. The starting point of scientific research on this subject is Venkatraman's 1994 study where he provides a framework on how the adoption of ICT changes an organization's roles and relationships with other organizations in the business network – in particular, what the strategic implications for all organizations will be. In his study, Venkatraman explicitly focuses on the inter-organizational process level. His framework takes the capabilities of ICT as a starting point and he claims that the range of potential benefits from ICT adoption is positively associated with the degree of business transformation. The scope of his work goes beyond an organizational perspective of process innovation, to include an assessment of the complete structure of the business network. However, in this study, Venkatraman does not provide a method and tool for making a detailed assessment of the potential benefits of adopting ICT in a business network. As mentioned above, assessing margin at the inter-organizational level brings an additional perspective to business science. A method and tool to assess margin in an ICT-enabled business network design will add this dimension to the theory and practice of ICT-enabled BNR.

1.2 Research design

Yin (1994, p.19) defines a research design as follows: 'It is an action plan for getting from the initial set of questions to be answered to some set of conclusions about these questions. It is a plan that guides the investigator in the process of collecting, analyzing, and interpreting observations.' The research design includes a discussion of the unit of analysis, the research objectives and questions, and the research approach.

1.3 Unit of analysis

The unit of analysis in this dissertation is that of the inter-organizational network or business network, in which at least three organizations are directly interrelated in the production process (this is also called an 'ABC relationship'). This means that the ICT applications studied – such as EDI, the Internet, Extranets or other forms of inter–organizational information systems – cross organizational borders. In the analysis of the inter-organizational network, we also include customers. The perspective of analysis is that of the *focal actor,* which is the organization in the business network that analyzes the service requirements of customer orders and allocates to other actors in the network the

business activities necessary to fill that particular order (see also the definition in chapter 2).

1.4 Research objectives

The first objective is to develop a formal method for the ex ante assessment of the effect of ICT adoption on margin in a business network. The MND method of Hoogeweegen (1997) is taken as the starting point. The initial objective for designing MND was to assess the impact of EDI at the level of the supply chain. It combines quantitative assessment, such as activity-based costing, with a specific view on how networks of organizations should reengineer their business processes. Sanchez & Mahoney (1996) have defined modularity as 'a special form of design which intentionally creates a high degree of independence or a loose-coupling between component designs by standardizing component interface specifications.' Wolters (2002, p.91) incorporates this concept into the MND method at three different levels: modularity of products and services, modularity of processes and modularity of supply chains.

MND will be explained in detail below and evaluated as to what extent and under what conditions the method can be enhanced and used for the ex ante assessment of revenues and margin due to ICT adoption and their distribution among the organizations in a business network.

The second research objective is to analyze the ability of the enhanced method to support decision making in regard to the adoption of ICT in a business network, where *decision making* is defined as the process of converting information into action (Simon, 1976). Mintzberg et al. (1976) define a decision-making process as 'a set of actions and dynamic factors that begins with the identification of a stimulus for action and ends with the specific commitment to action. Decision-making is controlled by various explicit and implicit policies through which available information is interpreted.' According to Simon (1976), 'most human decision-making whether individual or organizational, is concerned with the discovery and selection of optimal alternatives.'

MND focuses on supporting organizational decision making and solving organizational problems (Wolters, 2002, p.13). It has been implemented in a decision-support system (DSS) and subsequently applied in the air cargo sector (Hoogeweegen, 1997). MND's DSS supports the process of searching for the best alternative. Here, we first analyze the ability of the MND DSS to do this, in view of the new requirements. Then, we decide whether or not it can be used to validate the propositions underlying the enhanced method. If so, we will use it in the case study research. If not, we will have to develop an alternative DSS that can be applied in the case study research.

1.5 Research questions

Related to these two objectives, two central research questions have been formulated. The first research question (RQ_1) is formulated as follows:

RQ_1: *Can we develop a method for ex ante assessment of margin to be applied in ICT-enabled redesign of business networks – in particular, a method that can assess the relative changes in margin for the business actors involved?*

The second research question (RQ_2) is formulated as follows:

RQ_2: *What impact does the use of such a method have on the decisions of the actors involved to adopt a specific ICT-enabled redesign of the business network?*

1.6 Research approach

In order to answer the research questions, the following steps have been undertaken:

- *Step 1: Review of relevant literature*. A review of the relevant literature was conducted by analyzing previous research on the behavior, preconditions, risks, transactions, costs and revenues of an ICT-enabled business network, on formal methods and tools for ICT-enabled business redesign and on redesign decision-making and decision-support systems. An important place is given to the evaluation of Hoogeweegen's (1997) MND method, its validation by Wolters (2002) and the elaboration of the concept of margin in a business network.
- *Step 2: Development of the research model.* To investigate the relationship between ICT adoption and the margin of a business network, a *prescriptive* research model (i.e., one that indicates the desirability of defined causal relationships) was developed based on Bacharach's (1989) guidelines on theory development. According to Bacharach, a theory may be viewed as 'a system, i.e. model, of constructs and variables in which the constructs are related to each other by propositions and the variables are related to each other by hypotheses.' The research model contains the constructs and variables that are associated in the literature with the assessment of the margin of ICT-enabled business networks and the related propositions, which are formulated in the form of testable predictions.
- *Step 3: Development of the research protocol and the decision-support system.* To support the validation of the research model, a 14-step research protocol was developed. To support the use of this research protocol in practical situations, a decision-support system (i.e., an automated software program) called Business Network Navigator was developed.
- *Step 4: Empirical validation by way of case studies*. Two case studies were set up in the service industry. The guidelines for case study research given by Yin (1994) were followed, and the decision-support system developed here was used in the process of collecting and processing case data. The criterion for interpreting the findings of the case study is based on Campbell's (1975) idea of 'pattern-matching.' In this process, we looked for analytical validation and generalization (Yin, 1994), where the

previously developed theory (i.e., the research protocol and the research model) is used as a template to which the empirical results of the case studies are compared.

- *Step 5: Conclusions and recommendations.* Based on the previous four steps, conclusions about the research have been drawn and theoretical and practical implications discussed. Finally, recommendations for future research are formulated.

This research approach followed an inductive/deductive research cycle in which literature review and case studies are used to devise a research method. Van Aken (1994) calls this the '*reflective research cycle.*' *Induction* refers to the generalization of observed relationships in case studies into theoretical relationships between research variables. *Deduction* refers to the derivation of specific consequences in the form of testable predictions. Figure 1.1 illustrates the research design, enhancing the reflective cycle and the research methods.

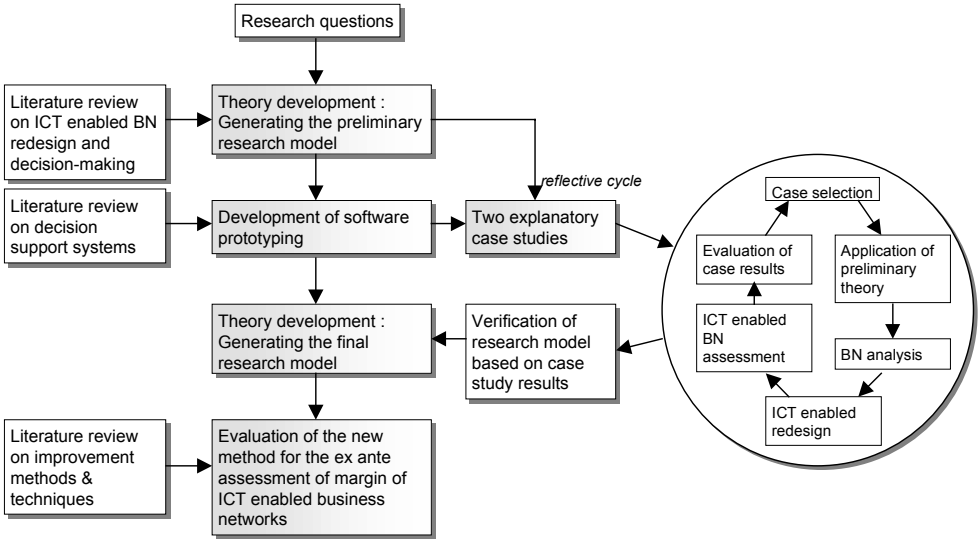


Figure 1.1: The research design

1.7 Structure of the dissertation

This dissertation is structured along the five steps of the research approach. Chapter 2 reports the findings of the literature review. Chapter 3 gives the development of the research model and its related propositions. Chapter 4 reports the development of the 14-step research protocol and the decision-support system. Chapter 5 and 6 present the two case studies. Chapter 7 reports the overall case findings and the validation of the research framework. Chapter 8 presents the conclusions and recommendations.

2 DEFINING AND ASSESSING ICT-ENABLED BUSINESS NETWORKS

2.1 Introduction

The main theme of this dissertation deals with the development of a formal method to assess the reengineering of a business network. Reengineering is a topic that has been widely addressed in the literature. It helps define strategies for bringing manufacturers, suppliers, and customers closer together (Liker et al., 1995). *Reengineering* means taking steps to redesign and simplify business systems and processes, to search out best practices (Prasad, 1999), to develop a more competitive and core-competent workforce (Prahalad & Hamel, 1994), to explore new business methods (Kearney, 1997), or to radically transform business (Venkatraman 1994). It fosters thinking outside the comfort zone (Luther, 1997), relies on value-added benefits to both the customer and the business (Vervest & Dunn, 2000), relies on strategic technology insertions (Shillito, 1994) during the product life cycle, and focuses heavily on the seven T's (talents, tasks, teams, techniques, technology, time, tools) (Prasad, 1999).

The ultimate success of reengineering depends on the people who do it and how well they can be motivated to be creative and to apply their detailed knowledge to the redesign of business processes (Davenport 1993). It is a business initiative that has broad consequences in terms of satisfying the needs of customers and the firm's other constituents. The actual design should not be viewed as the end of the business reengineering process. Rather, it should be viewed as a prototype, with successive iterations (Davenport & Short, 1990). The biggest obstacles that reengineering faces are (1) lack of sustained management commitment and leadership, (2) unrealistic scope and expectations, (3) resistance to change (Stoddard & Jarvenpaa, 1995).

However, is there a structured method for assessing the reengineering of a business network – in particular, prior to performing the actual change in the business network? Such a method would be increasingly more important as so many industries face the demands for customization. This customization challenges them to tailor products and services to the specific requirements of every individual customer, while at the same time maintaining their current levels of economies of scale (Pine, 1993). It forces organizations to be more flexible (defined in terms of their ability to produce different and customized products) towards the market without losing profitability, i.e., margin.

One questions the suitability of the current organizational design, which originated from the traditional supply chain (Porter, 1985), to respond quickly to a changing environment. The common view on organizational design (Porter, 1985) is that of a streamlined pipe that processes raw material into finished goods and delivers them to customers. But this is

rather simplistic; the reality is much more complex (Vervest, 1994): a network of vendors supplies an organization, which in turn, supports a network of customers, with third-party service providers (e.g., transportation companies) helping to link the entire network of actors together. Organizations are increasingly more aware of the benefits of a different approach to organizational design: *ICT-enabled business networks*. Examples of these new adaptive organizational designs include Sun Microsystems' virtual corporation (Davidow & Malone, 1992), Dell Computers' dynamic network (Miles & Snow, 1986), Olivetti's platform organization (Ciborra, 1996) and Ikea's value constellation network (Normann & Ramirez 1994). Organizations struggle with how they should accomplish this, and to what extent it will influence their current level of flexibility and profitability. They need methods and managerial techniques. Modular Network Design (Hoogeweegen, 1997) is one of the methods that supports the design and assessment of costs and throughput time of ICT-enabled business networks.

This dissertation puts the emphasis on the questions: Is it possible to develop a method for assessing the reengineering of an ICT-enabled business network with respect to margin? And what impact will such a method have in real-life situations? In order to answer these questions, we must first find an answer to the following questions:

- What is a business network (BN)? (see section 2.2.)
- What is the margin of a business network? (see section 2.3)
- What is ICT-enabled BN redesign? (see section 2.4)
- What is the impact of ICT-enabled BN redesign on the margin of a business network? (see section 2.5)
- What methods are available for assessing ex ante the impact of ICT-enabled BN redesign on the margin of a business network and how effective are they? (see section 2.6)

2.2 ICT-enabled business networks

2.2.1 Definition

A key concept in this dissertation is the 'business network' (BN). Some important definitions related to this concept are given in table 2.1.

Table 2.1: Definitions of business network

Author(s)	Definition of business network
Thorelli (1986)	Networks are two or more organizations involved in long-term relationships.
Oliver (1990)	Business networks are the products of the existence of inter- organizational relationships.
Miles & Snow (1992)	In a dynamic network, numerous firms (or units of firms) are operating at each of the points on the value chain, ready to be pulled together for a given run (i.e., a particular customer order) and then disassembled to become part of another temporary alignment.
Kambil & Short (1994)	A business network is the structure of interdependent relationships between the activities of a given firm and those of other firms in its competitive environment that influences each other's strategies.
Anderson et al. (1994)	A business network is a set of two or more connected business relationships, in which each exchange relation is between firms that are conceptualized as collective actors. Connected means the extent to which 'exchange in one relation is contingent upon exchange (or non-exchange) in the other relation.'
Hoogeweegen (1997)	A business network involves a large number of actors contributing to providing service offerings triggered by actual demand based on their core capabilities.
Van Aken et al. (1998)	A network is a set of organizations, which are connected by semi-stable relations.
Christopher (1998)	The network of connected and interdependent organizations mutually and cooperatively working together to control, manage, and improve the flow of materials and information from suppliers to end-users.

Often-mentioned features of a business network are a strong interorganizational design and an interactive and dynamic set of relationships acting in concert with one another for a common goal, bringing together core capabilities of different organizations to accomplish business improvements. One of the benefits of a business network is the increased flexibility of linking actors together. This provides a more agile (Preiss et al., 1994) arrangement for the network to produce from actual customer requirements as a starting point, and not on the basis of assumed or forecasted customer needs.

The critical difference between this and Porter's (1985) traditional view of value chains - which is the division of the company into a series of value-adding activities connecting a companies' supply side with its demand side - is that here, business networks start with the end customer requirements and work backwards in the value chain. This breaks with traditional approaches that focus solely on reducing costs such as transportation or production costs. It supports a customization viewpoint in which products and services are offered in ways that support individual customer requirements and create added value for the customer of the value chain. Pine (1993) and McCutcheon et al. (1994) call this 'customization' being the creation of product or service for the market of one. The new way of thinking about organizational design includes the assumption that organizations in the business network can *and* want to accelerate the process to serve the customer. One of the consequences is that organizations in the business network should base their production on actual customer demand instead of on stock (Hoogeweegen, 1997, p. 223).

An interesting and relevant contribution in the field of business network research classifies business networks into three types:

- The *stable network*. In a stable network, one core organization maintains tight relationships with a limited set of outside suppliers and distributors that also serve organizations outside the network. These business partners are carefully selected by the core firm and closely tied by contractual arrangements (Miles & Snow, 1992, p. 57).
- The *internal network*. An internal network consists of organizational units within one organization, buying and selling goods and services among themselves at prices established in the open market. To verify the price and quality of the products, which are part of internal transactions, the organizational units have a regular opportunity to buy and sell outside the network (Miles & Snow, 1992, p. 65).
- The *dynamic network*. A dynamic network consists of 'numerous firms (or units of firms) operating at each of the points on the value chain, ready to be pulled together for a given run and then disassembled to become part of another temporary alignment (Miles & Snow, 1992, pp. 66–67).

The first and third type of business network, i.e., the stable and dynamic networks, are of interest in our research. In this dissertation, the three-stage business network that contributes sequentially to the goods and/or completion of service – also called the 'ABC relationship' – is the subject of the research.

According to Thorelli (1986, p. 37) a network can be viewed as consisting of (1) actors' positions occupied by firms, households, strategic business units inside a diversified concern, trade associations, or other types of organizations and (2) links manifested by interactions between positions.

1. *Actors' positions.* A business network design encompasses a conceptual model that positions the actors in the process of filling orders. Business network design concerns decisions about the actors to be chosen and the roles (i.e., functions) they are to perform. An actor's position is a location of power to create and/or influence the network (Thorelli, 1986, p.37). Anderson et al. (1994, p. 3) defined a number of concepts to describe the actor's position in a business network. First, the *network horizon* 'denotes how extended an actor's view of the network is.' Second, the *network context* is 'the part of the network within the horizon that the actor considers relevant.' A third concept is *network identity*. Anderson et al. describe this as follows: 'Network identity is meant to capture the perceived attractiveness (or repulsiveness) of a firm as an exchange partner due to its unique set of connected relations with other firms, links to their activities, and ties with their resources.' According to Thorelli (1986, p. 38) positioning the actor in the business network becomes a matter of strategic significance as great as positioning the business in the

marketplace. The position that an actor occupies in a given business network depends on:

- the role of the actor in the order fulfillment process;
- the position of the actor in other networks;
- the power of the actor relative to other stakeholders in the business network.

Power – the ability to influence the decisions or actions of others – is central in business network analysis. The mere position of power is often sufficient to influence others. According to Thorelli (1986, p. 40) there are at least five interrelated but distinct sources of power for an actor in a BN:

- *Economic power base,* e.g., power based on market share or the actors' unique selling points or financial resources;
- *Technology superiority* demonstrated, for example, in product or process innovation and the ability to produce to order;
- *Expertise,* e.g., ICT capabilities in R&D, application engineering, pre- and post-sales service;
- *Trust* may be viewed as confidence in the continuation of a mutually satisfying relationship and in the awareness of other parties of what this requires of their performance as network members;
- *Formal legitimacy,* which may derive from long-term contracts, part ownership of another network member, joint ventures, patent rights.

2. *Links*. Links or interpositional relationships reflect the interdependence between actors over time. It shows the existing relationships of the actors and between actors in the network. Hoekstra & Romme (1992) defined six basic types of designs that can be used to describe the relationships between actors or, at a lower level, processes in the network: pipeline (one actor), chain (one supplier–one actor–one customer), shared resource (several suppliers–one actor–several customers), converging (several suppliers–one customer), diverging (one supplier–several customers), and network (several suppliers–several customers). One of the advantages of using ICT in a business network is the speed at which the actors can make new links to form new relationships. The ICT's capability to store, process, and exchange information quickly and inexpensively (Huber, 1990) make it an interesting enabler for rapidly implementing new links connecting business partners with each other and with customers as well (Benjamin & Wigand, 1995).

The technological possibilities of communication make it much easier to form new adaptive interorganizational forms. In their book *Creative Destruction*, Nolan & Croson (1995) support this view when describing the evolution towards new IT-enabled networks: 'Transformation to this new structure is the evolution from characteristics of the M-form functional hierarchy (the predominant organization

form in the Industrial Economy) to characteristics of the IT enabled network. Rather than having harder boundaries delineating the organization, the boundaries are more permeable accommodating strategic alliances with suppliers, customers and competitors. Inflexible functions and departments are replaced with flexible infrastructures and self-designed work teams, which conduct the day-to-day activities in serving customers, and draw upon shared infrastructures for resources and coordination such as human resources, project management and the shared knowledge and database infrastructure.'

In figure 2.1, a business network is viewed from the perspective of actors, customers, positions, and links as the constituting elements. The starting point for the formation of the business network is actual customer demand, denoted as the order placed by the 'begin-customer' (as opposed to the term of 'end-customer' in the supply-driven value chain). The actors (e.g., A1, B1, C1) working together to fill the same order form a temporary alignment. In addition, the business network model indicates the actors that are actually participating in the temporary alignment to produce to order. The actors in several temporary alignments working together to fill several orders for the same customers are considered as members of one particular network (Miles & Snow, 1992; Anderson, 1994; Kambil & Short, 1994). Furthermore, in the business network, the relationships (i.e., links between the activities of the several actors) are specified.

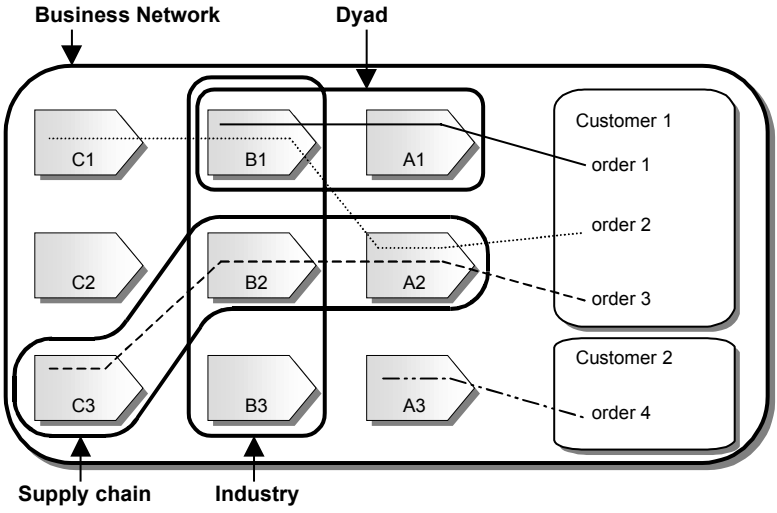


Figure 2.1: A business network, involving a large number of actors contributing to the filling of several customer orders (based on Thorelli, 1986; Anderson, 1994; Hoogeweegen, 1997)

In figure 2.1, several perspectives and levels of analysis can be considered. The first distinction is the level of analysis of the order-filling process, which can be considered from three perspectives: (1) the customer, (2) the actor, and (3) the network.

1. *From the customer's perspective*: the begin-customer's perspective describes how a particular customer perceives the filling of orders in the business network: e.g., the actors A1, B1 contribute to providing the service offering required in order 1 from customer 1. The same customer also places two other orders. The actors A2, B1, C2 contribute to providing the service offering required in order 2. The actors A2, B2, C3 contribute to providing the service offering required in order 3. The actor A3 provides the service offering required in order 4 from customer 2. The actors labeled as A1, A2, A3 are located nearest to the customers and are recognized as the focal actors. The actors labeled B1, B2, B3 and C1, C2, C3 are located upstream (on the left side of figure 2.1).
2. *From the actor's perspective*: The level of the actor or the single organization focuses primarily on how internal activities should be organized. Porter (1985, p. 38) calls this the value chain. For example, actor A1 participates in the process of filling order 1. Actor A2 participates in the process of filling orders 2 and 3. Actor A3 participates in the process of filling order 4. B1 participates in the process of filling orders 1 and 2. B2 participates in the process of filling order 3. C2 participates in the process of filling order 2. C3 participates in the process of filling order 3. The actors labeled with the same letter (A, B, or C) are actors that have the same field of activity and therefore can be considered to be competitors.
3. *From the perspective of connected relationships or the business network*: The highest level of analysis is that of the business network. In our example, the business network contains nine actors. Seven of the nine are activated and are involved in the process of filling orders 1 to 4. Actors B3 and C1 are part of the network but are not activated in the process of filling orders 1 to 4. Two actors (A1 and B2) are involved in different supply chains to fill order 2 and order 3, respectively. The actors (A1, A2, A3; B1, B2, B3; and C1, C2, C3) represent three different industries.

The perspective of connected relationships or business networks is important for our research. With respect to business networks, Anderson et al. (1994) describe two main perspectives. The first refers to the network as an organization-set and has been defined by Aldrich & Whetten (1981, p. 386) as 'those organizations with which a *focal organization* has direct links.' The second is formulated by Anderson et al. (1994, p. 2) as follows: 'A business network can be defined as a set of two or more connected business relationships, in which each exchange relation is between firms that are conceptualized as collective actors.' They continue with 'connected means the extent to which 'exchange in one relation is contingent upon exchange (or non-exchange) in the other relation (Cook & Emerson, 1978, p. 725; Anderson et al., 1994, p. 2). From the perspective of connected relationships, the interaction between the *focal relationship* (between seller and buyer) and

other relationships (of the seller and/or buyer with third parties) is investigated. In this dissertation, the perspective of analysis is that of the focal actor in the business network, which we define as follows:

Definition 2.1
The focal actor in the business network is the organization that analyzes the customer order on its service requirements and from there allocates the business activities necessary to fill that particular order to other actors in the business network.

The concepts (i.e., network horizon, network context, and network identity) developed by Anderson et al. (1994) can be used to analyze whether an organization is likely to be an appropriate focal actor. Relevant questions in this analysis include the following, for example: How extended is the actor's network horizon? How many actors (i.e., subcontractors) can be approached to fill a particular customer order? How do customers perceive the attractiveness of the actor's relationships, activities, and resources that is reflected in the network identity?

In figure 2.1, three more levels of analysis are distinguished (based upon Hoogeweegen, 1997, pp. 16–18):

1. *The dyad*. The dyad level focuses primarily on how two organizations that have a relationship, e.g., a seller and a buyer, should coordinate their activities to reduce external uncertainty, i.e., not knowing how actual demand patterns will evolve (after Davis, 1993). In our example, actors A1 and B1 form a dyad.
2. *The supply chain*. Normally more than two organizations participate in the order-filling process. The level of the supply chain includes, besides the dyads, the incorporation of the seller's supplier and/or buyer's customer, for example. Porter (1985) calls this the value system. In our example, actors A2, B2, and C3 form a supply chain.
3. *The industry.* The industry level enhances 'a group of firms that offer a product or a class of products that are close substitutes to each other' (Kotler, 1988, p. 235). Organizations operating within the same industry can be considered competitors. In our example, actors B1, B2, and B3 can be considered to be competitors in the same industry.

These three levels of analysis are not the main perspectives of analysis in this dissertation, but we will use the industry level to discuss the difference in focus of an organization and a business network with respect to the assessment of performance and profitability (see section 2.3). At this point in the discussion, the working definition of a business network that will be used in the remainder of this dissertation is introduced:

Definition 2.2
A business network is the structure of interorganizational relationships between the focal actor and interdependent external actors closely linked and working cooperatively together to fill customer orders

The advantage of this definition is that it enhances the elements of strategy, structure, and performance in the interaction. Thorelli (1986) supports this view when arguing that 'the structure-strategy (conduct)-performance paradigm could be extended to comprise the network.' Van Alstyne (1997) also supports our view when stating that 'networks are specifically characterized by elements of structure, process, and purpose/goals.'

2.2.2 The risks associated with ICT-enabled business networks

The use of ICT can increase the speed with which actors can make new links to form new relationships. However, the fact that actors in the dynamic business network have to do business with a number of different business partners leads to specific risks. Examples of such risks are:

- *Risks related to operations and opportunism:* These are risks related to transactions in the business network (Clemons et al., 1993). Operations risk is 'the risk that other parties in the transaction willfully misrepresent or withhold information, or under perform – that is 'shirk' – their agreed-upon responsibilities' (Clemons et al. 1993, p. 15). Opportunism risk includes 'the risks associated with a lack of bargaining power or the loss of bargaining power directly resulting from the execution of a relationship, that is, a difference between ex ante and ex post bargaining power (Clemons et al. 1993, p. 16).
- *Risks related to task uncertainty:* which is defined by Galbraith (1977) as 'the difference between the amount of information required to perform the task and the amount of information already possessed by the organization'. In the business network, activities (i.e., tasks) are (re)-allocated among the various actors, thus changing the role they play. From an actor's point of view, the decision about which tasks to perform in-house versus those that can be procured from outside can be considered after the comparison of the costs of internal production versus the costs of external production plus transaction costs (Williamson, 1981). In the case of the dynamic business network, it is less easy to apply this trade-off because it largely depends on the willingness and ability of the different actors to share accurate information on production and transaction costs. But it also depends on the sharing of accurate information on such things as the following, for example:
    - the predictability of customer demand and product variety, i.e., 'demand uncertainty';
    - the availability of sufficient raw materials or goods in the right amount and according to the right specifications (quality or price), i.e., 'supply uncertainty';

- the availability of adequate capacity to produce a particular product, i.e., 'process uncertainty.'

Venkatraman & Henderson (1998) support this dependency on information exchange between actors in the business network when stating: 'business networks rely heavily on real time and full access to information especially related to those activities that cross organizational boundaries. Information should no longer be viewed as the enabler of control or an asset to be controlled, . . . rather the goal is to turn information into knowledge.'

- *Risks related to partnership uncertainty*: One pitfall in business networks is unsuccessful partnering. *Partnering* is defined by Ellram (1991) as 'an ongoing relationship between organizations, which involves a commitment over an extended time period, and a mutual sharing of the risks and rewards of the relationship.' Table 2.2 provides an overview of the critical factors underlying successful partnerships in business networks, as mentioned in previous research (Thorelli, 1986; Zuurbier et al., 1996; van Alstyne, 1997; Tan et al., 1998). We have classified the critical success factors along three dimensions: (1) drivers for partnership, (2) main facilitators, and (3) characteristics of successful partnership.

Table 2.2: Critical success factors for business network partnerships

Drivers for partnership in business networks	Main facilitators in business network partnerships	Characteristics of successful partnerships in business networks
• Asset-cost efficiencies (cost reduction) • Customer service (e.g., shorter cycle times) • Marketing advantage (e.g., entrance into global markets) • Profit growth (e.g., creating new services)	• Strategic complementarity of actors • Actor compatibility (common culture and business goals) • Compatibility of managerial philosophy and techniques • Mutuality (joint objectives, share sensitive information) • Symmetry in power between actors	• Distribution of ownership, power, & loyalty among actors • Systematic exchange of information between actors (rapid & accurate transfers) • Trust, commitment, & communication • Extendedness (the continuation of the relationship in the future)

In the case studies (see chapters 5 and 6), assessing risk in the business network is limited to a qualitative analysis of the risks mentioned before, since risk components are difficult to quantify in monetary terms and therefore not easy to compare with production and transaction costs, for example.

2.2.3 The advantages and disadvantages of ICT-enabled business networks

Several authors (van Alstyne, Miles, van Aken, Powell, Nouwens) have specifically commented on the advantages and disadvantages of business network organizations. In table 2.3, an overview of some of the most frequently mentioned advantages and disadvantages of business networks is presented. Note that this list is not exhaustive.

Table 2.3: Overview of some advantages and disadvantages of business networks

Advantages	Disadvantages
Economies of scope through complementary assets Increased strategic flexibility Greater goal congruence Focusing on cooperation over the long term Risk sharing & reduction by mutual enterpreneurship Higher exchange of information & knowledge Achievement of higher quality & innovation Wider market reach Variable, faster, & less costly coupling	Weakening actors' own control of profits Lack of standardization and fixed agreements Increase in information overload Instability due to dependency on different actors Not a suitable structure for all organizations

Strategic and organizational flexibility at lower costs and risks can be an important advantage of a business network, when compared to other forms of organizing business activities, such as hierarchies or markets. Van Alstyne (1997) argues, 'Hierarchies tend to be vertical production runs of commodity products, that reduce risk by owning the assets they use (Malone, Yates & Benjamin, 1987; Williamson, 1975). Business networks in contrast, tend to be partnerships that exploit strategic opportunities by rapidly and flexibly adjusting their outputs to niche markets (seeking economies of scope through complementary, possibly intangible assets) and reduce risk through equity arrangements, repeated cooperation and trust. Members exercise joint control over assets rather than taking direction from an executive body. Hierarchical and network practices may be internally consistent but juxtaposed against one another; they typically compete.' Volberda (1997) argues, 'Organizations increase their strategic flexibility, creating stability in increasingly turbulent environments without vertical integration through linkages with partners and customers.' Other authors have argued as follows: 'Business networks are able to couple and uncouple with less cost and time than e.g. hierarchies' (Miles & Snow, 1992). 'In cases where a business partner no longer fits in to the strategy of the network, it is easier [thus less costly] to end the cooperation than it is to remove an organizational unit from an organization' (van Aken et al., 1998). Powell (1990) focuses on the benefit of cooperation oriented to the long term in increasingly complex markets, instead of continuous partner seeking and selection. Given its importance, the advantage of higher flexibility at lower costs and risks will be discussed further in section 2.2.4 and in chapter 3. Nouwens (1996) adds advantages such as (1) risk-sharing by mutual enterpreneurship, (2) exchange of information and knowledge at a higher level than in markets or hierarchies, (3) achievement of higher quality through cooperation of the best specialists in the different organizations, (4) achievement of important innovations by bundling R&D resources and expertise, and (5) wider market reach.

The main disadvantage of the business network is *the lack or the loss of (bargaining and control) power of the individual actor* to ensure the control of profits over the entire business network. The business network fosters cooperation and coordination between

stakeholders, overseeing the interests of the whole business network, in contrast to the interests of a particular actor. Nouwens (1996) argues that 'business network structures are not suited for all types of organizations.' He cites Johnston and Lawrence (1988, p. 98), stating, 'Organizations often try to weaken a supplier or a customer to ensure their own control of profits. This is understandable given the fact that the widely followed competitive model suggests that companies will lose bargaining power, and therefore the ability to control profits as suppliers, and customers gain strength. Naturally such companies tend to share as little information as possible and consequently managers often lack knowledge of the activities elsewhere along the value-added chain. Successful business networks rely on forming strategic partnerships with stakeholders who play a key role in coordinating and overseeing the whole business network.' Other disadvantages considered are (Nouwens, 1996) (1) the lack of standardization and fixed agreements, (2) the increase in information overload, (3) instability due to dependency on the commitment of the different actors. In the case studies (see chapters 5 and 6), the discussion about the individual actor's (lack of or loss of) power will be limited to the actor's influence on the decision regarding actual adoption of ICT in the business network.

2.2.4 How do business networks carry out transactions?

A transaction occurs when goods or services are transferred from one stage of activity to another. Organizations try to maximize the margins associated with transactions by setting the most appropriate coordination mechanism, three of which are highlighted here (see figure 2.2): (1) markets, (2) hierarchies, and (3) business networks. It is hypothesized that the level of risk and the level of trust (Ring & van de Ven, 1992) are determinants for the 'governance structure' (i.e., the explicit or implicit conceptual framework within which a transaction is located) (Williamson, 1981, p. 1544). Trust discourages opportunistic behavior, especially taking a long-term point of view, and therefore lowers the need for coordination within hierarchical structures; it favors coordination within business networks or even market coordination. The governance structures of markets and hierarchies are believed to work best in situations with low trust, whereas contracts are believed to work best in situations of high trust.

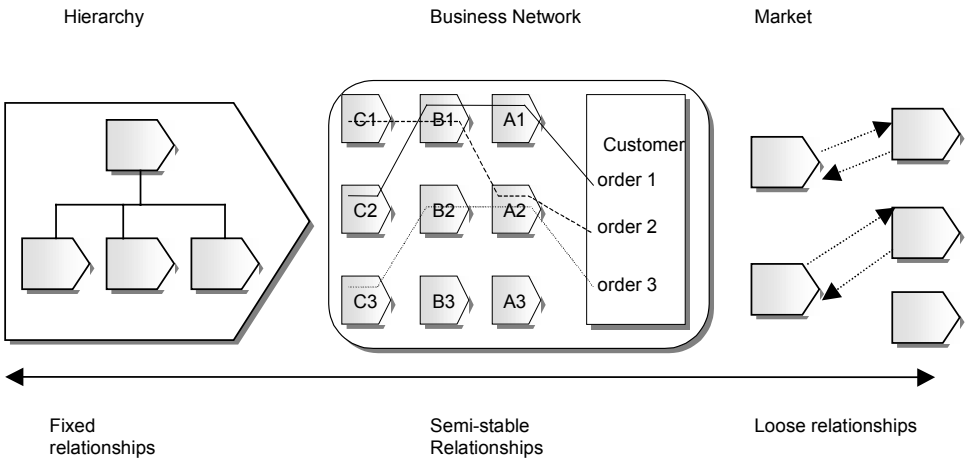


Figure 2.2: Hierarchies, markets and business networks, classified on the basis of the strength of relationships between organizational units

Williamson (1981), building on the work of Coase (1937), identified two basic mechanisms for the coordination of the value chain: markets and hierarchies. *Markets* coordinate the flow through the forces of supply and demand and the external transactions between different individuals and organizations. *Hierarchies*, on the other hand, coordinate the flow of materials by controlling and directing it at a higher level in the managerial hierarchy (Malone et al., 1987). Within organizations, the coordination of activities is based on a hierarchy: higher organizational levels control lower organizational units through instructions and feedback. Across organizations, the market is the coordination mechanism. In the marketplace, an organization agrees upon activities between external actors. Organizations can either perform business activities in-house, thus coordinating through their hierarchy, or they can out-source activities to suppliers, implying coordination by the market. Organizational boundaries occur where coordination through a hierarchy is interrupted by the market mechanism. Coordination by the hierarchy includes several types of organization management (Miles & Snow 1992; Mintzberg, 1983), such as:

- *Functional organization management*: An organization is divided into functionally specialized departments that together make complete products. It allows firms to achieve the necessary size and efficiency for mass production.
- *Divisional organization management*: Organizations are split up in divisions that specialize in specific products. These product-oriented divisions operate as nearly autonomous companies to their respective customers, while corporate management serves as an investment banker in strategic decisions.
- *Matrix organization management* combines elements of both functional and divisional organizational management.

Coordination by the market can be differentiated by the duration of the relationships between a buyer and a seller (Sheombar, 1995). The market mechanism might coordinate one-time transactions between buyers and sellers with short-term relationships. In this situation, a new agreement has to be established by the buyer and the seller each time a transaction is needed. Alternatively, the market mechanism can coordinate multiple transactions as part of a contract between a buyer and a seller that have a long-term relationship. In that case, the contract can be considered as a super-transaction established in the market.

The transaction costs economics (TCE) approach (Williamson, 1981) focuses on transaction costs as the determinant for explaining why the market (= outside procurement) or the hierarchy (= internal production) is used as the governance structure to process transactions. The relative advantages can be analyzed in terms of coordination costs (or transaction costs or governance costs) and production costs. Coordination costs include all information-processing costs necessary to coordinate the activities related to primary processes (Gurbaxani & Whang, 1991). Production costs include the costs of physical or other primary processes necessary to create and distribute the goods or services being produced. Market coordination is preferred when production costs are relatively low and coordination costs relatively high. Hierarchical coordination is preferred when production costs are relatively high and coordination costs are relatively low. TCE provides a good theoretical foundation for analyzing coordination by markets or hierarchies, as well as the circumstances causing changes in the competitive environment. However, several authors have criticized the theory because:

- TCE focuses too much on the individual organization instead of on the total value-added chain, which is based on mutual trust and a long-term focus (Creemers, 1993; Christiaanse, 1994; Heide & John, 1998).
- TCE does not pay enough attention to the role of information and communication technology (ICT) (Creemers, 1993). ICT allows more information to be communicated in the same amount of time or less, and the costs of communication have decreased, favoring both markets and hierarchies. Markets are more communication intensive than hierarchies (Toppen, 1999, p. 56) and are believed to benefit more from ICT than hierarchies because the unit costs of coordination are likely to decrease (Malone et al., 1987).
- TCE does not pay enough attention to resource-based perspectives. Organizations cannot carry out an activity merely because it is more efficient in terms of transaction costs; they need to have the necessary resources (Peteraf, 1993; Pfeffer & Salanick, 1978; van Alstyne, 1997).

An alternative to coordination by either market or hierarchy is coordination by b*usiness networks*. In a business network, several organizations (actors) are linked by semi-stable relationships (van Aken et al., 1998). Together, they make up a network, which can be

tight or loose depending on (1) the number (quantity), (2) intensity (quality), and (3) type (closeness to the core activity of the parties involved) of interactions between the members (Thorelli, 1986, p. 47). The relationships have a certain durability but are not fixed. In principle, the business network can be broken without destroying the organizations in the network. In a pure market, the relationships between organizations are extremely loose. A short-term relationship occurs for a one-time transaction and then disappears. In a pure hierarchy, the relationships between organizational units are fixed and exist indefinitely, possibly for the lifetime of the organization. A business network is intermediate between the vertically integrated firm on the one hand and the open market on the other. In contrast to an open market, there is a joint commitment among network actors to establish and cultivate relationships (Ching et al., 1996). Whereas, in a closed hierarchy there is unity of ownership, power, and loyalty, in a network this does not exist. There is distributed ownership, power, and loyalty instead (van Aken et al., 1998). In place of contracts in markets and employment in hierarchies, the normative basis in business networks consists of complementary strengths. In business networks, the climate is oriented toward mutual benefits, as compared to suspicion in markets and formalities in a hierarchy. Furthermore, the means of communication across networks are relationships instead of prices in the market and routines in a hierarchy (Powell, 1990).

Business networks provide organizations with the opportunity to increase flexibility, including the ability to process a greater number of different products as well as the ability to more frequently introduce new products and remove outdated ones. Bahrami (1992, p. 35) refers to organizations as having two abilities: the first is 'versatility' and the second is 'agility' – the ability of organizations to move. Hierarchies support productivity and markets support flexibility, but they are not geared to support them simultaneously, as required in competitive markets. By combining the benefits of both hierarchies and markets, networks can increase the flexibility of organizations, while maintaining their efficiency as hierarchies (Thorelli, 1986; Volberda, 1997).

Information technology facilitates electronic integration, which can be considered a form between the extremes of markets and hierarchies (Zaheer & Venkatraman, 1995). According to Miles & Snow (1992), business networks can achieve more flexibility than hierarchies because they represent autonomous units with a greater willingness to cooperate with others. Instead of advocating resource accumulation, a business network focuses on its own strengths and uses voluntary relationships to respond to dynamic market demand. Business networks are able to couple and uncouple with other actors at a lower cost and using less time than hierarchies. Hierarchies in vertically integrated firms are slow to react to rapidly changing customers with creative product offerings because they are bound to an installed base of dedicated resources that can not be adapted immediately. It is easier for a business network to make a link with a business partner than for a hierarchy to buy and integrate an organization. Dynamic networks operate in a

temporary constellation that meets the customer demands at that particular moment, and they can adapt their position to complex and changing customer demands.

In business networks, the flexibility of market mechanisms is, as far as possible, combined with the technical specialization and efficiency of functional organizations, the market responsiveness and effectiveness of divisional management, and the balanced orientation and capability to transfer assets that matrix organizations have (Miles & Snow, 1992). Pure markets provide the ultimate flexibility, because there are no dependencies between actors, and prices alone determine production and exchange (Powell, 1990). Markets fulfil some coordination needs but cannot achieve integration because there is no control to help reach a common objective. Prices are a simplifying communication mechanism, which can hardly capture the difficulties of a complex and dynamic exchange of products. Hence, markets become less efficient when dealing with demand chains that need an extensive exchange of information in order to offer more products and a greater variety of services. Because of the formation of semi-loose interorganizational relationships in business networks, information can be exchanged at lower costs and higher speed than in markets (Bahrami, 1992; Anderson, 1997; Pine, 1993; Van Asseldonk, 1998).

The conclusion may be that business networks are better geared to support both customization and flexibility at the same time. Whether business networks actually realize the full potential of customization – and at what level of coordination – largely depends on their managerial and technological capabilities. When BN management is not effective, the opposite situation could easily result. In such a case, a high level of coordination costs and a low level of flexibility would characterize the business network.

2.3 The margin of a business network

The margin of a single organization (i.e., an actor in a business network) can be defined as 'total revenues of the organization minus total costs' (Porter, 1985). The margin of a business network would be 'the total revenues of all the actors involved in the network minus total costs,' which is not a commonly held concept.

In 1985, Porter introduced the concept of 'value chain' to describe the activities of a single organization (see figure 2.3). The value created by these activities minus the costs of representing them is the margin the organization makes. This approach looks at how internal activities should be organized and linked in order to result in a margin between the value created and the costs.

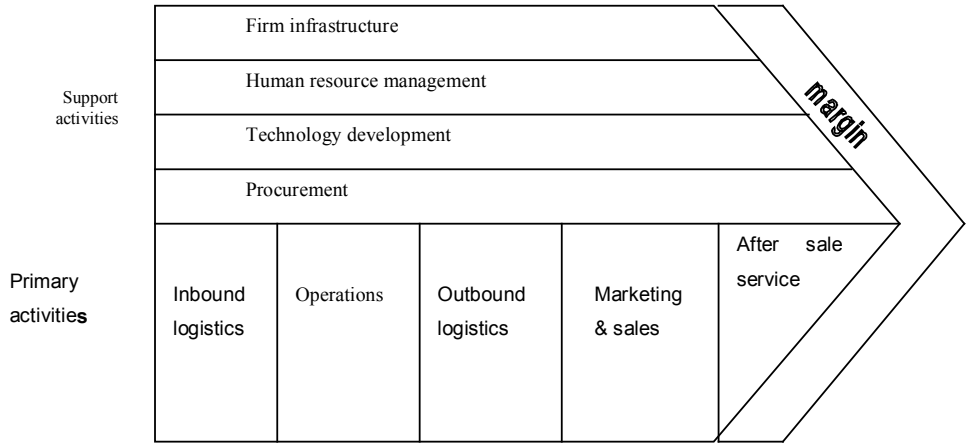


Figure 2.3: Margin of value chain

Later, Porter (1990) redefined the 'value chain' as the 'value system,' taking into account the importance of mutual connections between activities in the organization's value-creation process (see figure 2.4). Seen from this perspective, *strategy* is primarily the art of positioning the organization in the right place in the value system – the right business, the right products and segments, the right value-adding activities. Where the value system provides less guidance is in respect to investigating the parallel performance of activities and the radical reallocation of activities to other actors.

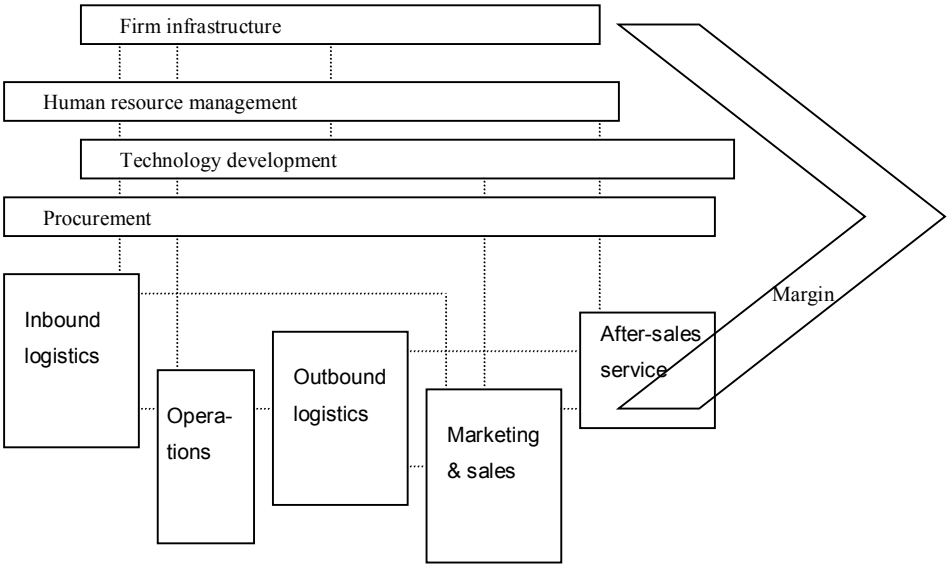


Figure 2.4: Margin of a value system

The focus of the single organization (i.e., value chain or system) lies in maximizing its profit (i.e., margin and/or turnover). This is often reflected in the drive to enlarge the role it plays in the industry. Porter's five forces model (1980) can be used to analyze an industry as a whole and, from the perspective of a single organization, to formulate strategies to increase one's performance and profitability within the industry.

In section 2.2.1, a framework for the description of the business network's activities (see figure 2.1) was introduced. The value created by the activities of the business network minus the costs of representing them is the margin of the business network. Value creation takes the revenues of the business network as the starting point and subtracts the costs of the business network in order to calculate the profit or margin. The focus is on how activities in the business network should be organized and linked to create a margin between the value created and the costs.

With respect to the assessment of margin in a business network, the following notations related to (1) the order, (2) the customer, and (3) the actor of the business network are described:

nc = number of customers of the business network
no_j = number of orders of a single customer (orders are always related to a specific customer)
na_{ij} = number of actors participating in filling a single order
j = a single-customer index, ranging from 1 to nc
i = a single-order index, ranging from 1 to no_j
k = a single-actor index, ranging from 1 to na_{ij}

The concept of order margin $(M_{ij})_t$ in a business network at given moment in time is visualized in figure 2.5 and can be computed as follows:

$(R_{ij})_t$ = revenues of a single order of a single customer at time *t*
$(C_{ij})_t$ = costs of a single order of a single customer at time *t*
Therefore, $(M_{ij})_t = (Rij)_t - (Cij)t$

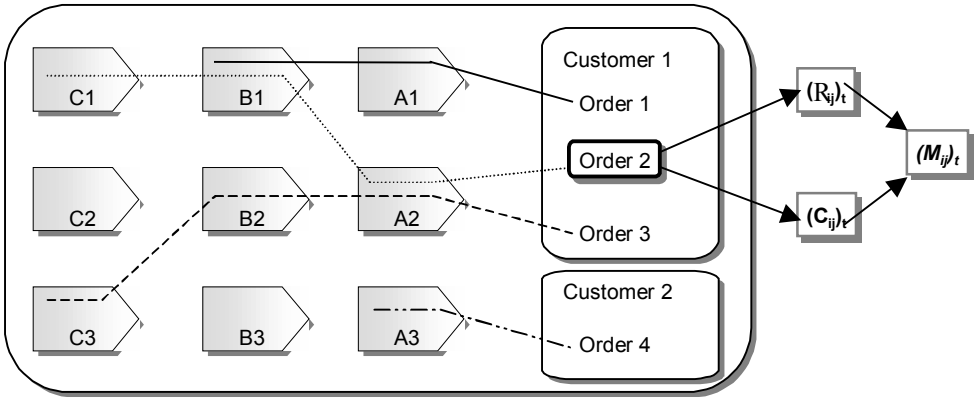


Figure 2.5: Concept of order margin in a business network

The concept of customer margin in a business network is visualized in figure 2.6. Considering all the orders of one single customer, customer margin at time *t* $(M_j)_t$ can be calculated by subtracting the total costs related to filling all the orders of that customer from the total revenues earned from that customer. Customer margin can be calculated as follows:

$$(M_j)_t = \left(\sum_{i=1}^{no_j} R_{ij} \right)_t - \left(\sum_{i=1}^{no_j} C_{ij} \right)_t$$

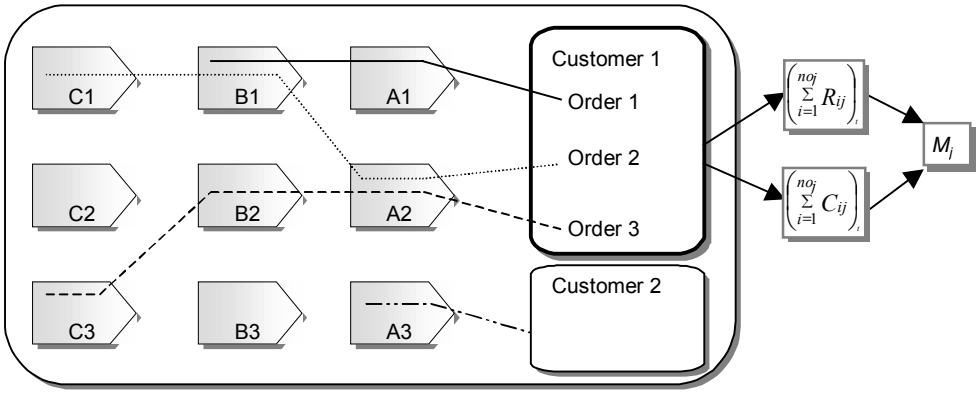


Figure 2.6: Concept of customer margin in a business network

The concept of margin in a business network takes into account all participating actors. It means that, from the perspective of the business network, the revenues of a single order through the network are the sum of the revenues of the participating actors. Similarly, the costs of an order are the sum of the costs of the participating actors. The concept of the

margin of a business network at time *t* is visualized in figure 2.7 and can be computed as follows:

$$R_{ij} = \left(\sum_{k=1}^{na_{ij}} R_k \right)_{ij}$$

$$C_{ij} = \left(\sum_{k=1}^{na_{ij}} C_k \right)_{ij}$$

Therefore,

$$(M)_t = \left(\sum_{j=1}^{nc} \sum_{i=1}^{no_j} \left(\sum_{k=1}^{na_{ij}} R_k \right)_{ij} \right)_t - \left(\sum_{j=1}^{nc} \sum_{i=1}^{no_j} \left(\sum_{k=1}^{na_{ij}} C_k \right)_{ij} \right)_t$$

Each actor directly influences the margin of a single order and, consequently, the margin of the whole business network. Common business practice is that actors will strive towards the optimization of their actor margin for order *i* from customer *j*. However, what really interests us is to determine how ICT adoption in a business network can improve the margin of the business network as a whole while also showing relative improvement in the margin of each actor involved.

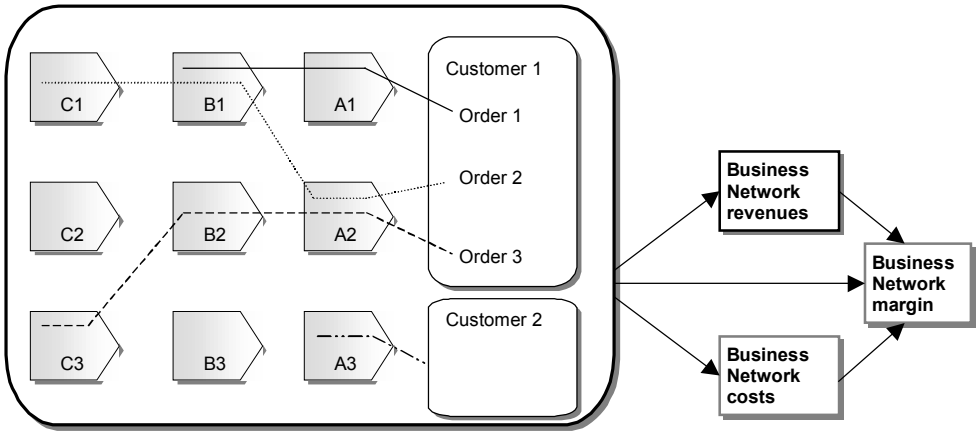


Figure 2.7: Concept of margin in the business network

In striving towards margin optimization, one would probably want to take other criteria into account besides revenues and costs, such as responsiveness to customized demand and customer satisfaction, BN capacity, throughput time of orders, etc., which might make the concept of BN margin seem too limited. With respect to the reengineering of the business network with the use of ICT, one would want to look at the performance improvement of the entire business network, in which various criteria – also called key performance indicators (KPIs) – are considered. Key performance indicators refer to a relatively small

number of critical dimensions that contribute more than proportionally to success or failure in the marketplace (Christopher, 1998) (see also appendix I).
This implies a discussion of trade-off between multiple key performance indicators (Caplice & Sheffi, 1995). In a business network, all the performance indicators are composites of, and dependent on, lower-level measures such as the actor and/or process. For example, BN agility is dependent on the throughput time of all actors' business processes in the business network. Therefore, in assessing the performance of a business network, three levels can be distinguished, as illustrated in figure 2.8, where

1. Business network performance refers to the performance of the business network as a whole.
2. Actor performance refers to the performance of the individual actor in the business network
3. Process performance is the performance of a business-related process.

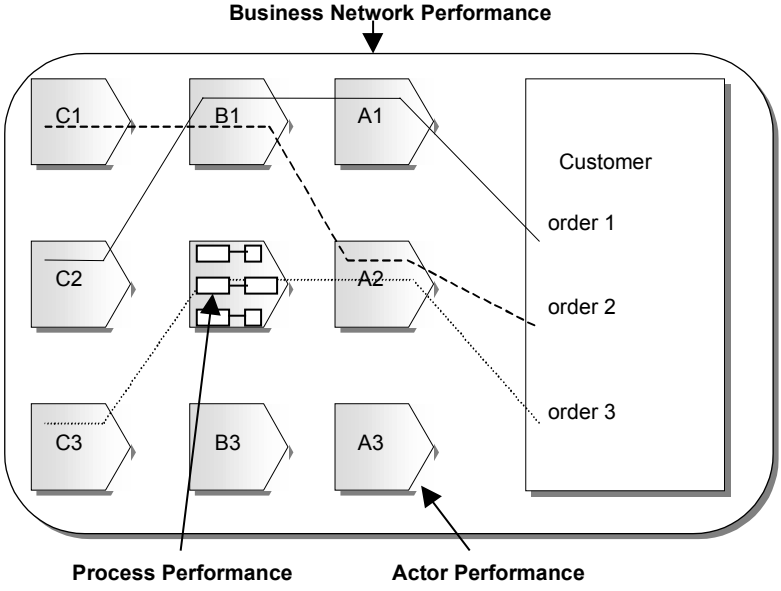


Figure 2.8: Three levels of performance assessment

Examples of some frequently mentioned KPIs that relate to these three levels are illustrated in table 2.4, based on the work of Toppen (1999) and Hoogeweegen (1997).

Table 2.4: Some relevant key performance indicators on three levels

Level of KPIs	Key Performance Indicator	Explanation
Business Network	Versatility	Ability of the business network to process a greater number of different products
	Agility	Speed at which the business network makes links with actors in the business network, measured in total throughput time in the business network
	Total costs	Sum of all the costs related to the goods and services produced in the business network
	Total revenues	Turnover of all the goods and services traded in the business network
Actor	Responsiveness	Flexibility of the organization, measured in lead time or order-cycle time
	Throughput time	Time needed to perform the chain of business processes
	Total organization cost	Sum of all costs related to the transactions of an actor
	Total organization revenues	Turnover of the organization
	Total margin	The end result of the total revenues generated minus the total costs performed by the organization.
Process	Business process effectiveness	Quality as perceived by customers
	Business process efficiency	Value-to-cost ratio (output divided by input)
	Business process cycle time	Lead time necessary to complete a functional transaction
	Process costs	Costs arising when the process is executed
	Process yield	Outcome of the process

Business network performance refers to the performance of a business network if it is to be effective and efficient in matching seller's offerings with buyer's preferences from (1) the customer's perspective, (2) the actors' perspective, and (3) the perspective of connected relationships. The performance of the business network should be analyzed together with:

- the business network actors (customers/buyers, suppliers/sellers, and intermediaries);
- the business network's interorganizational processes.

Business network performance is an overall performance measure that depends on the performance of all actors involved in the network. The performance element in business networks involves delivering the highest value-added for the customer at the lowest total cost. Other aspects of importance when analyzing BN performance include:

- Customized goods and services traded: The determination of the level of customization in terms of the configuration of the offering (product features), the quantity, the breadth (aggregation) and depth of the product, and the available variations (variety) are relevant to this. This factor in turn will affect customer satisfaction.
- Revenues and costs associated with transactions through the business network: The amount and price of the goods and service traded and the operating and coordination costs are relevant here. Next to the definition of the selling price (as opposed to cost price) for a good or service, the method of access (distribution) to the business

network is important in determining the final selling price of a good or service received. These factors in turn will affect customer profitability.

- The business network process itself: With respect to the business network process, the number, flexibility, and efficiency of actors participating in the business network, as well as the customer access to the business network, are important. These factors in turn will affect BN process efficiency.

In this context, we introduce our working definition of business network performance:

Definition 2.3
Business network performance is the degree to which a business network meets customer requirements effectively and efficiently at any point in time

2.4 ICT-enabled business network redesign

The influence and consequences of applying ICT across the boundaries of an organization have already been the subject of much research. Barett & Konsinsky (1982) were among the first to analyze interorganizational information systems (IOS). Porter & Miller (1985) argued that information technology could be an important enabler in optimizing linkages between organizational units, as well as links to the outside of the organization. According to Hammer (1990), IT is *the* key enabler of business process reengineering (BPR) and requires taking a broader view of both IT and business activity, and of the relationship between them. 'IT should be viewed as more than an automating or mechanizing force but as to fundamentally reshape the way business is done. Business processes represent a new approach to coordination across the firm: IT's promise – and its ultimate impact – is to be the most powerful tool for reducing the costs of coordination' (Davenport & Short, 1990).

Venkatraman (1994) goes even further when arguing that 'a positive relationship exists between the range of benefits to be obtained from IT use and the level of integration of IT with current organizational processes.' He distinguishes five levels of integration (see figure 2.9) to illustrate that the higher the degree of business transformation, the higher the range of potential benefits. The first three levels refer to the single organization level of analysis. At the first level, called *localized exploitation,* IT is used to automate local information-processing activities within departmental boundaries. At the second level, called *internal integration*, all automating activities at different departments are integrated into one infrastructure. At the third level, called b*usiness process redesign*, IT is used to reorganize and optimize business processes to increase the organization's efficiency and effectiveness. Other frequently used terms are business process reengineering (Hammer, 1990), business process innovation (Davenport, 1993) and intraorganizational business process redesign (Clark & Stoddard, 1996).

The last two levels of integration refer to the interorganizational levels of analysis. At the fourth level, called *business network redesign,* the use of IT is considered to improve both intra- and interorganizational processes and relationships. At the fifth level, called *business scope redefinition*, the use of IT is considered to find and define new activities for the organization to increase its scope and profitability.

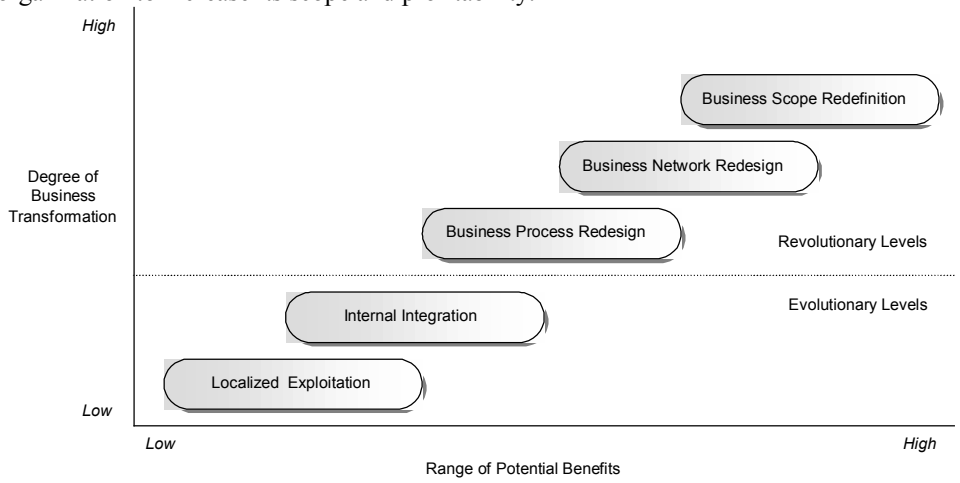


Figure 2.9: Five levels of IT-enabled Business Transformation (Venkatraman, 1994, p. 74)

Modular redesign of a business network

A key concept that can be used in the redesign of a business network is 'modularity,' which generally refers to the use of basic standardized components, i.e., 'modules' in the design of products, business processes, or supply chains. Henderson & Clark (1990) define a module as 'a physically distinct portion of the product that embodies a core design concept and performs a well-defined function.' Modular design avoids creating strong interdependencies among specific component designs and instead tries to create 'loosely coupled' component designs (see also Sanchez & Mahoney, 1996). Modularity can offer multiple benefits. For example, it helps to simplify products, systems, and processes and improves process performance (Persson, 1995). It can also be used to produce customized products efficiently (Venkatraman & Henderson 1998, p. 37). In this respect, Garud & Kumaraswamy (1993) refer to the economies of substitution: in a modular design, only parts of a process have to be substituted by other processes to produce a different product. Modular production can offer multiple benefits to an organization, such as delayed product differentiation (Lee & Tang, 1997), or 'postponed manufacturing' as it is referred to by Van Hoek (1998).

By delaying product differentiation, one delays as much as possible the moment where different versions of a product assume their unique identity, thereby gaining the greatest possible flexibility in responding to changing customer demands. Pine (1993) and, later,

Van Asseldonk (1998) address the use of modularity to achieve 'mass-customization,' i.e., large-scale production and distribution of customized goods. According to O'Grady (1999), modularity has widespread benefits in relation to the performance characteristics of a generic firm. These benefits include, for example, increased product variety and strategic flexibility, economies of scale, reduced order lead-time, lower capital costs, lower producing costs, de-coupling of tasks, design freedom, increased feasibility of product/component change, faster product evolution, simpler control, and ease of product upgrades, maintenance, repair, and disposal (O'Grady, 1999).

Use of modularity and ICT

Applying modularity is a rather complex task. Identifying the individual modules and the way they interact with other modules requires profound knowledge and information about them. Baldwin & Clark (1997) stress that modular systems are much more difficult to design than comparable interconnected or integral systems. An organization must be technologically capable of managing this increased (informational) complexity. If not, using modularity will not lead to the benefits mentioned but, instead, will increase costs or decrease the quality of the product or process and, in the end, decrease organizational profitability. The use of modularity and ICT are closely related. It is hypothesized that the use of ICT can support and enable modular designs for customized products, as well as of customized processes and supply chains (Wolters, 2002). Other hypotheses in this context include the use of ICT to support new bundling patterns (of product modules) (Bakos, 1998), the use of ICT to automate product and process modules themselves (Davenport & Short, 1990), or using ICT to link different modules and coordinate their development and execution (Vervest & Dunn, 2000).

2.5 ICT-enabled BNR and margin improvement

There is a seemingly sharp paradox between flexibility (defined as the ability to produce different and customized products) and improving margin. The research reported here was intended to investigate whether 'modularity' in the business network can shift this paradox by using ICT as an enabler. The impact of ICT on the individual performance indicators of margin – as opposed to the impact on margin of the business network, per se – has been the subject of earlier study. However, it is hypothesized that the use of ICT in an interorganizational context can lead to cost reduction, revenue generation, and increased flexibility. These benefits are addressed below. The impact of ICT-enabled redesign on improving the margin of a business network is the main subject of our research and therefore will be addressed separately in chapter 3.

Impact of ICT use on cost reduction

Many researchers have argued that ICT is particularly useful in information-intensive activities, since the use of ICT might affect the reduction of coordination costs and, therefore, decrease transactions costs (Coase, 1937; Williamson, 1985; Gurbaxani and

Whang, 1991). Nowadays, it is widely accepted that the use of ICT in general and the use of the Internet in particular reduces market inefficiencies by lowering transaction costs and complexity costs (Malone et al., 1987; Bakos, 1998; Gurbaxani & Whang, 1991; Anderson, 1997; Van Asseldonk, 1998).

Impact of ICT use on revenue generation
Some authors have investigated how the use of ICT might affect revenue generation in information-intensive activities. For example, Bakos & Brynjolfsson (1997) support the claim that using ICT supports new pricing strategies. They have researched Internet pricing strategies and found that bundling and unbundling of products is a function of marginal costs, and that increased differentiation and lowering the cost of product information can be reached simultaneously. They argue that 'the ability to customize products, combined with the ability of sellers to access substantial information about prospective buyers due to ICT use, is greatly improving the sellers' ability to price discriminate – that is to charge different prices for different buyers. Price discrimination is a powerful tool that allows sellers to increase their profits and reduce consumer surplus enjoyed by buyers. It enables sellers to service buyers who would otherwise be priced out of the market, an outcome that increases economic efficiency.'

Impact of ICT use on increased flexibility
Some authors have stressed the possibilities of ICT to increase interorganizational flexibility (Bahrami, 1992; Porter & Miller, 1985; Venkatraman, 1994; Vervest & Dunn, 2000). Lucas & Olsen (1994) focused specifically on an increase in flexibility as an outcome of ICT use. They argued that ICT may both increase and decrease organizational flexibility, which they called first and second order effects, respectively. ICT may attribute to flexibility by changing organizational boundaries where and when tasks are accomplished by (1) speeding up the processing of information and (2) enabling an organization to respond quickly to changes in market conditions.

2.6 Effective margin assessment methods

2.6.1 Available redesign and assessment methods
Examples of formal redesign and assessment tools have been found in the work of Kettinger et al. (1997), who investigated numerous methodologies, tools, and techniques that could support organizations in their redesign efforts. They developed a generic 'Business Process Redesign Project Stage-Activity' framework (figure 2.10), based on the study of 25 BPR methodologies, with generic stages and activities for business process change methodologies. They distinguish the following six stages: (1) envision, (2) initiate, (3) diagnose, (4) redesign, (5) reconstruct, and (6) evaluate.

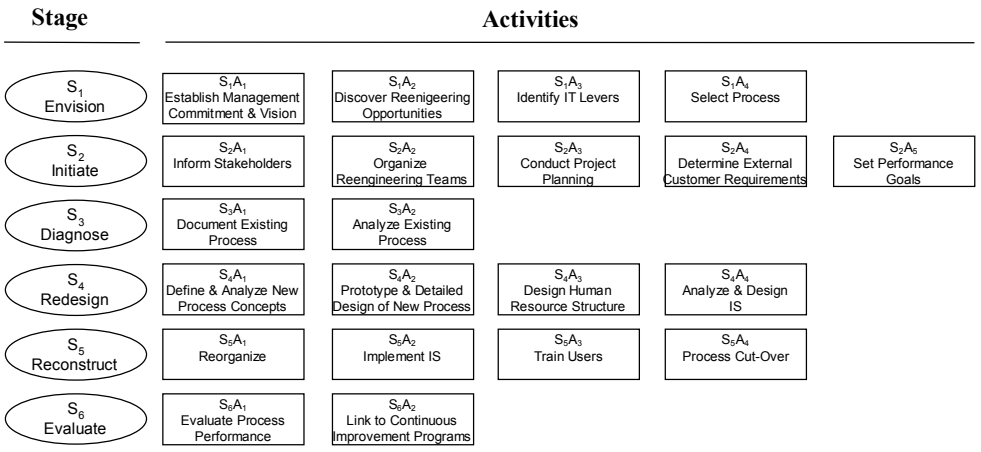


Figure 2.10: Stage–activity BPR framework (Kettinger et al., 1997)

Next, they map numerous BPR techniques and tools onto this framework and verify their support for each activity in each stage.

The modular network design method

One of the methods that is based on the principles of modularity and that can be used in ICT-enabled business network redesign is the modular network design (MND) method. In his dissertation on 'Modular Network Design: Assessing the Impact of EDI,' Hoogeweegen (1997) described the development of the MND method. The initial purpose of MND is to visualize and quantify the effects of redesign options based on an electronic data interface (EDI).

Modeling elements

From among the different techniques for process modeling, such as simulation, diagramming, and formal techniques, Hoogeweegen chose the program evaluation and review technique (PERT) diagramming technique. To visualize the process of order taking, processing, and organization (i.e., actor selection in a dynamic business network) and to compute the costs and throughput time of filling orders, Hoogeweegen (1997, p. 61) introduced four modeling elements: service elements, production elements, process modules, and process module networks. MND is based strongly on the concept of modularity. Within MND, the range of both products and/or services as well as organizational activities are described in modules, which are defined in table 2.5.

Table 2.5: Modeling elements of the MND method

Modeling elements	Description
Service elements (SEs)	Describe service attributes of modularly designed customer orders, produced (and delivered) to order in the business network in a certain period of time

Production elements (PEs)	Describe the modular set of business activities of various BN actors required to produce the customer orders
Process modules (PMs)	Describe an atomic or elementary unit of work, which has no externally visible substructure, which can be operated in various production elements, and which produces the same output when replicated and repeated
Process module network (PMN)	Indicates in what order specific sets of process modules (generated by various BN actors) need to be executed in order to fill a customer-specific order

These modeling elements enable the redesigner to model every individual customer solution in the dynamic business network and to demonstrate which, when, and how these modules are activated in the process of filling an order.

Generic procedure in the modeling and assessment of EDI-enabled redesign options
The generic MND procedure contains four steps (Hoogeweegen, 1997, p.63): the first three steps are the modeling steps and the last step is the cost and throughput time assessment step.

- Step 1: The organization that receives the customer order translates the incoming order into a particular set of service elements, which, in different combinations, describe different types of orders.
- Step 2: The selected set of service elements is translated into a set of production elements. The production elements describe the modular set of business activities of the BN actors necessary to produce the specific customer order.
- Step 3: The (subcontracted) actors in the business network select process modules to produce the requested production elements. A process module is a process step that is standardized, atomic, and not further visible. The process module network (PMN) is designed on the basis of the relationships (also called *dependencies*) between the process modules. The PMN indicates in what order the modules are executed to fill the customer order. The process module is introduced at the lowest level of process activity to support the assessment step.
- Step 4: For each of the PMNs, operating and transaction costs are computed on the basis of the activity-based costing (ABC) technique (Kaplan & Cooper, 1998), while throughput time is computed using the critical path method (CPM).

In his validation of the MND method, Wolters (2002, p. 21) argues that the concept of *meta-management* as developed by Moshowitz (1997) is useful for understanding Hoogeweegen's reasoning in putting forward four steps. According to Moshowitz, managing the virtual organization is managing the process of assigning satisfiers to requirements, which he refers to as *meta-management* of the virtual organization. He distinguishes four main phases in operations management when building a virtual organization and determines four basic activities for the virtual organization. The first phase is the determination and analysis of abstract customer requirements. This phase

refers to the receipt of a customer order (step 1 in MND). The second phase is the tracking of the possibilities for satisfying these requirements. This phase consists of the formation of the business network by selecting subcontractors – actors (step 2 in MND). Basic in his definition of a virtual organization is the distinction between abstract requirements and concrete satisfiers. Abstract requirements refer to what is needed (such as labor and tools) to complete a task; they are abstract in the sense that they may be met in a variety of ways (for example, by named individual workers and designated tools). The concrete satisfiers refer to all possible options that meet the abstract requirements. The third phase is the development and maintenance of the procedure for assigning (or allocating) satisfiers to requirements. This phase contains the actual production and delivery of products or services to the customer by the allocation of production elements among the network actors (step 3 in MND). In the fourth phase, the optimality is adjusted to meet the specific criteria of the allocation procedure. This phase refers to the analysis of performance, i.e., cost and throughput time, the result of which is used to improve order receipt and/or the procedure for chain formation, for instance (step 4 in MND). Therefore, it can be argued that in the MND method, Hoogeweegen (1997) has provided the tool for operationalizing Moshowitz's (1997) concept of the virtual organization, as illustrated in figure 2.11.

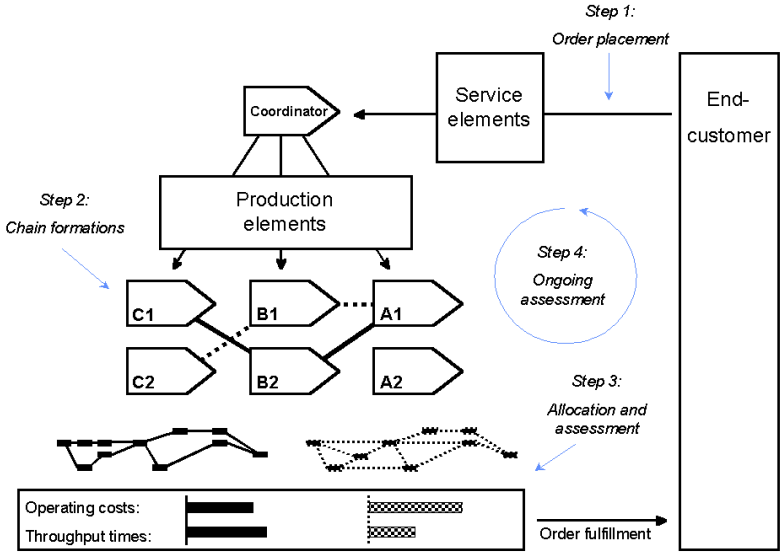


Figure 2.11: The four steps of modular network design (Wolters, 2002, p. 22)

Hoogeweegen (1997) also introduces the concept of 'temporary supply chain coordinator' (TSCC), which he defines as the organization that has received the customer order and is responsible for filling that particular order. In our definition, the TSCC is the focal actor in the business network (see definition 2.1.)

Assessment of cost and throughput time

Hoogeweegen (1997, p. 68) uses the ABC technique (Kaplan and Cooper, 1998) to assign the costs of resources to the execution of process modules. As Walton (1996, p. 43) proposes, 'ABC can be used to evaluate EDI because an activity based system assigns costs of specific products based on the products' use of activities.' This means that for each process module, one has to determine (1) the types of resources used, such as labor, materials, means of communications, (2) the quantity of resources required to execute the process module and (3) the cost of these resources per unit of analysis. Hoogeweegen (1997, pp. 30–31) distinguishes two types of costs: (1) operating costs – those involved in transforming (base) materials to (semi-)finished products and (2) transaction costs – the operational coordination costs organizations face in filling customer orders. Based on the critical path method, throughput time (i.e., the total time required to execute the process module) is calculated and equals the sum of all the operating times of the process modules that are part of the critical path. Throughput time is the operationalization of the concept of 'agility,' i.e., the system's ability to respond quickly (Bahrami, 1992, p. 35). As discussed above, agility is one aspect of strategic flexibility (Bahrami, 1992), the other aspect being versatility. Versatility has been defined by Hoogeweegen (1997, p. 27) as 'the extensiveness of a product and/or service range a system is able to deliver, both in terms of the variety of products and service and the number of options available to produce specific products or services.' The concept of versatility is not further operationalized in Hoogeweegen's dissertation.

IT redesign guidelines

Hoogeweegen uses the information technology analysis method, based on the work of Davenport and Short (1990) to come up with seven generic IT- and EDI-based redesign guidelines (as reported by Wolters, 2002, p. 34):

1. Support information storage and processing;
2. Automate information exchange (internal and external);
3. Reduce human labor in a process;
4. Treat geographically dispersed resources as though they were centralized;
5. Execute processes simultaneously;
6. Put the decision point where the work is performed and build control into the process;
7. Reallocate activities among organizations.

In Hoogeweegens' case-study research in the air-cargo industry, he attempted to translate these seven generic guidelines into more MND-related rules and guidelines. According to Wolters (2002, p. 61), 'only guidelines number 2, 5 and 7 are (in)directly translatable in MND terms, albeit they are not even EDI or IT specific. The other guidelines could not be translated at all while the bottom-up order perspective of MND is simply unsuitable for most of the guidelines.' In our case-study research (see chapters 5 & 6), we have made

another attempt to translate the seven generic guidelines into margin-improved, MND-related guidelines.

MND plan of approach
For the actual use of the MND method in case study research, Hoogeweegen (1997) provides a plan of approach with seven generic steps to redesign supply chains with the use of EDI (figure 2.12).

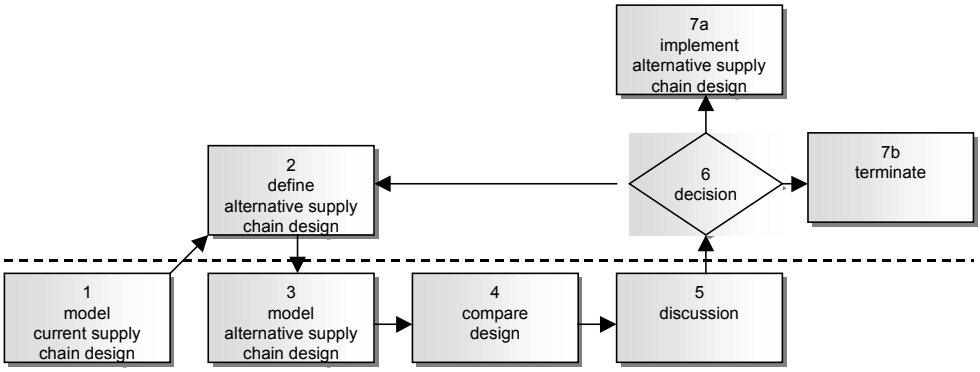


Figure 2.12: Plan of approach in modular network design (Hoogeweegen, 1997, p. 81)

- Step 1 concerns the modeling of current supply design. All processes that contribute to the processes of the customer order must be modeled.
- Step 2 concerns the definition of alternative process designs based on EDI redesign guidelines.
- Step 3 is the modeling of the alternative design as it was done in the current supply design.
- Step 4 is the comparison of the two designs in terms of process design and cost & time levels.
- Step 5 is the discussion of the results.
- Steps 6 and 7: in these steps, the members of the supply chain must decide whether to implement the alternative design (step 7a), to find other alternatives and repeat steps 2 to 6, or terminate the evaluation process (step 7b).

Decision support system
To support the modeler and/or decision maker in the consecutive steps of the MND approach, an automated software program – which may be considered as a decision support system (DSS) – *Erasmus in Chains*, was developed. A DSS supports the decision-making process of managers with flexible access to models and relevant information. This approach emphasizes the analysis of key decisions with the aim of improving both the effectiveness and the efficiency of decision making (McCosh & Morton, 1978). Erasmus

in Chains was programmed in Microsoft Access, using Visual Basic Tools. The output of the process module networks was generated with Microsoft Project, which contains the PERT chart functionality. The use of Microsoft products guaranteed a well-known user interface that had been proven successful.

In his validation of the MND method, Wolters (2002) chose this framework to map MND-related techniques. He concludes that MND mainly supports the activities in stages 2, 3, and 4 (Wolters, 2002, p. 82), as illustrated in table 2.6.

Table 2.6: Mapping MND on Kettingers' stage-activity BPR framework (Wolters, 2002, p. 82)

Stage	1				2					3		4				5				6	
Activity	1	2	3	4	1	2	3	4	5	1	2	1	2	3	4	1	2	3	4	1	2
Activity Based Costing																					
Brainstorming																					
Data Flow Diagramming																					
Hierarch. Colored Petri Nets																					
IDEF 0,3, 6																					
IDEF 1,1X, 4,5																					
IDEF 2																					
Information Technology Anal.																					
Process Flowcharting																					
Simulation																					
Value-Chain Analysis																					
Modular Network Design																					

In the initiation stage, MND supports the determination of customer requirements. In the diagnosing stage, MND supports the documentation and analysis of the existing process. In the redesign stage, MND supports the prototype and the detailed design of the new process. The other stages and activities are not supported by the MND method.

It is also hypothesized that the MND method supports decision-making for interorganizational redesign. Based on the outcomes of his case-study research, Hoogeweegen (1997, p. 153-154) concludes that 'the application of the MND approach can be used to evaluate EDI enabled redesign options. Its application matches the customer order, described in service elements, onto process modules, to be executed to fulfill the customer order. It enables an assessment of the impact of EDI at the level of the supply chain and works as facilitator to rethink current business operations and to consider business process redesign trajectories to meet the trend of customization.' He further argues that MND delivers useful information to support managers in making the decision to adopt EDI, but emphasizes that the role of the MND approach in the process of EDI decision making had not been investigated. In his validation of the MND method, Wolters (2002, p. 24) argues that 'visualization of all business processes in process module networks could enable the detection of improvements and redesign options. MND may be used to compare different process module networks which all refer to the fulfillment of the same set of service elements, but that use ICT applications such as EDI or Internet, or that use ICT differently. Based on such comparison, a decision whether to implement a specific ICT application can be supported through the assessment of its impact on process module network design, costs and throughput time. Furthermore MND allows the coordinator to constantly evaluate the composition of its set of service elements, the way service elements are translated into

production elements and last but not least, the composition of the network of sub-contractors. It may also support management in defining modules and their mutual interfaces.'

2.6.2 Assessment methods and ICT-enabled BNR decision-making

If one has a method for assessing ICT use, will this influence ICT decision-making? Silk (1990) commented on the process of ICT decision making as follows: 'the process of performance measurement of ICT applications is concerned with the formal and informal organizational dynamics involved, starting with the initiation of an ICT-enabled business process redesign project and culminating in review and approval. In some organizations it is a highly political process, where the informal dynamics predominate (Weil and Olson, 1989). In others, the process may be structured (Doll and Torkzadeh, 1987; Mc Keen and Guimaraes, 1985).' From Silk, one could conclude that having a method would not have an impact on ICT decision making.

On the other hand, Parker and Benson (1988) emphasize in their book *Information Economics* the need for formal tools and methods to establish a causal relationship between the use of ICT and (the changes in) business performance. They distinguish between two very different decision-making processes in applying information technology:

1. Decision-making processes to justify the improvement of business performance as a result of the application of information technology. These decisions assess the *value* of the information technology or ICT project in comparison to the estimated costs. *Value* for Parker and Benson should be quantifiable in terms of real performance improvement, such as traditional cost reduction and/or revenue generation. Parker and Benson enhance the concept of *value* with six new components: (1) return on investment, (2) strategic match, (3) competitive advantage, (4) management information support, (5) competitive response, and (6) strategic information-system architecture.
2. Decision-making processes with respect to the technological viability and feasibility of an IT application. These decisions assess the costs – and more specifically, the recovery of such costs – on the basis of available project resources in comparison with the resources required to successfully implement the project.

Parker and Benson argue against mixing these two very distinctive types of decision processes. Specifically, they argue that *information economics* should assess the business-related justification of alternative ICT-enabled organizational designs. From Parker and Benson, one could conclude that having formal tools to link business performance to ICT would support the decision-making process; however, they provide few if any tools to perform such formal assessments. They also do not make clear to what extent businesses actually use such tools and what impact these tools would have on actual decision making.

Authors like Lee and Billington (1992) and Davis (1993) relate effective decision making about redesign to the understanding of sources of uncertainty. The advantage of formal tools, accepted by the parties involved, is that although the outcome is still not known, they reduce uncertainty because they can support:

- the description of the current system;
- the analysis of the zero-based situation;
- the 'controlled' change of a system.

Based on de Leeuw's (1988) work on system theory, a business network could be considered – from a design perspective – as a 'system.' BN redesign means changing the conditions of the system. Therefore, formal tools that support the 'controlled' change of the conditions of the system will influence the decision making involved in BN redesign, if the tools include:

- the business activities related to the primary transformation processes of the different actors involved in the business network (refers to the 'managed system');
- the planning, controlling, and coordination of business processes in the business network while aiming at realizing the objectives within the restrictions set by the BN strategy and its physical design (refers to the 'managing system');
- the information system in the business network, where the key lies in the integration of IS systems, not just the interface. The level of this integration is closely related to the level of coordination of the decisions of different sub-units within an actor and between the actors in the business network;
- the establishment and coordination of tasks, i.e., the connections among business activities between the different actors involved in the business network (referring to the 'organization structure'). Malone (1987) defines coordination as 'the additional information processing performed when multiple, connected actors pursue goals that a single actor pursuing the same goal would not perform.' He states that a shared goal is needed for coordination. Later he defines coordination as 'the act of working together' and 'the act of managing inter-dependencies between activities' (Malone, 1991). According to Sheombar (1995), coordination is the adjustment of decisions leading to actions and can be accomplished in two ways: by parties directly influencing one another's decisions or by influencing one another's information and interpretation regarding the processes, the status of the processes, and the goals of the other party.

2.6.3 Extending the MND method towards margin assessment

Assuming that the use of a formal redesign tool is positively associated with actual adoption of ICT in the business network, it is worthwhile to find out if the MND method can be enhanced to serve the purpose of our research. A formal redesign tool for assessing the reengineering of the ICT-enabled business network in terms of margin would need to include the following:

- a formal model that captures the ex ante assessment of the margin and flexibility of the business network (see sections 2.3 and 2.5);
- a modular redesign method, since the use of modularity and ICT in a business network are closely related (see section 2.4);
- a formal protocol to support the 'controlled change' of the business network through the definition of generic stages and activities in the redesign process (see section 2.6.1).

From Hoogeweegen (1997) and Wolters (2002), one can conclude that at the operational level, the MND method is a good *starting point* because:

- the MND method relates tools and techniques to support the initiation, diagnosis, and redesign of the primary transformation processes in the business network (this relates to the 'managed system');
- the MND method provides four generic 'modules' that can be used as redesign variables to model the connections of business activities (i.e., tasks of the different BN actors involved in specific customer orders) in a uniform and consistent manner (this relates to the 'organization structure');
- the MND method provides the four-step generic procedure for the visualization and assessment of the business activities, roles, and relationships of the different actors in the business network, thus operationalizing the concept of the virtual organization;
- the MND method operationalizes two relevant KPIs for assessing the ex ante margin and flexibility, i.e., costs and throughput time, by linking these KPIs to specific redesign variables and operationalizing one dimension of strategic flexibility (agility);
- the MND method translates three of Davenport and Short's (1990) seven generic IT redesign guidelines into more MND-related rules and guidelines for case-study research;
- the MND method provides a seven-step plan of approach for comparing – in a uniform and consistent manner – the effects on costs and throughput time adopting ICT (i.e., EDI) in alternative designs.

However, for the purpose of our research, the MND method needs to be enhanced in the following ways:

- at the operational level, with
    1. the operationalization of revenues and versatility in the business network, and the linkage of these KPIs to available redesign variables in the business network;
    2. a procedure to assess BN margin and the (re)distribution effect of the margin among actors in the business network;
    3. ICT redesign guidelines that result in margin-improved redesign options;
    4. a procedure to compare various BN designs on all the aspects mentioned above;

- at the strategic level, with
    1. support in the analysis of the more strategic BN drivers;
    2. support in the establishment of shared objectives in the business network and its corresponding KPIs;
    3. a model of the business network, representing the relationship between ICT adoption, available redesign variables, and margin. Note that the previous three requirements relate to understanding the 'managing system';
    4. support in the analysis of the 'information system' of the business network and, more specifically, of the level of electronic integration that can be realized in the business network.

  This type of support can be related to the 'envision stage' (Kettinger et al., 1997), as discussed further in chapter 4.

2.7 Conclusions

The rapid development of information and communications technologies have made business networks – defined for the purpose of this study as *the structure of interorganizational relationships between the focal actor and interdependent external actors, closely linked and cooperatively working together to fill customer orders* – much more possible and desirable. Business networks can have great advantages over more traditional forms of interorganizational coordination, such as hierarchies and markets. In particular, business networks can provide a higher degree of strategic as well as operational flexibility, while at the same time, lowering costs and risks. In today's business world, customers demand – and are offered – a greater variety of products, at lower cost, with rapid dispatch. The result is that the advantages of the business network will outweigh some of its major disadvantages, such as the loss of bargaining power and less control of individual actors.

As the modern organization gradually moves into incredibly complicated business network arrangements, it will face the question: What impact will this have on our overall performance? It is surprising that so little attention has been given in the literature to the development of formal methods to assess the impact of such new arrangements, made possible through the smart use of ICT and increasingly made necessary as a result of customer demands and competitive pressures. Porter's (1985) traditional view of the value chain is inadequate for such an assessment. A method is required that can give a much more detailed assessment on a variety of criteria, or key performance indicators. We have identified (see table 2.4) a set of performance indicators, which can be summarized as follows:

1. Cost reduction: in terms of total BN operating and transaction costs. In this context, *total* means the sum of all costs for all parties in the business network;
2. Revenue generation: increase in sales revenue or revenue per customer and number of customers;

3. Increased flexibility: by way of higher agility (speed of linking within the business network) and more versatility (ability to handle a greater variety of different products).

The modular network design (MND) method originally developed by Hoogeweegen (1997) provides a sound basis for assessing BN rearrangements made possible through the use of ICT. This method develops *modularity* as a key concept for assessing and managing the complexity of ICT-enabled redesign of business networks. It does not, however, address the concept of *margin* – defined as total business network revenues less total business network costs – as an assessment criterion, which needs to be developed and tested. In particular, this enhancement of the MND method should address the relative changes in business performance between various actors in the business network. This is not a trivial task since it requires – inter alia – commonality among actors on the use of comparable costing methods and the exchange of internal data on business performance.

The MND method, despite its attractive potential to reduce complex business tasks into common and shareable modules, does not provide a *methodology* to apply the method in real-life situations. This methodology – or protocol for its use – needs to be added to create a sound assessment method that can be tested in real-life business situations.

Even if a formal assessment method can be developed and deployed in real-life situations, little evidence could be found in the literature that such a method would have an impact on the outcomes of actual business decisions. Parker and Benson (1988) argue strongly in favor of a formal method to assess changes in business performance as result of ICT, but they provide little support for its actual use. Malone (1987) emphasizes the need for strongly shared common goals for any coordination effort to be successful. Factual experiences with the MND method are too limited to draw generalizations. This should be a major objective for further study.

Here, the research model (the constructs and variables for assessing ICT-enabled business network redesign) is developed in Chapter 3, and the research protocol (the methodology for applying the model in real-life business situations), in Chapter 4.

3 ICT-ENABLED MODULARITY AND THE REDISTRIBUTION OF MARGIN-IMPROVED FLEXIBILITY

3.1 Introduction

To develop a method for the ex ante assessment of margin to be applied in the ICT-enabled redesign of a business network first requires a clear definition of the assessment critieria (hereinafter referred to as *business network key performance indicators*, or KPIs) to evaluate alternative BN designs. The implicit research assumptions are twofold:

1. The use of ICT enables new BN designs that were not possible or feasible without these new, technological capabilities. More specifically, ICT would increase the speed of linking actors in the business network and therefore enhances *agility*. At the same time, ICT increases the business network's ability to handle more differentiated products and thus improves the degree of *versatility*.
2. Such new or alternative arrangements of the business network can improve its overall margin (loosely defined as differential total revenues minus differential total costs for a specific BN design). Different arrangements will have differential results with respect to margin as well as to agility and versatility.

The challenge is to find the most suitable arrangement. The previous chapter identified 'business modularity' as defined in MND (Hoogeweegen, 1997) as a sound starting place for both assessing and designing alternative arrangements of business networks. MND assumes that ICT enables 'modularity' in business processes, products and supply chains (Wolters, 2002), which in turn, allows new design options for the business network, or the redesign of an exisiting situation. These options can subsequently be assessed on a number of criteria, based on which, actors in real-life situations will make their actual choice to adopt one design or another, or do nothing at all. Which option will be chosen by any specific actor depends on a variety of factors, one of which may be their absolute gain (improved margin in comparison to the present situation) or relative gain (improved margin in comparison to other actors in the business network). Parker and Benson's (1988) value components (see section 2.6.2.) are also important in the choices made by BN actors, particularly the return on investment (i.e., the specific revenues minus the specific costs of designing and implementing the chosen design option).

In summary there are three basic constructs in the research model:

1. *ICT-enabled modularity:* ICT enables business 'modularity,' which provides a rigorous method to generate new options for redesigning a business network.
2. *Margin-improved flexibility:* Redesign options can be assessed with respect to their impact on business performance, particularly with respect to cost and revenues

(defined as margin) and flexibility (defined as the multiplier of agility and versatility).
3. *Redistribution* concerns the actual adoption of BN redesign options by the actors in the business network.

These constructs are developed in more detail below (see sections 3.2 to 3.4) and eventually are put together in a *prescriptive* model (i.e., indicating the desirability of the defined causal relationships) in section 3.5.

3.2 ICT-enabled modularity

The rigorous method to generate new options for business network redesign applying ICT-enabled business modularity is described in the work of Hoogeweegen (1997) and Wolters (2002). They hypothesize that the use of ICT can support and enable modular design of products, processes, and supply chains. The key lies in the modularization (i.e., efficient 'un -and re-bundling' of modules) due to ICT use. The modeling elements of the MND method (see table 2.5) allow the re-designer to:

1. determine the service elements (SE) – those predetermined components of the product portfolio that can be rapidly brought together to form the customer solution;
2. map these specific SE/customer combinations onto the modularly designed BN processes.

The ICT enabling in the business network provides the infrastructure that automates the linkages between the products and process modules – an infrastructure that enables the business network to be as efficient as possible in bundling unique, customer-specific product modules with customized process modules among different BN actors. The 'bundling capabilities' of the business network will affect the current design and thus the performance of the business network. Therefore, ICT-enabled business modularity and the performance of the business network are closely related.

Business modularity requires that the basic standardized components in the design of products, processes, and supply chains in the business network (labeled as *business network redesign variables*) be defined. So, to generate new options for redesigning a business network, the following redesign variables will be used:

1. the constituent elements of the business network, i.e. actors, customers, positions, and links, as described in section 2.2.1;
2. the modeling elements of the MND method, i.e., service elements, production elements, process modules, and process module network, as described in table 2.5.

3.3 Margin-improved flexibility

'Margin-improved flexibility' (see also figure 3.1) is the performance indicator that measures the degree to which a business network generates higher margin while flexibly responding to the demand for customization. It is the degree to which the business network

can realize a profitable ICT-enabled business transformation by generating a higher incremental change in revenues than the incremental change in costs. A BN redesign option with a high level of agility and versatility in the process of filling customized orders, resulting in a lower change in costs than in revenues, will have a high level of margin-flexibility. A redesign option with a low level of agility and versatility in the process of filling customized orders, resulting in a higher change in costs than in revenues, will have a low level of margin-flexibility. So, it could be argued that a redesign option that has a high level of margin-flexibility would be preferred over a redesign with a low level of margin–flexibility.

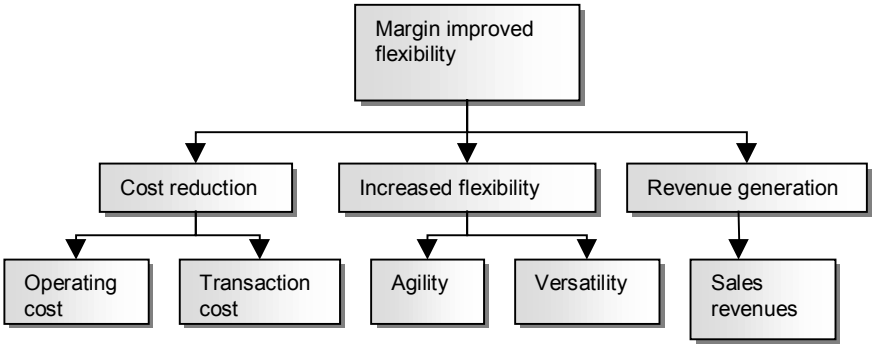


Figure 3.1: Margin-improved flexibility

The question of how much the ICT-enabled transformation in the business network will improve, or contribute to the deterioration of, costs, revenues, and flexibility of the business network first requires an assessment of current performance. To assess the level of margin-flexibility, the following variables are used:

1. *Costs of the business network:* including the total operating costs and total transaction costs of all participating actors;
2. *Flexibility of the business network:* including the agility and versatility of the business network;
3. *Revenues of the business network:* including the total sales revenues of all participating actors.

Based on the assessment of the current level of margin-flexibility, performance gaps can be derived and possibilities for improvement through ICT-enabled modularity can be identified. Once the ICT-enabled redesign option has been modeled, the new level of margin-flexibility can be assessed. The change in the margin-flexibility of the business network can be identified by comparing the two levels.

3.4 Redistribution of margin-improved flexibility

'Margin-improved flexibility' of the business network may seem to be a rather complex performance measure to use in making decisions about redesign. The duality of interest between the business network as a whole and its individual actors can present a source of uncertainty when it comes to actual decision making. However, it could be argued that the redesign option would be less likely to be implemented when only a few actors benefit from the redesign than when the benefits of margin-improved flexibility are equally distributed among all the actors involved in the business network. Margin-improved flexibility can be assessed at the *level of the actor* as well as the *business network,* which provides some insight into the effect of redistributing margin-improved flexibility among all the actors involved. This insight is necessary in order to answer the question: Under which conditions will the ex ante assessment of margin-improved flexibility lead to actual implementation?

3.5 The research model and its propositions

In order to investigate to what extent and under what conditions the use of ICT-enabled modularity in BN redesign can realize a margin- and flexibility-improved transformation of a business network, we need a scientifically valid research model. Validating the model in empirical situations can also help us answer the two research questions formulated in chapter 1. The research model and propositions for subsequent testing are described below. Bacharach's (1989) guidelines on theory development have been used, particularly in developing relationships between constructs in terms of propositions.

Putting together the constructs, variables, and causal relationships discussed above results in the research model that is depicted in figure 3.2.

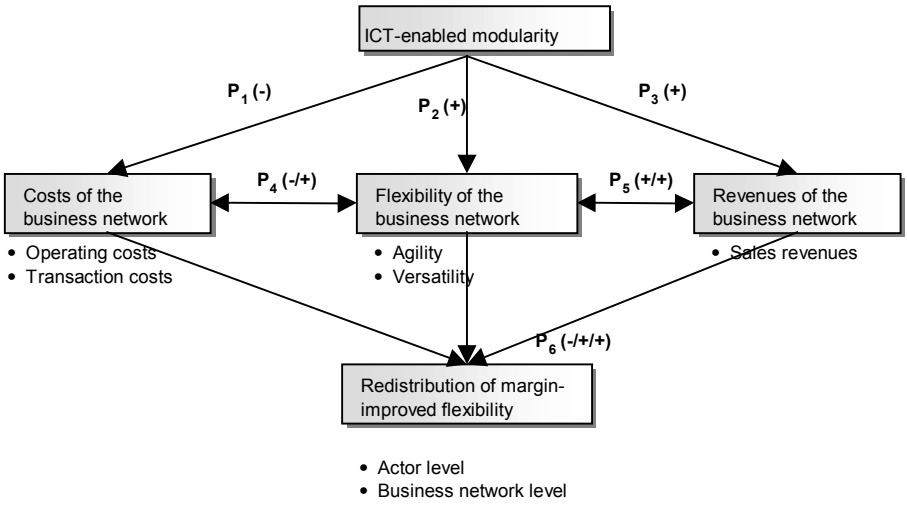


Figure 3.2: The research model

Note – (=decrease) or + (=increase) refers to the change in the defined causal relationship

Each of the defined (causal) relationships makes up one proposition, which will be described below.

P_1: *The use of ICT-enabled modularity in the business network lowers the costs of the business network*

The first proposition relates to the relationship between ICT-enabled modularity and the reduction in BN costs. We have argued that the use of ICT in the business network supports the modularity of products, processes, and BN design and lowers operating and transaction costs. An example can illustrate this relationship: when ICT is used in the business network to modularize and integrate BN processes, it underlies the flow of products, services, money, and information among actors in the network. This allows a more equal flow to be realized in the BN capacity. For example, earlier availability of customer demand can lead to lower coordination costs since this information helps in optimizing production planning. Earlier information on the required production capacity in a certain period of time gives the production planners opportunities to optimize the sharing of resources among actors in the network. So, ICT-enabled collaborative manufacturing in the business network can lower operating costs, provided that the decrease in operating and coordination costs outweighs the increase in operational costs involved in managing the ICT-enabled processes. An ICT-enabled design option that shows higher cost efficiency – for the same amount of products and services produced – will be favored over designs that result in lower cost efficiency.

P_2: *The use of ICT-enabled modularity in the business network increases the flexibility of the business network*

The second proposition relates to the relationship between ICT-enabled modularity and the increase in flexibility in the business network. We have argued that the use of ICT supports the modularity of products, processes, and BN design and increases variety and throughput time. The two benefits of agility and versatility are closely related. An example can illustrate this relationship: the use of ICT in the business network may contribute to flexibility by changing the organizational boundaries where and when tasks are accomplished by (1) speeding up the processing of information and (2) enabling an organization to respond quickly to change in market conditions. Increased linking speeds support higher response behavior in organizations. The cooperative attitude of actors participating in the business network, together with the increased linking speed enabled by ICT, makes it easier to establish supply chains for new products. As a result, more products and services (variety) can be offered simultaneously, while new products can be introduced more rapidly. An ICT-enabled redesign option that shows, ceteris paribus, such improvement in flexibility will be favored over designs that decrease the flexibility of the business network.

P_3: *The use of ICT-enabled modularity in the business network contributes to increased revenues in the business network*

The third proposition relates to the relationship between ICT-enabled modularity and the increase in revenues in the business network. We have argued that the use of ICT supports the modularity of products, processes, and BN design and permits more customer-specific pricing. An example can illustrate this relationship: the use of ICT can facilitate new (information-rich) product bundling among actors in the network and therefore permits unique, customer-specific designs and pricing. The trade of more and/or higher-priced products and services in the business network will generate additional revenue. An ICT-enabled redesign option that shows, ceteris paribus, a higher potential for additional revenue in the business network will be favored over designs that show a lower potential for additional revenue.

P_4: *The use of ICT-enabled modularity in the business network* lowers *costs and increases the flexibility of the business network at the same time*

The fourth proposition relates to the concept of 'cost-efficient flexibility' (Hoogeweegen, 1997). ICT-enabled redesign options that show, ceteris paribus, improvements in both costs and flexibility at the same time will be favored since both the customers and the BN actors will benefit. Customers get more individualized designs and the business network can produce these customized designs at lower costs and shorter production times.

P_5: *The use of ICT-enabled modularity in the business network contributes to increased revenues and increases the flexibility of the business network at the same time*

The fifth proposition relates to the concept of 'revenue-efficient flexibility.' One can argue that the increase in the variety of customized products is accompanied by an increase in revenues if the increased variety can be sold at customer-specific prices. ICT enabling in the business network supports the central skills needed for achieving business precision, such as micro-segmentation and precision pricing. Therefore, ICT-enabled designs that, ceteris paribus, contribute higher revenues and increase versatility at the same time will be favored since both the customers and the BN actors will benefit. Customers get more variety and the business network will increase its selling effectiveness.

P_6: *When all current BN actors benefit from the margin-improved flexibility created by ICT-enabled modularity, the ICT-enabled redesign option will be implemented*

The sixth proposition is related to the supposed relationship between the redistribution of 'margin-improved flexibility' and actual redesign decision making. As argued in section 2.7, the challenge in ICT-enabled BNR lies in finding the most suitable new arrangements for the business network as well as for its individual members. Different arrangements will have different results with respect to the distribution of margin-improved flexibility, so redesign options that provide an equal distribution of the benefits among all actors involved will be more likely to be implemented than those that result in an unequal distribution. .

4 METHODOLOGY FOR THE ASSESSMENT OF MARGIN-IMPROVED FLEXIBILTY

4.1 Introduction

Developing the methodology – or protocol for its use – for applying the research model to real-life business situations first requires a clear definition and understanding of the principle stages and activities in ICT-enabled BN redesign projects.

Redesigning an existing business network in order to realize a profitable ICT-enabled business transformation is an initiative that has broad consequences in terms of satisfying the needs of all stakeholders involved, including customers. It requires disciplined thinking about the key drivers of business success and margin-flexibility by tracing them through the customer, the product and service offerings, the BN processes, and ultimately, the actions of the various actors involved. It requires a shift in attention from a preoccupation with individual key performance indicators (KPIs) to an awareness of how these KPIs work as a system and how they can lead to increased margin-flexibility for the business network. The process of getting to the final redesign option is valuable because redesign managers can gain tremendous insight into how the KPIs of the actors involved in the network interrelate. Focusing the redesign team on such a basic process is one of the most important things one can do to improve management decision making in both strategy and implementation.

The research protocol that supports BN managers using the ex ante margin-flexibility assessment method in their redesign efforts is formalized below (see sections 4.2. to 4.3). To allow flexible access to the research model and the research protocol in real-life situations, a decision support system has been developed (see section 4.4.).

4.2 The five redesign and assessment stages

The principle stages and activities in ICT-enabled BN redesign aimed at improving the margin-flexibility of the business network can be derived from the different requirements related to the enhancement of the MND method, which have been discussed in the previous two chapters. In summary:

1. The first requirement relates to the support of the 'envision stage' (see figure 2.13), i.e., support at the strategic level through the analysis of (1) the strategy, including the level of electronic integration, and (2) the shared objectives of the current business network.
2. The second requirement relates to the investigation of the (re-)distribution of margin-improved flexibility (see sections 3.3 and 3.4).

3. The third requirement relates to the support of the 'controlled system' change (see section 2.6.2) and to the translation of ICT redesign guidelines resulting in margin-improved redesign options (see section 2.6.1).

These requirements are interrelated. Assuming that structure follows strategy (cf. Thorelli, 1986), the analysis of the current BN structure requires an understanding of the overall strategy of the business network. This will help the redesign decision-makers to define the boundaries of the business network under study. The boundaries of the business network under study can be defined by identifying the product-market combinations that the business network is serving, since it is customer demand that drives the activities of the business network (see figure 2.1). A change in customer demand will affect the current product-market combinations the business network is serving and, thus, lead to the adaptation of the strategy. The shared objectives of each actor and of the current business network as a whole can be derived from the characteristics of the product-market combinations and the strategy of the business network. These objectives can be monitored and evaluated by translating them into predefined key performance indicators at the level of the process, the actor, and the business network, itself. When the performance of the business network does not satisfy the shared objectives, measures, such as the following, will need to be taken:

- Changing the strategy of the business network, e.g., serving other, more profitable, product-market combinations by establishing new strategic partnerships;
- Changing the objectives of the business network, e.g., from a focus on cost reduction to a focus on revenue generation or service enhancement;
- Changing the structure of the business network, e.g., by changing the roles and/or relationships between actors;
- Changing the product and process characteristics, e.g., product/service variety or workflow routines, sequence of process tasks, etc.;
- Changing the level of electronic integration at the level of the process, actor, or business network.

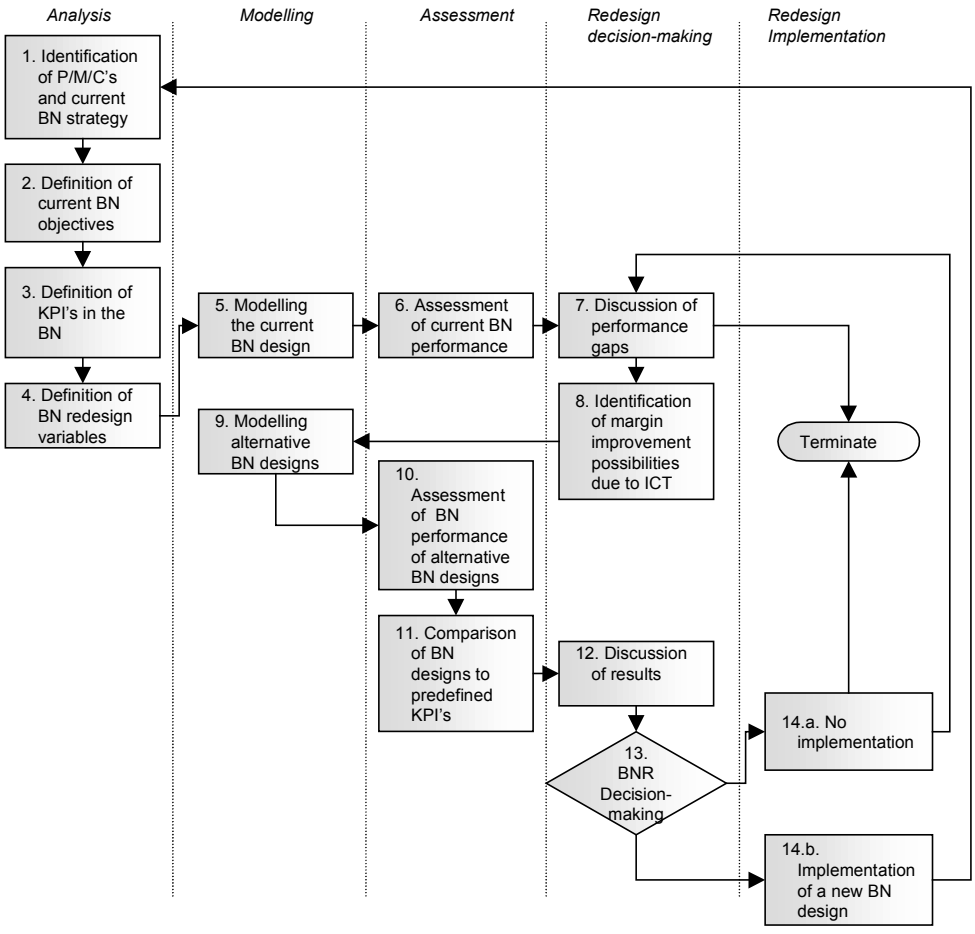
When significant gaps in performance arise, decision-makers will want to consider alternative ICT-enabled options for the business network. Alternative designs can be defined by adjusting the structure of the business network, which can be visualized and modeled based on the use of the redesign variables. The impact of the adjustment of the redesign variables (i.e., the use of ICT) on the performance of the business network can be assessed and compared to current performance. Then, the decision to implement the alternative design, to define other alternatives, or to terminate the evaluation process can be made.

In summary, the following five stages can be distinguished in the process of redesigning ICT-enabled business networks:

1. *Analysis:* The first stage involves getting information and developing a common understanding about the product-market combination the business network is serving, its strategy and shared objectives. It contains the definition of the corresponding margin-flexibility-related KPIs and the definition of the available redesign variables. In this stage, the boundaries of the business network under study will be defined.
2. *Modeling:* The second stage involves the modeling of the current BN design and the predefined, alternative ICT-enabled design options.
3. *Assessment:* In the third stage, the ex post assessment of the margin-flexibility of the current BN design and the ex ante assessment of the alternative ICT-enabled design options are carried out, together with a comparison of the various designs.
4. *Redesign decision making:* The fourth stage involves the discussion of the performance gaps in the margin–flexibility of the current design and the possibilities for improvement due to ICT, thus setting the boundaries for the alternative ICT-enabled redesign options that will need to be modeled and assessed. This stage includes the process of choosing the final redesign option.
5. *Redesign implementation:* The fifth and last stage relates to the actual decision-making for implementing redesign. This stage includes identifying the best conditions for implementing the chosen ICT-enabled redesign.

4.3 The 14- step research protocol

These five stages, together with their related activities, result in a five-stage, 14-step research protocol (figure 4.1).



Note: P/M/Cs = product-market-combinations
BN = business network
KPIs = key performance indicators
BNR = business network reengineering

Figure 4.1: The research protocol

In the next five subsections, the activities for each stage and their related redesign techniques and tools are defined and discussed. In this process, the remainder variables of the research model that are not operationalized in the original MND method are further specified.

4.3.1 Operationalization of the first stage: analysis

The analysis is facilitated by using *business network scenarios*. 'Scenarios are considered to be the best available language for the strategic conversation. They allow differentiation in views, but they also bring people together towards a shared understanding of the situation, making decision-making possible when the time has arrived to take action' (Van der Heijden, 1996). A business network scenario is an aid in the analysis that will define the boundaries of the business network under study. Since a business network is always part of a larger business network, the boundaries of the network being studied are investigated by determining the extendedness of the business network horizontally (i.e., the width of the business network) and vertically (the length of the business network) (see also figure 2.1.). A business network also markets multiple products to multiple distribution channels, satisfies multiple customer orders, and is supplied by multiple suppliers. So, one has to determine the degree of decomposition when analyzing and designing business networks. What aspects of the business network can be analyzed separately without losing sight of reality? This question can be answered with the following four steps:

S*tep 1: Identification of product-market combinations and the current strategy of the business network*

The increased complexity of the market environment, coupled with the multi-product, multi-market, and multi-national nature of the business network will lead the actors to develop their strategies around *portfolio analysis* (Kotler, 1988). Portfolio analysis enables organizations to make better decisions with respect to which market or product should be maintained, which expanded, which phased out, and which new interorganizational relationships or ventures pursued. A well-known and commonly used framework in portfolio analysis is the General Electric business screen, which is used to determine each strategic business unit's strengths and weaknesses by combining a number of factors into a composite value. It is also used to assess environmental factors that represent risks and opportunities. Thus, the method uses multiple factors to assess each unit's business strengths and market attractiveness. The business screen matrix is divided into nine cells to represent high, medium, or low market attractiveness and strong, average, or weak business strengths. For portfolio models like this, the return on investment must be measured for a given business unit, within a given industry, under specific market conditions, and following a given marketing strategy. This makes it a useful model for our research.

The use of information and communication technologies will enable the business network to move into new markets, to expand existing opportunities, to improve customer service, and to exploit competitors' weaknesses (Venkatraman & Kambil, 1991; Norman & Ramirez, 1993; Vervest & Dunn, 2000). Furthermore, increased demand for mass customization (van Asseldonk, 1998), the effects of globalization (i.e., open markets), new competitors (e.g., Internet service providers), and the increased demand for multi-

channeling and worldwide accessibility of services place increasing demands on the management of new product-market combinations in the business network. Once the characteristics of the new product-market combinations have been identified and mapped onto the business network's strategic capabilities and current strategy, new or adapted strategies can be developed. Once the direction for the future strategy of the business network is set, the overall redesign strategy and its related objectives can be derived.

Step 2: Definition of the business network's current objectives
The shared objectives of (each actor and of) the current business network can be derived from the characteristics of each of the product-market combinations and the BN strategy. In this context, Christopher (1998) emphasizes that in order to achieve leadership through interorganizational relationships, an organization must go through a number of fundamental transformations:

- Make the change from a function to a process orientation;
- Switch the organization's emphasis from product management to customer management, reflecting the fact that it is through the creation of customer value that organizations compete;
- Change from a transaction mentality to a relationship mentality, since it is through the management of relationships that the business gains and maintains competitiveness.

So, to be successful in the market, BN management should be focused on realizing a process orientation in the network, together with good management of customer and actor relationships. These transformations should in some way be reflected in the business network's objectives. This requires joint definition of and agreement on the objectives of the business network, and monitoring them. With the establishment of the shared objective of margin-improved flexibility in the business network, both the customers and actors of the network benefit. The customers will benefit from the increased variety of customized products and services, and the actors will benefit from increased flexibility and selling effectiveness as well as the decrease in costs, resulting in increased profitability. The objectives can be monitored and evaluated by translating them into predefined key performance indicators at the level of the process, the actor, and the business network.

Step 3: Definition of the key performance indicators in the business network
This step is related to the importance of using appropriate and uniform network-wide performance measures that are relevant to the business network's objectives and, thus, to its customers and performance. Establishing relevant KPIs in a business network requires careful selection to ensure that the KPIs support the selected strategy and that each actor agrees upon the definition of each measure and how it is to be calculated. Furthermore, they must agree on the data sources (such as where the data reside), the frequency of measuring, and the level of measurement (e.g., category, department, customer, etc.). The

shared objective of margin-improved flexibility in the network can be monitored and evaluated by translating it into the margin-related KPIs at the level of the process, actor, and business network.

In this process, four assumptions have been made:

- The relevant KPIs are related to the activities in the primary transformation processes of the actors involved in the business network.
- The process level is assumed to be enhanced at both the actor level (i.e., including all interorganizational processes) and the business network level (i.e., including all inter- and intraorganizational processes).
- The assessment of investments in ICT will be limited to the operational costs related to ICT enabling and will exclude initial investments. Therefore, this KPI is assumed to be enhanced in the area of costs and, eventually, the margin of the business network.
- To capture customer demand, we consider the level of flexibility to be the relevant KPI.

In table 4.1, the margin-related, operationalized KPIs, at the level of both the actor and the business network, are summarized.

Table 4.1: The key performance indicators related to margin flexibility

Level of assessment	KPI	Definition
Actor level	Actor costs	All the costs of operations and transactions – related to customer orders – that are performed by a single actor in the process of filling customer orders in the business network.
	Actor revenues	All the sales revenues – related to customer orders – generated by a single actor in the business network.
	Actor flexibility	The ability of a single actor in the business network to respond quickly to a diverse set of customer orders. Actor flexibility contains two elements: *Actor versatility*, which refers to the extensiveness of a product and/or service range a single actor of the business network is able to deliver. *Actor agility*, which refers to the period of time it takes a single actor of the business network to full customer orders.
	Actor margin	The end result of all actor revenues generated minus all actor costs.
BN level	BN costs	All the costs of operations and transactions – related to customer orders – performed through the business network in the process of filling customer orders. *Operating costs* in the business network refer to the costs of production-related tasks performed through the business network in the process of filling customer orders. *Transaction costs* in the business network refer to the costs of managing the dependencies between the production elements and the costs related to the trade of the relevant sets of service elements through the BN.
	BN revenues	The sales revenues – related to the customer orders – generated by the business network.
	BN flexibility	The ability of the business network to respond quickly to a diverse set of customer orders. BN flexibility contains two elements: *Business network versatility*, which refers to the extensiveness of a product and/or service range the business network is able to deliver. *Business network agility*, which refers to the period of time it takes to fill a customer order through the business network.
	BN margin	The end result of the BN revenues generated minus all BN costs.

The analysis of the financial values of these KPIs requires access to and insight into the business network's profitability systems, including the activity-based costing practices of all the actors involved in the network.

Step 4: Definition of the redesign variables in the business network

This step refers to the analysis of the structure of the business network, which requires the analysis of (1) all the tasks related to the primary transformation processes, (2) the tasks

related to the planing, controlling, and coordination of these processes, and (3) the BN information system. This analysis can be facilitated when a common vocabulary is used (i.e., by using the constituent elements of the business network described in section 2.2.1 and the modeling elements of the MND method described in table 2.5). Alternative BN designs can then be easily defined based on adjustments of the commonly defined redesign variables.

4.3.2 Operationalization of the second stage: modeling

This stage covers the activity of modeling of the current (step 5) and the alternative (step 9) business network designs. It is fully supported by the MND method (see also section 2.6.1), so further operationalization is not required here. Table 4.2 gives an overview of the main activities of the redesign team when modeling a business network scenario along the four steps of the MND method.

Table 4.2: Overview of the main activities in the modeling stage, based upon the MND method

Steps	Main activities
Step 1: Translation of the incoming order into a particular set of service elements	Analyze the 'Flower of service' Define the service elements
Step 2: Translation of the selected set of service elements into a set of production elements	Analyze the production elements Determine the network of actors Assign the production elements to the focal actor and external actors Define the link of production elements to service elements
Step 3: Design of the process module network (PMN)	Analyze the process steps Analyze the links among process elements Analyze the links of process steps to production elements
Step 4: Assessment of PMN costs and throughput time	Define the assessment procedures

For specifying service elements (SEs), the ' Flower of service' identified by Lovelock (1995) can be used. The 'Flower of service' describes the dimensions of value-adding features offered by an organization to its customers. Such features include, for example:

- information elements, i.e., documentation, conditions of sales/service;
- consultation elements, i.e., advice, personal counseling;
- order-taking elements, i.e., on-site fulfillment of order-entries;
- billing elements, i.e., periodic statements of activity, invoices for individual transactions, verbal statements of payments due, etc;
- payment elements, i.e., self-service, paying direct to payee or intermediary, etc.

Another way to identify SEs is to conduct an archival analysis of orders previously filled. The differences in customer requirements reflected in these orders indicate how service elements could be specified.

4.3.3 Operationalization of the third stage: assessment

The third stage covers the ex post margin assessment of the current business network design (step 6), the ex ante margin assessment of the defined alternative ICT-enabled redesign options (step 10), and the comparison of the various designs (step 11). The ex post and ex ante assessments of costs and agility (i.e., throughput times) have already been operationalized in the MND method (see section 2.6.2). Therefore, we will focus on the operationalization of the remaining, predefined KPIs – (1) versatility, (2) revenues, and (3) margin – together with the comparison of the various designs and the definition of assessment procedures. Assessment procedures specify how to link the relevant BN redesign variables to specific key performance indicators.

Versatility

The second dimension of flexibility in the business network that needs to be operationalized, is the versatility of the business network. *Business network versatility* refers to the extensiveness of a product and/or the range of services the business network is able to deliver. The extensiveness of the product or range of services can be defined by measuring the number of relevant sets of service elements, i.e., the variety the business network is able to produce and deliver in a given period of time. The more different relevant sets of service elements that can be constructed, the higher the extensiveness of the product or service range. Business network versatility can decrease when, for example, the actors in the business network decide to phase out the less profitable or the less popular products or services. Business network versatility can increase when, for example, the actors in the business network decide to expand their portfolio by developing new products or forming new ventures. So, the procedure for calculating the versatility of the business network involves measuring the total amount of relevant sets of service elements produced in a given period of time.

Revenues

Revenues refer to sales revenues related to the customer orders that are generated by the business network. The assessment of BN revenues is related to the number of relevant sets of service elements that are traded in the network. The starting point of this relationship is the view that trade processes in the business network are in fact a complex constellation of actions and reactions between customers and actors. The output of this interaction is a product or service that fits most actual demand and represents value to the customer, since a price is paid. Or, in other words, the selection of a customer-specific order activates specific (sets of) activities in the business network. The result of this interaction (i.e., performance), to which every actor of the business network has contributed, can be measured quantitatively. Depending on the actor's pricing strategy, the price of service elements can be variable or fixed. Since the price of each selected (set of) service elements is known, the sales revenues in the business network can be calculated by adding up the selling prices of all the sets of service elements traded in the business network in a given

period of time. This assessment can be made at either the level of the actor (i.e., the distribution of [part of] the sales revenues generated in the trade process by one particular actor) or at the level of the business network.

Margin

The concept of BN margin is illustrated in figure 2.11 and has been operationalized by subtracting total BN costs from total BN revenues. For the assessment of margin, it is important that in the end, the 'entities' that form the business network are also financially responsible. Often referred to as strategic business units or divisions, such entities have their own balance sheets and are fully responsible for the strategy of pricing and costing their activities. In this dissertation, entities that have these characteristics are called *actors*. Note that the margin of the business network is the end result of factors that, ceteris paribus, can influence the following:

1. *An increase of revenues at the same cost level:* A general factor that can influence revenues is the pricing strategy; for example, the higher the value of different ways of bundling service elements, the higher the price can be. A perception of higher quality of, for example, ICT-enabled service elements by the customer can lead to the acceptance of higher prices.
2. *A decrease of cost at the same price level:* General factors that can influence operating costs include, for example, the use of new production techniques and technologies, cheaper collaborative manufacturing, a cheaper labor force, increased purchasing power (so that material costs can be lower). They also include environmental and political regulation, higher network capacity based on critical mass, etc.
3. *A higher (differential) increase in revenues than the related (differential) increase in costs*.

Comparison of the various designs

The procedure for comparing the margin of different business network designs is illustrated in figure 4.2. The differential change in margin of the business network (ΔM) can be calculated by subtraction (M_2-M_1), once the margin of the current business network design (M_1) and the margin of an alternative design (M_2) are assessed.

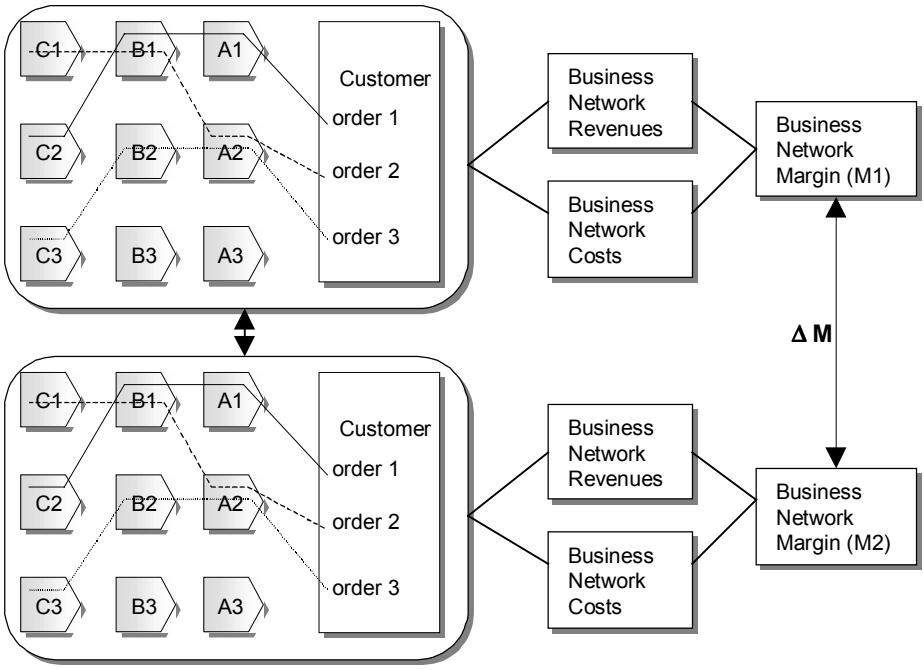


Figure 4.2: Procedure for comparing different business network designs by margin

4.3.4 Operationalization of the fourth stage: redesign decision making

The fourth stage, i.e., decision making about redesign, involves discussing the performance gaps in the margin flexibility of the current BN design (step 7) and identifying improvement possibilities due to ICT (step 8). The discussion of performance gaps in the margin flexibility of the current business network starts with the thorough internal and external analysis of the current BN design that was done in the analysis stage. From there, the directions that will lead to performance improvement due to the use of ICT can be predicted. In this context, the ICT redesign guidelines of Davenport and Short (1990) can be used. Eventually, steps 7 and 8 result in setting the boundaries of the alternative ICT-enabled redesign options that will be modeled and assessed.

The internal and external analyses will have revealed the fundamental drivers of flexibility, revenues, and costs in the business network. So, questions related to how to improve the flexibility, revenues, and/or cost structure of the business network with the aid of ICT will need to be answered. Examples of such questions are:

- *Which of the customers of the business network erode rather than build profitability and why?* The delivery of service to customers consumes resources. Each customer and service place different demands on the business network, requiring different levels of resources, sufficient in some cases to erode profitability. How can the use of

ICT optimize the use of resources? ICT can help optimize the use of resources by, for example, adding new relevant sets of production elements, such as cheaper and/or faster solutions for a certain set of service elements; changing sequential coupling of process modules into pooled coupling (where the execution of one process module does not depend on the completion of another); adding new process modules, such as information processing activities, that can speed up physical activities by making information available earlier; or removing those process modules that only process redundant information (i.e., information that has been processed or exchanged earlier in the network but which is then processed or exchanged again).

- *Which activities have the greatest leverage over improving service or customer profitability and why?* Some activities will deliver aspects of service that are highly valued by the customer. Further investment in these activities may yield disproportionate additional profit.
- *How can ICT optimize customer profitability?* For example, the use of ICT enables the expansion of relevant sets of service elements to include the existing database of elements, or the development of new service elements, e.g., using the Internet as an information channel instead of regular mail. Customer profitability is improved by either increasing gross margins or reducing the costs of customer servicing. Ways to increase gross margins on products include (1) increasing revenues (sales) by enhancing coverage, increasing closure rates, or building repeat sales or (2) raising the percentage of margins by reconfiguring pricing/terms, focusing on profitable customers, or improving negotiation strength. To look for possibilities for reducing the costs of serving customers, the following questions can be asked: (1) What service activities are performed and what is the selling/service effort involved in performing them? What is the cost of customization? What is the cost of after-sales service? (2) Who performs the activities and is it done in-house or by a third party? Where should accountability lie? How cost-efficient are the resources used? (3) When are activities performed? Can the frequency of the activity or the impact on the activity be altered? (4) Can activities be redistributed to other actors in the business network or can other resources be used?
- *What drives cost within the business network?* Resources in the business network are consumed in response to different events. For example, a new customer will bring benefits but will also require additional effort. A new service code may require further revenue for stock control. Different events of this type are all drivers of cost. Some will influence the growth of costs more than others. How can the use of ICT minimize costs in trade or production channels? One example is the introduction of the Internet as a new channel for transactions or electronic delivery.
- *What inefficiencies exist within the business network?* The measurement of process performance in terms of cycle times, trends, variability, and error is well established. The amount of unrelated activity that takes place within a process is a measure of the additional resources needed as a result of inefficient methods and errors within that

process, indicating opportunities for improvement. How can ICT reduce these inefficiencies?

Steps 11 and 12 will reveal the critical factors related to the selection of the final redesign option through comparison of the current and alternative business network designs on the predefined KPIs (step 11) and discussion of the results (step 12).

Step 13 relates to the actual decision-making, i.e., whether or not to implement the chosen ICT-enabled BN design. Simon (1976) observes that we often mistakenly think of decision-making activity as occurring only at the moment of choice. In fact, decision making is a complex sequence of differentiated activities occurring over time. Numerous distinct paths can be followed to arrive at a decision. Often, choosing the path (determining the structure of the process) is more important and more difficult than traversing it (executing the process). Keen and Morton (1978) conclude that there are five approaches to managerial decision making:

1. *Rational decision making:* where the manager is completely informed, knows all the alternatives, and can make an optimal choice ('objective rationality');
2. *Satisfying decision making:* where an alternative that satisfies all participants is sought ('bounded rationality');
3. *Organizational procedures:* where decisions are seen as the output of standard operating procedures used by organizational subunits;
4. *Political decision making:* where a decision is seen as the result of negotiations between actors – power and influence determine the outcome of any given decision;
5. *Individual differences:* which presupposes a very important role for the character of the individual –personality and style are of great importance.

In general, a mix of these approaches is applied when a decision is made (Benders et al., 1983). The steps used in real-life situations will reveal which approach the redesign team has chosen.

4.3.5 Operationalization of the fifth stage: redesign implementation

The fifth and last stage includes the actual implementation of the redesign option (step 14). This stage includes the identification of the best implementation conditions, since successful implementation depends on several critical factors. The analysis of real-life situations (see also chapters 5 and 6) will help to reveal these factors.

4.4 The Business Network Navigator

To allow flexible access to the research model and to support the modeler and/or decision maker in the consecutive steps of the research protocol, a new automated software program, called *Business Network Navigator* was developed. It supports the decisions involved in steps 3, 4, 5, 6, 9, 10, and 11 of the research protocol. Business Network Navigator was programmed in Arena®. Arena provides alternative and interchangeable

templates for graphical simulation modeling and analysis modules that one can combine to build a fairly wide variety of simulations. Therefore, the Arena environment can be used to include menu-driven point-and-click procedures for constructing the following:

- databases of all available redesign variables and the performance indicators related to margin flexibility that are necessary to capture the boundaries of a business network design;
- business network scenarios that visualize the filling of orders through the process-module network and simulate change in business activities, roles, and linkages between actors in the business network;
- management reports – as the simulation proceeds, the simulation tool keeps track of statistical variables to calculate the required output.

A detailed description of the development of the Business Network Navigator and how it works is given in appendix I

5 MARGIN-IMPROVED FLEXIBILITY ASSESSMENT IN THE POSTBANK – POST OFFICES – PTT POST CASE

5.1 Introduction to the case study research

The next step was to gain actual experience with the research model, the research protocol, and the Business Network Navigator in real-life situations. Therefore, a first explorative effort was carried out focusing on two different industries. The first case study was conducted in the financial service industry and the second, in the intellectual property industry. Yin's (1994) guidelines were followed for the case study research. And tests were set up to establish the correct operational measures for the constructs being studied ('construct validity'), to establish the domain to which they could be generalized ('external validity'), and to demonstrate that the approach could be repeated with the same results ('reliability'). This was done using the following (Yin 1994, p. 78):

- multiple sources of evidence, i.e., accountancy systems such as activity-based costing and customer profitability systems, expert interviews, etc.;
- project teams for expert testing purposes to validate the results obtained. The project team for the first case study consisted of (1) the key responsible persons (i.e., commercial and financial, ICT) for the distribution channels in the business network, (2) the scientific researcher from ERASMUS University, and (3) the key account marketing manager of the PTT Post (the author of this dissertation);
- databases of case data.

The Business Network Navigator was used to process the case data. It relates the available redesign variables in the business network scenarios to the absolute values of predefined key performance indicators and, from there, computes the margin and flexibility level of the current and the redesigned BN scenarios. In order to run the Business Network Navigator, specific input data are required. Therefore, a list of activities necessary to obtaining the required input data must be made (table 5.1). This list is derived from the main activities underlying the ex ante assessment method.

Table 5.1: List of data collection activities related to the Business Network Navigator

Data collection activities	
1.	Gather and analyze the 'Flower of service' for the services under study
2.	Determine the SEs of the customer order under study
3.	Gather and analyze the PEs of the order-filling processes (OFP) under study
4.	Determine the network of external actors involved in the OFP under study
5.	Assign PEs to focal actor and external actors
6.	Determine the links of PEs to SEs of the customer order under study
7.	Gather and analyze the PMs in the OFP under study
8.	Analyze the links among the PEs of the OFP under study
9.	Analyze links of process steps to PEs of the OFP under study
10.	Analyze the amount of SEs traded in the BN under study
11.	Gather and analyze the selling price of each set of SEs traded in the OFP under study
12.	Gather and analyze the actors' resources (such as direct material, direct labor, and overhead) that can be contributed to these Pes
13.	Gather and analyze the 'cost drivers' per PE of the assigned actors under study
14.	Gather and analyze the costs per unit 'cost driver' (= resource tariff) per PE of the assigned actors under study
15.	Measure the resource consumption of these 'cost drivers' of PEs of the assigned actors under study
16.	Measure the number or relevant sets of SEs provided in the OFP under study
17.	Measure the 'duration driver' of each of the PMs in the OFP under study

Note:
SEs = service elements
PEs = production elements
PMs = process modules
OFP = order-filling process

5.2 Why these cases?

The number of potential suitable cases was seriously limited by some of the requirements for selecting cases for analysis, in particular, finding an existing business network that is struggling with ICT-enabled redesign issues, and has the following characteristics:

- an ABC relationship between the focal actor and two external actors (for 'external validity');
- commonality among actors regarding the use of comparable costing methods;
- commonality among actors on the exchange of internal data on business performance.

Because of these requirements, the selection of cases for research had to be pragmatic and, at times, opportunistic. Given the interest of the PTT Post in ICT-enabled modularity and improving business performance (see chapter 1), the initial search was among its business partners, to find one that was struggling with ICT-enabled redesign issues. As it happened, the PTT Post Offices needed to analyze new ICT-enabled concepts for retail distribution. So the responsible managers at Post Offices, Postbank, and the PTT Post were asked to cooperate in the first validation effort, which they eventually agreed to do. However, one problem that had to be solved first was their reluctance to provide the 'open-book calculations' necessary for our research. Therefore, a secrecy agreement had to be signed, stating first that a 'key' would be used when presenting the data of the individual actors. Using such a key does not reveal the confidential ABC data of the individual actors, but

keeps the relationship between the data intact. Given that the scope of the research lies in evaluating the relative change in margin, the first case study was conducted with this in mind.

Later, it happened that another customer of PTT Post, the European Patent Office (EPO), also needed to analyze a new ICT-enabled distribution concept, which would make the comparison of experiences with the research methodology even more interesting. So, the responsible redesign manager at the EPO was asked to cooperate in the second validation effort. In this instance, the participants did not object to the exchange of internal data on business performance.

In the remainder of this chapter, the results of the first case study are presented; the results of the second case study are given in chapter 6.

5.3 Set-up of case study 1

The case study on the Postbank–Post Offices–PTT Post was conducted in the period November 1998 to August 1999. The case aimed to identify the impact of ICT use in the distribution system of the current business network. Post Offices needed to analyze new, ICT-enabled concepts for retail distribution as result of the following:

- changing customer requirements with respect to the home-banking services;
- developments in channel marketing, i.e., the advent of the Internet;
- decreased sales volume of Postbank services at the Post Offices;
- the introduction of less complex postal services at the Post Offices, i.e., self-service.

The distribution system was investigated by means of a specific customer order in which the three actors were directly interrelated in the production process. Central in the analysis of the business network was the focal actor, i.e., the Postbank. The current business network was analyzed and the current business network scenario, together with three ICT-enabled redesign scenarios, was modeled and assessed. The same order was analyzed in each of the scenarios, from order placement to after-sale filling of the order – in other words, from the opening of a giro account to the delivery of the transfer order book at the customer's house. This made the various scenarios comparable in terms of:

- the type of services requested by the customer of the business network;
- the relationship between services requested and the type of processes required in the business network to provide these services;
- the relative change in margin-flexibility levels;
- the distribution of expected benefits among the actors in the business network.

5.4 Experience with the 14-step research protocol

5.4.1 Step 1: Identification of product-market combinations and the current strategy of the business network

Because of changing customer requirements and the declining profitability of the Post Offices, the two owners of the retail organization, i.e., the Postbank and PTT Post (sharing capital equity of 50:50) forced the Post Offices to initiate new ICT-enabled retail distribution concepts. The two owners are part of two officially listed companies: Postbank BV is part of the large international financial concern, the ING Group, and PTT Post is part of the TNT Post Group (formerly part of KPN Holding), and is a large international player in mail, express, and logistics. As part of the privatization of KPN Holding in 1989 (KPN Yearly Report, 1989), the retail division of the Postbank and PTT Post was turned into a separate company, both legally and financially: the Post Offices BV. Since that time, the three organizations have worked together commercially through a value-added partnership, which is based on a long-term commercial contract. The terms of this contract are renegotiated every five years. In their drive to become global market players, Postbank BV and PTT Post BV are continuously assessing the payback of large ICT investments on future revenues and cost reduction. In this context, they also focus on rendering their distribution systems more margin effective (i.e., more cost and revenue effective) and tailored more fully to changing customer needs.

5.4.2 Step 2: Definition of the business network's current objectives

In a drive to increase the effectiveness and efficiency of the retail distribution system, the decision was made to analyze the feasibility of new ICT-enabled retail concepts. The main drivers for participating in the redesign study were as follows:

- For the Postbank, it was primarily to gain insight into new retail concepts in order to increase market coverage in its domestic market while keeping the costs of distribution low, and second, it was to increase the internal efficiency of the current process of opening new giro accounts.
- For the Post Offices, it was to increase internal efficiency and profitability.
- For the PTT Post, it was to find opportunities to increase the efficiency of postal distribution networks related to the process of opening new giro accounts.

5.4.3 Step 3: Definition of key performance indicators in the business network

The first consideration in executing this step was to include all key persons involved. The key persons mutually responsible for the performance of the retail channels were officially and individually invited to participate in the project team. One problem that came up in the beginning was the selection of the customer-service processes to be analyzed and assessed. Postbank BV was initially opposed to investigating a primary business process in the BN but eventually supported the idea of a pilot case study on a secondary business process, i.e., opening of a new giro account. A second consideration was the inability to provide the necessary costing data at the interorganizational (i.e., business network) level. Therefore,

the starting point was the definition of the pre-defined key performance indicators at the actor's level. From there, the KPIs at the BN level were derived.

The key performance indicators were defined as follows:

- *Operating costs* contain the total (i.e., fixed and variable) costs of the production tasks that are related to the opening of a giro account, including the cost of producing and distributing a 'transfer order book' to the new customer.
- *Transaction costs* contain the fixed and variable costs of marketing, sales, and internal and external communication that are related to the opening of the giro account, based on the customer profile. Since the focus of the case was to demonstrate whether the use of ICT has a positive or a negative effect on the relative change in margin, the changes in operating and transaction costs in each of the scenarios were considered. The initial cost of investment in ICT, as such, was not included, but the ICT effect was enhanced in the relative change in fixed and variable operating costs.
- *Sales revenues* contain the amount of relevant sets of service elements traded and their corresponding selling prices.
- *Agility* contains the operating time, i.e., the time it takes to complete the production tasks related to the opening of a giro account, including the cost of producing and distributing a 'transfer order book' to the new customer. Actor agility, as such, was not specified in the existing management accounting system at the Postbank and Post Offices, in contrast to PTT Post. Since PTT Post is a time-critical industry, operating, throughput, and delivery times for each type of mail service were available. In order to get measurements at the actor level for the Postbank and Post Offices, the operating times of the relevant production tasks were first distilled from different internal sources of production information and, when possible, benchmarked with external sources to assess the sensitivity of the data obtained.
- *Versatility* contains the measurement of the total amount of relevant sets of service elements that are related to the opening of a giro account, including the distribution of the 'transfer order book' to the customer's house. Actor versatility, as such, was not specified for either of the actors involved; therefore, the pre-defined assessment procedure (see section 4.3.3) was used to measure this KPI in each redesign option.

5.4.4 Step 4: Definition of the redesign variables in the business network

A consideration that was faced in the execution of this step was that not all of the key people involved were familiar with the principles of modularity in the design of products, processes, and business networks. Therefore, the use of the redesign variables – the constituent elements of the business network (see section 2.2.1) and the modeling elements of the MND method (see table 2.5) – was not always clear, but required training and detailed discussion. For example, the difference between production elements and process modules is not always obvious. This also applies to the difference between service elements and production elements. As research at PTT Post revealed, what was initially

considered a production element turned out to be an 'invisible' service element (Delporte & Rauscher, 1998).

For this step, first the relevant parts of the product portfolio (i.e., the *service elements*) of the different actors involved were specified, based on three types: operational, supportive, and invisible. *Operational* service elements are service elements that describe the functional aspects or service features of the service. Examples are conditions of sales/service, shipping and billing documentation, advice, etc. *Supportive* service elements refer to customer links that support the operational service elements and which are required from the perspective of management and control. Examples are quality reports, claim procedures, etc. *Invisible* service elements are service elements that are offered by the company delivering the service but which often remain invisible to the end customer. Examples are R&D, concept development, account planning, etc. These invisible service elements are often translated into hidden sales costs or overhead. The advantage of breaking the product portfolio down into modular entities or sets of service elements is that individual service elements represent a different value to the customer, depending on preferences of time and place. Moment-specific differences represent an important economic potential for suppliers (Gilmore & Pine, 1997). Eventually, this resulted in a database of service elements in Business Network Navigator. A complete overview of these service elements is also given in the case study report (van Oosterhout & Delporte, 1999, p. 21–22).

Second, based on the process information gathered in the previous step, the relevant production tasks at the level of the actor and the business network could be specified for a specific customer order. Eventually, this resulted in a database in Business Network Navigator of all *production elements* and *process modules* available in the business network. A complete overview of the database of production and process modules is also given in the case study report (van Oosterhout & Delporte, 1999, p. 23–24).

5.4.5 Step 5: Modeling the current BN design

At the time the case study was done, the process for opening a giro account involvied the following:

- order intake based on person-to-person contact at the Post Offices;
- order processing at Postbank BV;
- distribution of the order-related documents between the Post Offices and Postbank, and home delivery to the customer by PTT Post.

This constitutes the current design: the customer interacts with the front-office employees of the Post Offices during the order intake. The order processing is allocated to the back-office employees at the Postbank. The logistics of the order are allocated to the PTT Post.

Based on the pre-defined dependencies between the different modeling elements in the current design, the process module network could be drawn as depicted in figure 5.1. This scenario is 'order 1.'

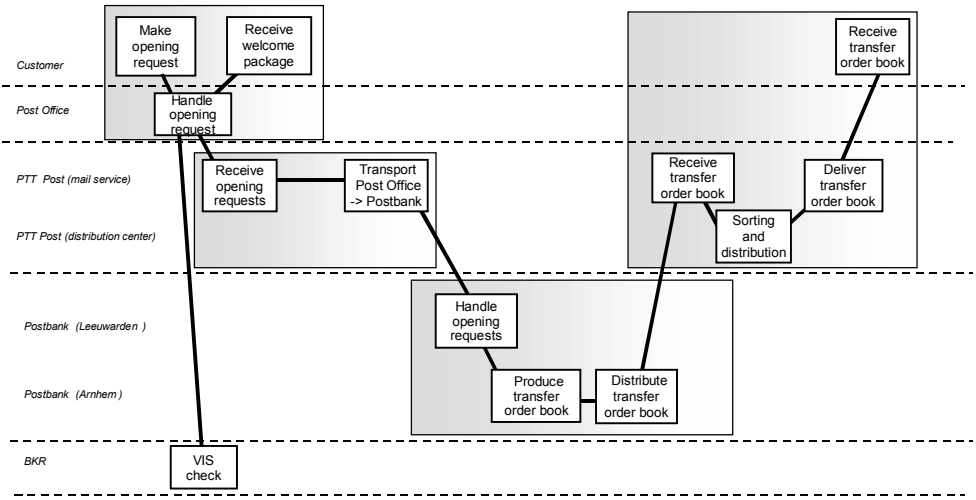


Figure 5.1: Schematic view of the process module network of the current design (order 1)

The process module network describes the order in which each BN actor performs a specific part of the process for the total completion of the order. In the current situation, it is the Post Offices that handle the opening request and send the document to the Postbank by mail. It is the Post Offices that follow the fraud-control procedure by contacting the Bureau Krediet Registratie (Credit Registration Office). The Postbank does the data entry and the processing of the opening request and produces the transfer order book. Then, the PTT Post transports the opening request from the Post Offices to the Postbank and delivers the transfer order book to the customer's home. The dotted lines indicate the dependencies of main tasks in this process module network.

5.4.6 Step 6: Ex post margin assessment of the current BN design

Based on the list of data collection activities (see table 5.1), input data were gathered and entered into Business Network Navigator, and BN margin and BN flexibility were computed as illustrated in table 5.2. During this process, key participants, often business controllers, verified the collected data and the data sources before entering them into Business Network Navigator.

Table 5.2: The distribution of BN margin and BN flexibility of order 1 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in numbers
Postbank	73.63	0	– 73.63	3420	-
Post Offices	5.05	15.9	10.85	35	-
PTT Post	4.50	4.1	– 0.40	2546	-
Total	83.18	20	– 63.18	6001	24

Assessing BN costs

How was the completion of order 1 in the business network linked to the assessment of BN costs? In business network design, one of the challenges is to build a BN cost structure that enables the mass customization of highly individualized sets of service elements at a low cost-to-serve level. However, there were problems determining the costs at the BN level because appropriate data were not available. The outcome of a cost assessment is largely dependent on the perspective chosen: the network perspective versus that of the single actor. The costs of one actor do not correspond to the costs of another actor who is subcontracted to the first. The former are costs needed for an ABC analysis; the latter are tariffs charged by one organization to another. This was the case with the Postbank, which normally paid a fixed amount per order handled by the Post Offices. The management accounting system was not so refined that the cost object could be a specific customer, instead of a product or department. So, the Postbank could not provide cost-performance measures that pertained to individual customers (also denoted by Kaplan & Cooper (1998) as the second-generation customer cost analysis). Therefore, an attempt was made to carry out a *customer order cost analysis* at the level of the entire business network.

ABC techniques, together with the pre-defined assessment procedure, were used to assign customer costs to activities. For each of the defined production elements, the resources were identified in terms of labor, material, ICT equipment, cost of sales, etc. When hard data were missing, the required resource utility of production elements and process modules was estimated. The corresponding resource tariffs were estimated based on benchmarking with similar production elements. However, this procedure must be regarded with caution since the resource tariffs of the same production elements produced by different actors may differ, depending on the efficiency of a particular actor.

Eventually, the costs were assessed by multiplying the resource consumption of the relevant set of production elements by the specific resource tariffs. Resource consumption is a function of two elements (Kaplan and Cooper, 1998): (1) 'intensity drivers,' which count resource consumption when an activity is performed, and (2) 'transaction drivers,' which count the number of times an activity is performed over a specified period of time. Resource tariffs indicate the resource cost per unit of activity over a certain period of time. In the business network, one or more actors can work together to produce the selected

production elements. In this regard, the business network should be able to optimize the allocation of activities and costs to be performed within the business network – i.e., cost optimization.

Assessing BN revenues

How was the completion of order 1 in the business network linked to the assessment of BN revenues? In the business network, several seller-buyer relationships exist, with various actors working together to provide customized sets of service elements for the customer of the network. From the perspective of the actors, there is 'internal trade' in the network between actors. In the case study, *internal trade* refers to the customer delivery services bought at PTT Post for the transfer order book and the delivery of business services from the Post Offices to the Postbank. From the perspective of the business network, there is 'external trade' with the end customer, who usually pays an all-in price to a single actor, often the focal actor. In this respect, the business network should be able to optimize selling effectiveness and, consequently, the revenues in the business network – i.e., revenue optimization. In the assessment of revenues at the BN level, the revenues of both internal and external trade were included since an attempt was made to carry out a second-generation *customer order revenue analysis* (Kaplan and Cooper, 1998). For the assignment of revenues to customer orders, the pre-defined assessment procedure could be used because the selling price of each of the internally traded sets of service elements could be determined. Note that in this particular scenario, the opening of the giro account was a free service for the end customer.

Assessing BN margin

Knowing the BN revenues and BN costs related to order 1, BN margin could be computed. As depicted in table 5.2, the completion of order 1 resulted in a negative margin contribution for the entire business network and for two individual actors (i.e., the Postbank and PTT Post).

Assessing BN agility

Another challenge in business network design is to build a business network that enables quick delivery of highly individualized customer orders, preferably at a low cost-to-serve level. So, how was the completion of order 1 in the business network linked to the assessment of BN agility? Operating times were assigned to production elements (which are part of the critical path in the process module network) based on the 'duration drivers' (Kaplan and Cooper, 1998) of combinations of production elements/process modules. These duration drivers indicated the time necessary to perform the unit of work in the process module network. Once the duration driver for each unit of work for order 1 was defined, the total operating time of the process module network was calculated. This is expressed in the number of minutes it takes to perform the necessary combination of production elements/process modules.

Assessing BN versatility

From a strategic perspective, the extent of the product/service range can be assessed by an extensive portfolio analysis. However, the assessment of versatility in the case study was assigned to a more operational level, taking into consideration the product/service range related to opening and using a giro account. So, the assessment was based on the total amount of service elements available to the BN customer.

5.4.7 Step 7: Discussion of performance gaps in the margin flexibility of the current BN design

Based on a yearly volume of about 500,000 new giro accounts, the completion process generated a substantial loss for the focal actor of the business network: the Postbank. Actual performance, together with increasing demand for alternative transaction channels were the drivers behind the consideration of alternative business network scenarios. The Postbank suggested simulating the layout of a multi-channel approach that would permit the reorientation of its distribution channel based on the use of ICT so that they would be more responsive to customer needs and more profitable at the same time. The level of ICT enabling in the current BN design lay in the integration due to ICT of the actor's own business processes, as depicted in table 5.3.

Table 5.3: Dimensions of ICT enabling in the current business network design (order 1)

Business network integration	**Business process integration**		
	No integration	Internal integration with own business processes and applications	Integration with actor's business processes
Customers	—	—	—
Postbank	Stand-alone EDI	EDI integrated with other internal processes, e.g., order entry, order processing, and production	—
Post Offices	Stand-alone EDI	EDI integrated with other Post Offices via ALD network	—
PTT Post	Stand-alone EDI	EDI integrated with other internal processes, e.g., sales marketing, finance based on TVI infrastructure	—

Discussions within the project team resulted in three redesign scenarios, where the current design is order 1:

1. The aim of the first redesign was to focus on optimizing margin flexibility by using ICT in the current design (order 2).

2. The aim of the second redesign scenario was to optimize margin flexibility by using ICT in a 'self-service banking' distribution channel (order 3).
3. The aim of the third redesign scenario was to optimize margin flexibility through an 'internet banking' distribution channel (order 4).

5.4.8 Step 8: Identifying improvement possibilities due to ICT

To identify possibilities for improving the process, the seven generic redesign guidelines of Davenport and Short (1990), discussed earlier, in chapter 2, were used:

1. Support information storage and processing;
2. Automate information exchange (internal and external);
3. Reduce human labor in a process;
4. Treat geographically dispersed resources as though they were centralized;
5. Execute processes simultaneously;
6. Put the decision point where the work is performed and build control into the process;
7. Re-allocate activities among organizations.

Filling the same order through different distribution channels requires the integration of different front- and back-office processes between actors in the business network. In the case of integrating front-office processes, ICT enables management of the customer relationship within the business network. In the case of integrating back-office processes, ICT optimizes resource planning within the business network. In comparing the business network scenarios, the enabling role of ICT in redesigning service and business processes and its impact on (the distribution of) margin flexibility will be discussed together.

5.4.9 Step 9: Modeling the alternative BN designs

First redesign

The current design was taken as the starting point for modeling the second order ('order 2' in Business Network Navigator). In optimizing business processes with ICT, Davenport and Short's (1990) redesign guidelines 1, 3, 5, and 7 were used. The transport of the opening request from the Post Offices to the Postbank, which involved human labor, was replaced by a new ICT-enabled business process in which the conversion from physical document to electronic document took place earlier in the process. This enabled the reallocation of activities among PTT Post and the Postbank (in other words, by-passing the data center of the Postbank). At the time of this research, PTT Post was testing the introduction of three generic document input services (DIS): Imaging Service, Indexed Images Service, and Hybrid EDI. Market research at 175 European companies (Pino and Company, 1997) on future investments in ICT showed that 88% of the companies were planning investments in document technologies, 39% in workflow management systems, 11% in record management, and 10% in digital archiving systems. The main drivers in Dutch companies for investing in DIS imaging and workflow management systems were (1) efficiency, (2) quality, (3) flexibility, and (4) competitive advantage. An estimate of the

digitalization of incoming mail in the Netherlands showed a potential of about 900 million pieces per year. Furthermore, estimates of the trade-off between in-house handling versus out-sourcing demonstrated an increasing tendency to out-source in the near future. Key reasons for outsourcing are (1) cost savings (since initial OCR/ICR investments were estimated to be high), (2) reliability, (3) confidentiality, and (4) connection with in-house standards. In order to assess ex ante the impact of ICT outsourcing to PTT Post, the Postbank agreed to simulate this scenario for the existing channel.

Based on the dependencies between the different modeling elements in this scenario, the process module network could be drawn as depicted in figure 5.2.

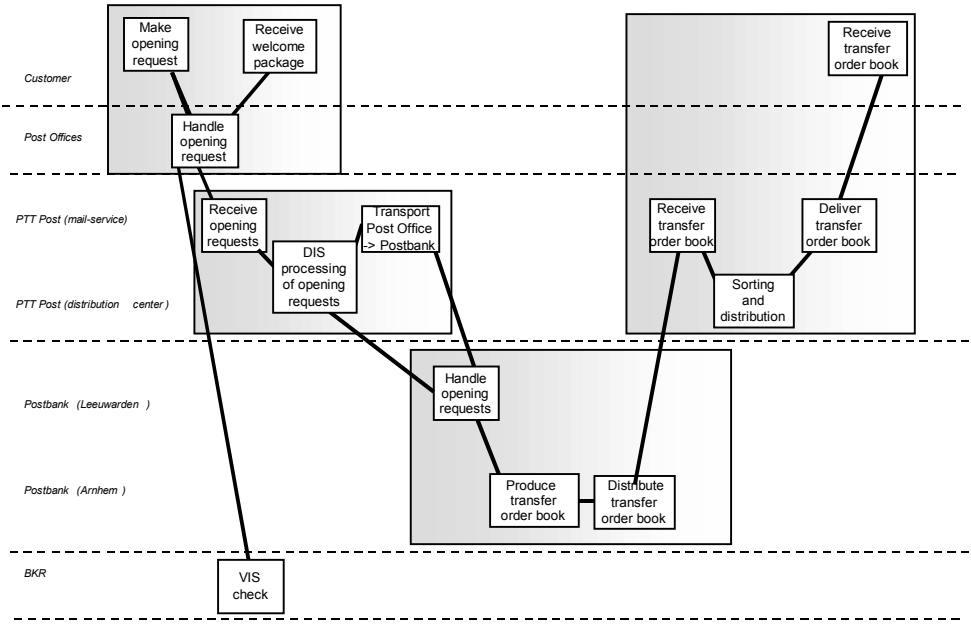


Figure 5.2: Schematic view of the process module network of the first redesign (order 2)

The process module network describes the order in which the actors perform the process of filling the order. In the current situation, it was the Post Offices that opened the request, did the fraud-control procedure and sent the request to the Postbank by mail. But it was PTT Post that did the data entry for the opening request. In this scenario for order 2, the opening request is converted from physical electronic form and sent electronically to the Postbank. The Postbank only processes the electronic requests and produces the transfer order book. At the end, PTT Post delivers the transfer order book to the customer's home.

The potential of ICT in optimizing the business network lies in the fact that:

- The process modules related to transporting physical opening requests from the Post Office to the Postbank become redundant.
- The process modules related to the production element 'processing incoming opening request' at the Postbank can start earlier in the network.
- The process modules related to the production element 'production of the transfer order book' run parallel instead of in sequence.

The level of ICT enabling, with respect to filling order 2, is summarized in table 5.4. The focus of the ICT-enabled integration is extended to the actor's business processes, i.e., business network integration.

Table 5.4: Dimensions of ICT enabling in the first redesign (order 2)

Business network integration	**Business process integration**		
	No integration	Internal integration with own business processes and applications	Integration with actor's business processes
Customers	—	—	—
Postbank	Stand-alone EDI	EDI integrated with other internal processes, e.g., order entry, order processing, and production	**Electronic document exchange with PTT Post DIS center processes**
Post Offices	Stand-alone EDI	EDI integrated with other Post Offices via ALD network	
PTT Post	Stand-alone EDI	EDI Integrated with other internal processes, e.g., sales marketing, finance via TVI network	**Electronic document exchange with external Postbank PDP processes**

Second redesign

Due to increased competition, the Postbank had been looking for ways to increase service coverage in the Netherlands while reducing the costs of their existing distribution channel. Therefore, an increase in the number of Post Offices was not viewed as an option; instead, the Postbank considered self-service banking concepts that a customer could easily access at any existing retail point. So, the second redesign scenario contained the modelling of all processes related to the opening of a giro account at a self-service retail point. Initially, the main requirement was that the retail service point had to provide at least the same level of service the customer received when opening a giro account at the Post Office in the current scenario. Based on the reallocation of activities between actors in the business network and the dependencies between the different modeling elements, the process module network of this order ('order 3') could be drawn as depicted in figure 5.3.

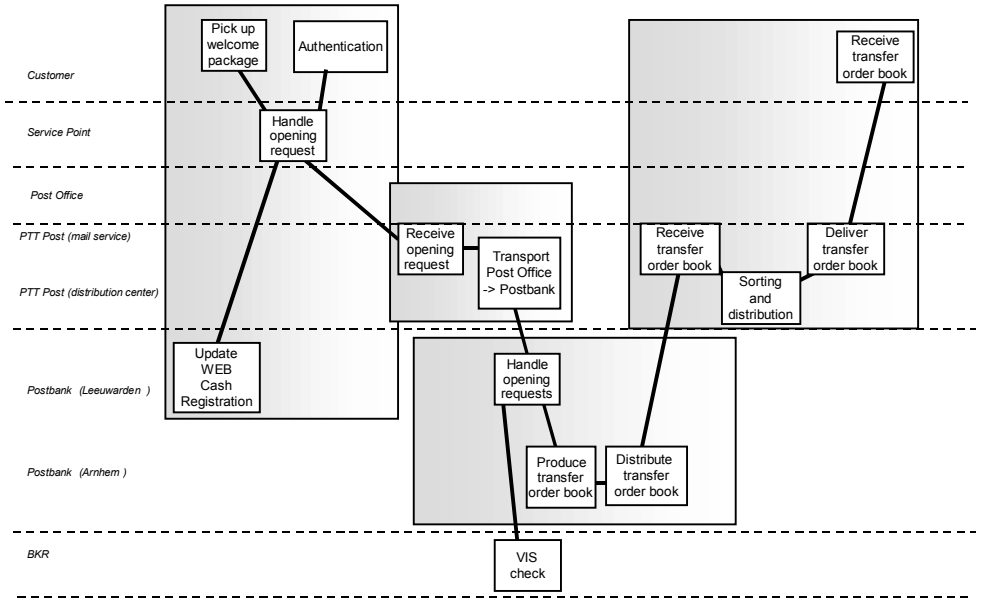


Figure 5.3: Schematic view of the process module network of the second redesign (order 3)

This redesign enhances the use of a web-based multimedia kiosk at the retail service point. The optimization lies in servicing the customer through a physical service point combined with an electronic channel to communicate or make transactions. In addition to dropping costs and creating alternative distribution channels for retail banking products, the new technology of multimedia kiosks also offers the opportunity of selling non-banking products to the customer of the retail channel. Here, the opening request would be handled at the service point and sent to the Postbank by mail. The Postbank would do the data entry and processing of the opening request, the fraud control check, and the production of the transfer order book. At the end, the PTT Post would deliver the transfer order book to the customer's home.

Davenport and Short's (1990) redesign guidelines 1, 2, 3, and 5 were used in optimizing the business network processes with the use of ICT. The potential of ICT in BN optimization lies in the fact that the use of the multimedia kiosk speeds up the exchange of customer information to the Postbank as well as to the customer, i.e., the number of the new account can immediately be revealed to the customer. The level of ICT enabling, with respect to the completion of order 3, is summarized in table 5.5. The focus of the ICT-enabled integration is extended to the actor's business processes ('business network integration').

Table 5.5: Dimensions of ICT enabling in the second redesign (order 3)

Business network integration	Business process integration		
	No integration	Internal integration with own business processes and applications	Integration with actors' business processes
Customers	—	—	—
Postbank	Stand-alone EDI	EDI integrated with other internal processes, e.g., order entry, order processing, and production	**Electronic messaging** **Exchange with Retail Service Point** **via web-based multimedia kiosk**
Retail Service Point	Stand-alone EDI	EDI integrated with other internal processes	**Electronic messaging** **Exchange with Postbank** **via multimedia kiosk**
PTT Post	Stand-alone EDI	EDI Integrated with other internal processes, e.g., sales marketing, finance production	

Third redesign

The third redesign enhances the Internet-based distribution channel in the business network. The market for electronic banking has increased at an astounding pace in recent years. Especially in Europe, direct banks, discount brokers, and financial intermediaries heavily populate the Internet. Low-end customers, which usually do not get full service because of their low profitability, will experience a significant increase in the service provided because electronic banking is mainly driven by fixed costs, in contrast to traditional banking. With ICT prices continuing to fall drastically, this effect will be increasingly relevant for higher-end customer segments as well. Electronic banking will evolve to be much more than just a nice feature, but rather, the strategic instrument for the financial service industry of the future. At the moment, electronic banking is mainly limited to transaction banking and is thus a commodity product that is characterized by noncomplexity and homogeneity.

Ssearch engines and shopping agents, however, have started to provide customers with complete market overviews, which contributes to the problem of decreasing customer loyalty in the financial service industry. Banks suffer not only from the loss of customers but also from increasingly competitive markets and decreasing margins in these markets (Van Rossum, 1999). Several studies have revealed that customer satisfaction and customer loyalty have a strong positive correlation, especially in the financial service industry (Kirshan et al., 1999, p. 1194–1209). However, standardized electronic banking products are not customized and usually do not meet the complex financial needs of individual customers. Poorly served customers can easily substitute these homogeneous products for competitors' products. Therefore, the key factor for a successful electronic

banking strategy is to transform electronic banking products into individually customized solutions for customers' problems, according to the customer's needs and preferences. This notion requires a new understanding of doing business for companies in the financial service industry, especially of doing business electronically (Sealey, 1999, p. 171–176). High marginal costs have forced banks to offer standardized mass products; however, one of the main characteristics of ICT is its negligible marginal costs per customer, which could drastically reduce the marginal costs of a one-to-one approach. Consequently, ICT will not only be the enabling technology for individual electronic banking, but also – through channel integration – for individual banking over all channels (Wells et al., 1999, p. 53–61).

Although the Postbank had experience with tele-banking activities (*girotel*) for giro-account transactions, the actual opening of a giro account by a new customer through the Internet was new to them. At the time, the following commercial, legal, and political constraints surrounded this redesign scenario:

- *Commercial constraints:* The Postbank was providing a tele-banking service to existing business customers for 7.5 euro a month. Opening a giro account via Gironet or the Internet was not on the shortlist of services to be added. However, some competitors were already offering free Internet banking services.
- *Legal constraints*: Banking laws in the Netherlands oblige financial institutions that have physical outlets to do a person-to-person authentication during the process of opening a new account.
- *Political constraints*: Internal discussions about the impact of new technologies on business processes (e.g., chipper, 'smart phone') and the traditional branch-centered model did not facilitate a one-to-one marketing approach. At the time, the segment-oriented approach still prevailed.

The first step in this redesign was to analyze how, given these constraints, the opening of a new giro account via Internet could be done in a commercially, legally, and politically acceptable way. To facilitate decision-making, an electronic prototype of a Web-based request to open a giro account was made. The prototype was based on (1) an Internet browser interface, (2) a Website as a single point of contact, (3) Internet applications available from the key-mail Website of PTT Post, such as a secured mailbox for sending and receiving communications. Nowadays, there is a simple certification and notarization service that many organizations in both the public (e.g., PTT Post) and private domains (e.g., Diginotar, Verisign.com) provide. But at the time the case study was done, this was a new area for the Postbank. Therefore, the experience of PTT Post with key-mail application forms was used and two services were combined into one Postbank Web page:

4. opening a new giro account at the Postbank;
5. applying for a key-mail certificate at PTT Post.

The Internet raises several fears about privacy and security. The major countermeasures are cryptography, digital signatures, CA (certification authority), and NA (notary authority), in that order (Zhou and Gollman, 1996). Certification ensures the genuineness of an entity before trading begins. Notarization safely stores the evidence of events and actions during trading for a long time and, subsequently, certifies the fact by presenting formatted evidence (a 'notary token'). Certification authority and notary authority both act as a kind of trusted third party. The secure delivery mechanism of PTT Post has been studied as one of the main techniques of notarization and certification (PTT Post, 1998). The delivery notarization stores evidence of the delivery to and receipt by the intended recipient as well as the existence of the data and the originator. The evidence consists of the digital signature information, authentication time, the data, delivery receipt from the recipient, etc. A sender submits the data with digital signatures using the format specified, together with the recipient's certification information. The sender simultaneously receives a claim check for the notarization, but delivery is not guaranteed. The key-mail certificate authenticates every sender before the information is submitted to the receiver. The specified receiver submits a request to the key-mail server for delivery. The communication protocol between the server and recipient is encrypted. When the recipient takes the encrypted data from the key-mail server, a receipt (consisting of a digital signature for the received data using the recipient's 'private' key) is automatically generated and returned to the key-mail server.

Based on the dependencies of the different modeling elements, the process module network for order 4 could be drawn as depicted in figure 5.4.

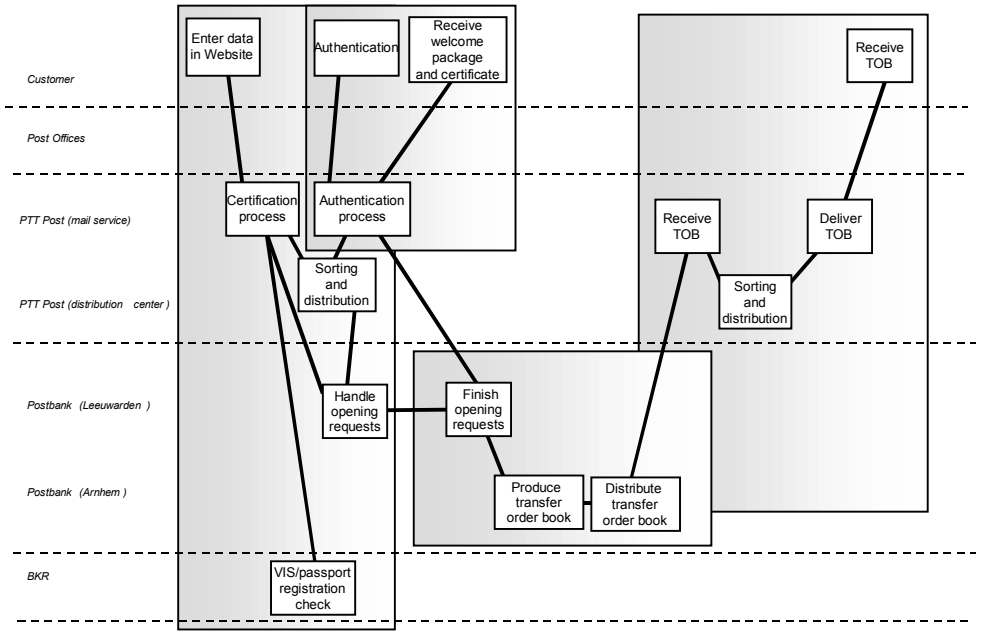


Figure 5.4: Schematic view of the process module of the third redesign (order 4)

In this scenario ('order 4'), it is the customer who fills out the Web-based opening request for the giro account and the key-mail certificate. The PTT Post handles the application of the key-mail certificate and does the fraud control check and the certification. The person-to-person authentication procedure takes place at the customers' home when the welcome package is delivered. It is the Postbank that, in parallel, processes the Web-based opening request and starts producing the transfer order book. New customers are notified about the opened account by e-mail to their personal, secured mailbox. PTT Post delivers the transfer order book physically at the customer's home. In optimizing the BN processes with ICT, Davenport and Short's (1990) redesign guidelines 1, 2, 3, 5, and 7 were used. The potential of ICT in optimizing the business network in this redesign lies in the fact that:

- customers become more involved in the business network since they are paying the cost of communication with the focal actor;
- using the Internet as a transaction channel by-passes the need for a physical retail outlet;
- combining services brings the PTT Post back into the certification and authentication processes;
- the Internet supports information storage and processing between the PTT Post and Postbank and enables parallel (instead of sequential) actions within these two actors.

The level of ICT enabling, with respect to the completion of order 4, is summarized in table 5.6. The focus of the ICT-enabled integration is extended to the actor's business processes, i.e., BN integration, including ICT-enabled integration with the customer.

Table 5.6: Dimensions of ICT enabling in the third redesign (order 4)

Business network integration	**Business process integration**		
	No integration	Internal integration with own business processes and applications	Integration with actors' business processes
Customers	—	—	**Secured electronic filing via the Internet at Postbank and PTT Post**
Postbank	Stand-alone EDI	EDI integrated with other internal processes, e.g., order entry, order processing, and production	**Electronic messaging exchange with Postbank**
PTT Post	Stand-alone EDI	EDI Integrated with other internal processes, e.g., sales marketing, finance production	**Electronic messaging exchange with Postbank**

5.4.10 Step 10: Ex ante margin assessment of the alternative BN designs

Data validity

As discussed in step 6, an attempt was made to carry out a revenue and cost analysis of customer orders in order to assess the margin contribution of the specific customer orders in the business network. Collecting reliable and accurate costing data turned out to be a difficult task because not all actors could provide the same precision and accuracy of data. To prevent any pitfalls related to source and accuracy of data, we introduced a 'record memo field' in Business Network Navigator, where the source(s) and type of data can be further specified. We hereby distinguish 'hard' costing data from 'soft' data. Hard costing data were the costing data the actors were able to provide since they kept a full and detailed account of them in their accountancy systems. 'Soft' costing data were less accurate and precise; they were cost estimations made by controllers and accepted by the case study project team after a 'sensitivity analysis.' The sensitivity analysis was performed to evaluate the ranking of the different redesign scenarios. For example, what happens if the value of data is increased or decreased by 10%? Will the same scenario still be the best performing? And how big may changes be before there is a scenario shift?

Ex ante margin assessment of the first redesign

Using procedures similar to those discussed in step 6, the BN margin and BN flexibility level of the first alternative BN design could be assessed, as illustrated in table 5.7.

Table 5.7: Distribution of BN margin and BN flexibility of order 2 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in numbers
Postbank	69	0	– 69	2578	-
Post Offices	5	15.9	10.9	35	-
PTT Post	8.6	7.35	–1.25	3327	-
Total	82.6	23.25	– 59.35	5940	25

Compared to the current BN design, the first redesign shows the following:

- a cost reduction of 0.69% for the entire BN;
- a revenue improvement of 16.25% for the entire BN;
- a margin improvement of 6.06% for the entire BN. Extrapolation of the results to the yearly volume of about 500,000 new giro accounts would reduce the yearly loss in the business network by 1.915 million euro;
- an improvement in agilty of 1% for the entire BN;
- an improvement in versatility (1 new set of SEs) for the entire BN.

Ex ante margin assessment of the second redesign

Using procedures similar to those discussed in step 6, the BN margin and BN flexibility level of the second alternative BN design could be assessed, as illustrated in table 5.8.

Table 5.8: The distribution of BN margin and BN flexibility of order 3 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in numbers
Postbank	60.9	0	– 60.9	3419	-
Postoffices	0	0	0	0	-
Retail Service Point	2.27	2.41	0.14	35	-
PTT Post	5.45	3.86	– 1.59	2546	-
Total	68.62	6.27	– 62.35	6000	25

The second redesign compared to the current BN design shows the following:

- a cost reduction of 17.5% for the entire BN;
- a reduction in revenues of 68.65% for the entire BN;
- an improvement in margin of 1.31% for the entire BN. Extrapolation of the results to the yearly volume of about 500,000 new giro accounts would reduce the yearly loss in the business network by 415,000 euro;
- no change in BN flexibility.

Ex ante margin assessment of the third redesign

Based on procedures similar to those discussed in step 6, the BN margin and BN flexibility level of the second alternative BN design could be assessed, as illustrated in table 5.9.

Table 5.9: The distribution of BN margin and BN flexibility of order 4 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in number s
Postbank	52	0.5	– 51.5	3386	-
Post Offices	0	0	0	0	-
PTT Post	30	27.27	– 2.73	4056	-
Total	82	27.77	– 54.23	7442	25

The third redesign (order 4) compared to the current BN design shows the following:

- a cost reduction of 1.41% for the entire BN;
- an improvement in revenues of 38.85% for the entire BN;
- an improvement in margin of 14%. Extrapolation of the results to the yearly volume of about 500,000 new giro accounts would reduce the yearly loss in the business network by 4.475 million euro;
- a decrease in BN agility, i.e., an increase in operating time of 24%;
- an increase in BN versatility (1 new set of SEs).

Compared to the current situation (order 1), order 4 displays a lower level of total costs. The results should be regarded cautiously since the level of analysis is a single order. Given the low initial volume of Internet transactions, the initial unit cost is rather disproportion when compared to the other scenarios. However since variable order costs have been reduced considerably in this redesign, total operating costs have decreased.

At the time the case study was done, PTT Post's pricing policy for new electronic services was still in debate. The main issue was how to assign and divide the high fixed costs of the ICT infrastructure. On the one hand, early adopters of the new service should be motivated to use the certificates since, in the new economy, the added value comes from scalability (in contrast to scarceness, as in the old economy). Therefore, lower initial pricing would be favorable. On the other hand, the existing management reward systems required a rather quick pay-back period for the initial ICT investment and would therefore require higher initial pricing. Therefore, as input for the redesign study, the product manager provided different pricing scenarios for the key-mail certificates. Eventually, the project team decided to use the 'middle-of-the-road' scenario. Since the Internet processes were new, the intensity and transaction drivers of the production elements assigned to the Postbank had to be estimated, but for the production elements assigned to PTT Post, real ABC data could be based on their business experiences with secure delivery systems. Therefore, the final margin result should be regarded cautiously.

5.4.11 Step 11: Comparison of the various BN designs

As stated in section 5.3, the various BN designs can be compared in terms of (1) type of service requested, (2) the relationship between types of services and the ICT-enabled

processes required to produce these services, (3) the relative change in levels of margin flexibility, and (4) the distribution of expected benefits among the actors.

Since the latter two points also refer to the use of the research model, they will be discussed in detail in chapter 7. Here, the discussion is focused on the comparison of various BN designs in regard to the first two criteria.

The personal banking scenarios
The comparison of the two personal banking scenarios (orders 1 and 2), as viewed in table 5.10, reveals the following:

- electronic transport instead of physical transport of documents;
- no change in front-office integration between actors (i.e., at the customer interface);
- change in back-office integration between Post and Postbank processes due to electronic document exchange;
- by-passing the data-entry center of the Postbank;
- improving service in terms of shorter throughput time for the customer.

Table 5.10: Comparison of the personal banking scenarios

Distributionc channel	Business network scenario	Change in service design	Change in front-office integration between actors	Change in back-office integration between actors	Change in roles of actors
Personal banking	Order 1	No change	No change	No change	No change
	Order 2	Service improved	No change	Change	By-passing data center of Postbank

The self-service scenario (order 3) versus the current personal banking scenario
Comparing the self-service scenario to the current (i.e., personal banking) scenario reveals the following (table 5.11):

- an increase of electronic messaging exchange;
- change in front-office integration between the retail service point and the Postbank;
- no change in the back-office integration between the retail service point and Postbank processes;
- By-passing the Post Offices and making physical transport from the Post Office redundant;
- providing a new, additional service channel for the customer.

Table 5.11: Comparison of the self-service scenario and the current personal banking scenario

Distributionc hannel	Business network scenarios	Change in service design	Change in front-office integration between actors	Change in back-office Integration between actors	Change in roles of actors
Self-service banking	Order 3	Extra service channel	Change	No change	By-passing Post Offices

The Internet banking scenario (order 4) versus the current personal banking scenario

The comparison of the Internet banking scenario versus the current personal banking scenario, as viewed in table 5.12, reveals the following:

- changes in the front-office integration between actors in the business network; the advantages of this business network integration are multiple:
  1. for the customer: the purchase of two services requires only one transaction without the extra communication costs of surfing to two diiferent sites on the Internet;
  2. for the Postbank: the bundling of services with PTT Post provides a solution for the person-to-person authentication requirement, solves the security issue of Web-based financial transactions (via a trusted third party), and lowers marketing costs;
  3. for PTT Post: the bundling of services with the Postbank provides a customer-friendly solution for the distribution of key-mail certificates and lowers marketing costs;
- change in the back-office integration between PTT Post and Postbank processes; the advantages of this integration between actors in the business network are:
  1. reduction of total operating costs for both actors since process modules at Postbank can run in parallel instead of sequentially;
  2. total by-passing of the distribution channel of the Post Office;
  3. redesign of services due to a new service location and new, digital customer interface.

Table 5.12: Comparison of the Internet banking scenario and the current personal banking scenario

Distribution channel	Business network scenario	Change in service design	Change in front-office integration between actors	Change in back-office integration between actors	Change in roles of actors
Internet banking	Order 4	Extra service channel and digital customer interface	Change (digital customer interface)	Change	By-passing Post Offices Reintroducing PTT Post as certifying authority

Use of ICT redesign guidelines

For each of the redesign scenarios the use of Davenport and Short's (1990) ICT guidelines can be evaluated (table 5.13).

Table 5.13: ICT redesign guidelines of Davenport and Short (1990) used in case study 1

Redesign guidelines	Order 2	Order 3	Order 4
1. Support information storage and processing	√	√	√
2. Automate information exchange (internal and external)		√	√
3. Reduce human labor in a process	√	√	√
4. Treat geographically dispersed resources as though they were centralized			
5. Execute processes simultaneously	√	√	√
6. Put the decision point where the work is performed and build control into the process			
7. Reallocate activities among organizations	√		√

Based on the case study results, these ICT redesign guidelines can be refined as follows:

- create virtually linked production plants for the physical handling and processing of documents between actors in the business network (order 2);
- switch from physical mail-based customer transactions to transactions based on digital documents in the business network (orders 3 and 4);
- search for earlier availability of customer transaction information to enables a more equal production flow in the business network (orders 2, 3, and 4);
- transmit digital customer data from an ICT-enabled point of sales of one actor to streamline the back-office processes of another actor in the business network (orders 3 and 4);
- adopt the bundling of Web-based services among actors in the business network (order 4);
- synchronize processing of customer data between actors in the business network (orders 2, 3, and 4).

Benefits of ICT use in business network optimization

The role ICT plays in optimizing business networks can be discussed from different perspectives. For example, the use of ICT enables:

- the improvement and/or versatility of products and services in the business network;
- the integration of business processes within an actor;
- the integration of business processes between actors in the business network;
- a change in roles of actors in the business network.

Different categories arise when the following questions are asked:

- Will the use of ICT (a) improve service in terms of quality, such as shortening throughput time, improving convenience for customers, etc., or (b) provide new or additional services, such as more customized bundling of services?

- Will the use of ICT increase or decrease the level of process integration internally (i.e., business process integration) or externally (i.e., business network integration)?
- Will the use of ICT change the roles network actors currently play in the business network?

The benefits of using ICT are related to the following:

- The first category of ICT benefits refers to *improvements in business processes*. Within this category, the implementation of ICT will affect process efficiency but will not change the service design for the customer, per se. Furthermore, the roles the actors play in the business network will remain the same.
- The second category of ICT benefits refers to *integration* of *business processes* within an actor. Process integration appears in either the front-office processes, back-office processes, or both. When integrating front-office processes, ICT enables customer relationship management (CRM) within the actor. When back-office processes are integrated, ICT optimizes resource planning within the actor.
- The third category of ICT benefits refers to *business network integration*. When front-office networks are integrated, ICT enables CRM between actors in the business network. In cases where back-office networks are integrated, ICT optimizes resource planning between actors in the business network.
- The fourth category of ICT benefits refers to *business network redesign,* capturing those ICT-enabled business networks in which the roles of participating organizations have been changed. The general guideline to finding optimization based on the use of ICT within this category is to focus on activities that are arbitrarily assigned to a particular actor, and which could also be performed by other (cheaper or more flexible) actors.

All these points can be evaluated in the redesign scenarios.

- *Change in level of service design:* Change in the quality of service in terms of reduced throughput time for the customer is demonstrated in orders 2 and 3. Service redesign in terms of a different service location is demonstrated in order 3. Service redesign in terms of both a new service location and transaction interface is demonstrated in order 4. In this last scenario, a break between operating time (24-hour access) and place (no physical outlet anymore) is also realized.
- *Change in level of back-office integration within an actor:* A higher level of back-office integration due to ICT is realized in order 2.
- *Change in level of front-office integration between actors:* A higher level of front-office integration due to ICT is realized in orders 3 and 4.
- *Change in level of back-office integration between actors:* Higher levels of back-office integration due to ICT are realized in orders 2 and 4.

- *Change in roles of the actors:* In orders 2, 3, and 4, some actors are removed from the transaction. In order 4, one actor is reintroduced. The entry of a new actor is demonstrated in order 3.

The roles of the actors in the various BN designs are summarized in table 5.14.

Table 5.14: Cross- scenario analysis of roles of actors in case study 1

Actors	Roles of actors in order 1	Roles of actors in order 2	Roles of actors in order 3	Roles of actors in order 4
Postbank	Retail banker	Retail banker	Retail banker	Internet banker
Post Offices	Retail organization	Retail organization		
Retail service point			Retail organization	
PTT Post	Logistic service provider	Logistic service provider Electronic document processing center	Logistic service provider	Logistic service provider Certifying authority

5.4.12 Step 12: Discussion of results

Within the project team, the various BN designs were ranked in terms of the improvement in BN margin. The margin results of all BN designs are illustrated in table 5.15.

Table 5.15: The distribution of the BN margin among actors per order in case study 1

	Order 1	Order 2	Order 3	Order 4
Postbank margin	– 73.63	– 69	– 60.9	– 51.5
Post Offices margin	10.85	10.9	0	0
Retail service point margin	0	0	0.14	0
PTT Post margin	– 0.40	– 1.25	– 1.59	– 2.73
BN margin	– 63.18	– 59.35	– 62.35	– 54.23

Note that despite the improvement demonstrated, the BN margin still remains negative for the entire BN and the margin improvement is not equally distributed among all actors. The 'best' BN design related to the opening of a giro account in terms of BN margin is the Web-enabled BN design (order 4), followed by the design in which the hybrid EDI integrates the production plants of the Postbank and PTT Post (order 2). In these designs, the back-office processes of both actors are streamlined to the benefit of the customer and

the actors in the network. The BN design ranked third is that in which an ICT-enabled point of sales transmits digital customer data and thus streamlines the back-office processes between the retail service point and the Postbank (order 3).

5.4.13 Step 13: Actual decision making

After examining the case study results, the following decisions were made:

- The Postbank decided not to investigate the hybrid-EDI redesign scenario further because of (1) the marginal improvement in margin, (2) the fear of personnel problems when outsourcing, (3) the increased dependency on PTT Post, which would reduce its negotiating power in other matters, and (4) the product manager of the Postbank giro accounts would not be responsible for business processes or customer margin but only for product turnover.
- The Postbank and PTT Post decided not to follow up on the retail service point pilot. Later, they announced the withdrawal of part of the services offered at 875 post offices (Postbank and PTT Post services, in particular) and concentrated on offering complete services at only 800 post offices instead of 1675.
- The Postbank decided not to further investigate the impact of the Web-enabled redesign scenario in partnership with PTT Post because of (1) the price of the key-mail certificate, (2) doubts about the competence of PTT Post as the certifying authority, (3) Internet developments within ING (i.e., ING Direct), and (4) the upcoming campaign to promote Girotel services.

5.4.14 Step 14: Implementation decision making

Despite the results of the ex ante BN margin assessment, none of the proposed redesign scenarios were actually implemented. Exit interviews with the project members at the Postbank (Delporte, 1999) revealed only superficial information on the failure to implement any of the redesigns. According to the project members, 'the final decision to actually redesign is a Board responsibility, not that of operational managers. Operational managers can only make suggestions about possible redesigns. Given the low feasibility of the proposed redesign scenarios, the doubts of the Postbank about PTT Post's competence/skill to become a certifying authority and the technological superiority of the Postbank (i.e., the Girotel, Gironet, and Freeler infrastructure), it is understandable that no implementation decision was made at the Board level.' Note that the project members at the Postbank were mainly operational managers who could not mobilize enough power and influence around the more strategic implications of innovative ICT use. The project team did not contain an experienced ICT manager but was composed of merely marketing and product managers. Their personal targets (increasing the number of new giro accounts) conflicted with the redesign objectives of the business network – decreasing the costs of distribution via the Post Offices (the most important sales channel for this service).

6 MARGIN-IMPROVED FLEXIBILITY ASSESSMENT IN THE EPO – DPO – ABN/AMRO – PTT POST CASE

6.1 Set-up of case study 2

The second case study – of the European Patent Office (EPO), Dutch Patent Office (DPO), ABN/AMRO Bank, and PTT Post – was conducted in the period from January 2000 to December 2000. In this case study the research framework developed in chapters 3 and 4 was used to assist the project team responsible for market testing a new Web-based application service: Epoline®. With the aid of a specific customer process (i.e., the process of applying for a European patent), the relationships between applicants, the European and Dutch Patent offices, the ABN/AMRO Bank, and PTT Post were investigated and redesigned with the use of ICT. First, the current business network was analyzed; then the current BN scenario, together with one ICT-enabled redesign scenario, was modeled and assessed. The same process was analyzed in both scenarios, which makes them comparable in terms of:

- the type of patent services requested by the applicants;
- the relationship between types of patent services and ICT-enabled processes requested to produce these services;
- the relative change in levels of margin flexibility;
- the distribution of expected benefits among the actors in the business network.

The focal actor, the European Patent Office, was central to the analysis of the business network.

6.2 Experience with the 14-step research protocol

6.2.1 Step 1: Identifying product-market combinations and the current strategy of the business network

The result of the European countries' collective political determination to establish a uniform patent system in Europe, the European Patent Organization was established by the Convention on the Grant of European Patents (EPC) signed in Munich in 1973. As a centralized system for granting patents, administered by the European Patent Office on behalf of all contracting states, it is a model of successful cooperation in Europe. The European Patent Organization comprises a legislative body, the Administrative Council, and an executive body, the European Patent Office (EPO). The EPO was established in 1977. It has six buildings in four locations (Munich, The Hague, Berlin, and Vienna) in three countries and employs nationals from all contracting states. It is entirely self-financing; its operating and capital expenditures are defrayed out of procedural fees and from a proportion of the renewal fees for European patents. The remainder of the renewal fees is paid to the contracting states. In a typical year, approximately 113,340 patent applications are filed (EPO 1999). To respond to international customers applying for a

European patent, the European Patent Office and national patent office (i.e., the Dutch Patent Office [DPO]) work together based on institutional arrangements for partnerships. The respective relationships of the EPO and DPO with PTT Post and ABN/AMRO are based on short-term commercial contracts.

6.2.2 Step 2: Defining the business network's current objectives

Because of the rapid yearly growth in European patent applications (13% in 1998 and 7.4% in 1999) and the related increase in workload and backlog at the EPO, the European Patent Organization was forced to look at ways to boost the efficiency and productivity of the procedure for granting European patents. At the end of 1999, the decision was made to reengineer business network transactions.

From the EPO's point of view, the main drivers for the redesign were:

- to increase the efficiency and productivity of the existing procedure for granting patents by (a) simplifying internal procedures and (b) eliminating clerical work for the applicant as well as for the EPO;
- to 'democratize' the application procedure and enlarge the customer base by providing pan-European interactive services;
- to expand its ICT infrastructure to other BN actors, i.e., the national patent offices.

The main drivers for the participation of the other actors in the redesign were:

- for PTT Post: to find future business opportunities for document handling and processing services;
- for DPO: to increase internal efficiency and productivity;
- for ABN/AMRO bank: to find opportunities for internal cost savings and to introduce electronic banking services at the EPO.

The reengineering task force (at the level of the EPO Board) formulated an overall redesign strategy to direct the team members in their reengineering efforts. The project team used this redesign 'action agenda' to design the new customer distribution system.

6.2.3 Step 3: Defining the key performance indicators in the business network

The first consideration in executing this step was to include all key persons involved. Therefore, the key persons responsible for the redesign at the EPO, DPO, PTT Post, and ABN/AMRO were officially approached. Initially, there was a problem obtaining the necessary costing data at the inter-organizational level (i.e., the level of the business network), so the starting point was the definition of the predefined key performance indicators at the actors' level. The KPIs at the business network level were derived from there.

The key performance indicators were defined as follows:

- *Operating costs* contain the total (i.e., the fixed and variable) costs of production tasks related to the application for a European patent, including the payment of the application fee.
- *Transaction costs* contain the fixed and variable marketing, sales, and internal and external communication costs related to the application for a European patent. Investment costs in ICT, per se, were not included, but the ICT effect was calculated based on the related, fixed, and variable operating costs. All actors agreed to consider a 'single-channel position' for each order, which means that allocation of the total operating costs relate to that one specific channel.
- *Sales revenues* contain the amount of relevant sets of service elements traded internally and externally in the business network and their corresponding selling prices.
- *Agility* contains the operating time (i.e., the time it takes to perform the production tasks related to applying for a European patent). Data on actor agility were available within each actor.
- *Versatility* contains the measurement of the total amount of relevant sets of service elements related to the application for a European patent, including the payment of the application fee. Actor versatility data were available from the start for the EPO and PTT Post, since part of their portfolios were already modularly designed. For ABN/AMRO and the DPO, the relevant part of the portfolio had to be modularly described first before the necessary data could be gathered.

6.2.4 Step 4: Defining the redesign variables in the business network

Since two of the four actors (i.e., EPO and PTT Post) were already familiar with the modular design of products and processes, the project team quickly adopted the proposed redesign variables. At the beginning of the modeling study – given the priority of market testing epoline®, the research budget, and the timetable – the analysis was set up in terms of the following:

- the actors involved and their relationship to the applicant, to the EPO and DPO, to the mail service provider (i.e., PTT Post), and to the financial institute (i.e., ABN/AMRO), as illustrated in figure 6.1;
- the steps in the application process, including payment of the application fee and confirmation to the customer, as shown in figure 6.2;
- analyzing the financial processes involved in payments by check. Other forms of payment (credit card, debit account, etc.) were not included in the BN scenarios.

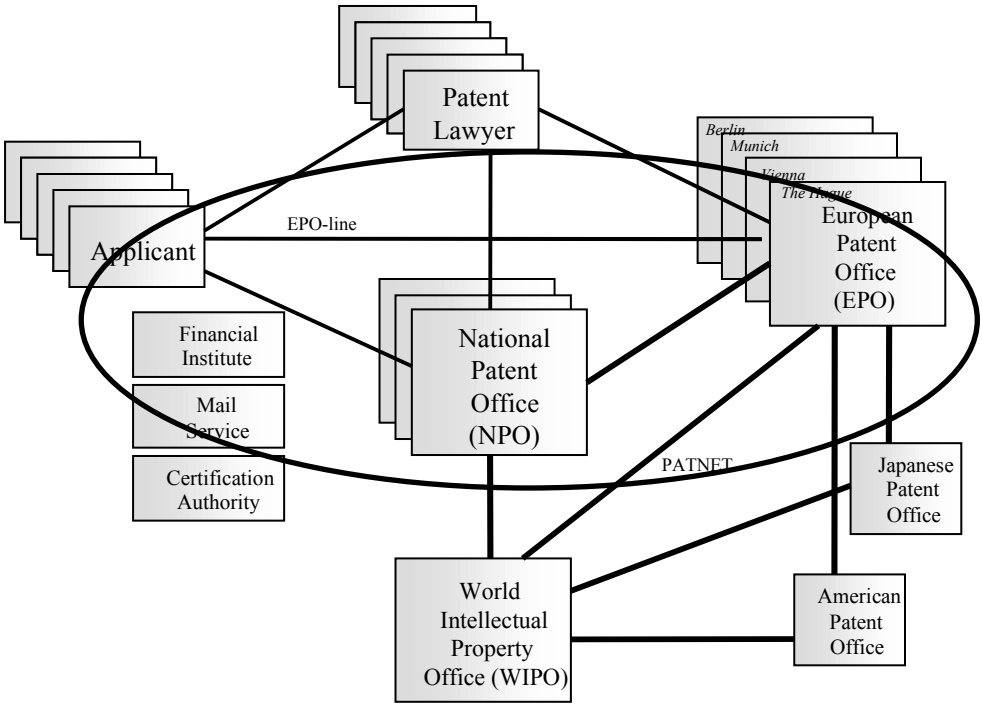


Figure 6.1: Outline of the business network design with regard to the actors involved

From this starting point, the database of service elements was put into Business Network Navigator. A complete overview of the service elements is also given in the case study report (Van Oosterhout and Delporte, 2000, p. 25–28). Based on the process information gathered within all actors, the relevant production tasks could be specified at the level of the actor and the business network. Eventually, this added up to a database in Business Network Navigator of all *production elements* and *process modules* available in the business network. A complete overview of this database is also given in the case study report (Van Oosterhout and Delporte, 2000, p. 23–24).

6.2.5 Step 5: Modeling the current BN design

The current situation for applying for a European patent at the time of the case study is illustrated in figure 6.2. Based on the predefined dependencies between the different modeling elements in the current design, the process module network could be drawn (referred to here as order 5). In the current situation, it is the National Patent Office that requests the patent application on behalf of the applicant. The PTT Post transports the application forms and confirmation letters. The EPO handles and processes the application form. And ABN/AMRO processes the check payment. The thick line indicates the dependencies of main tasks in this network.

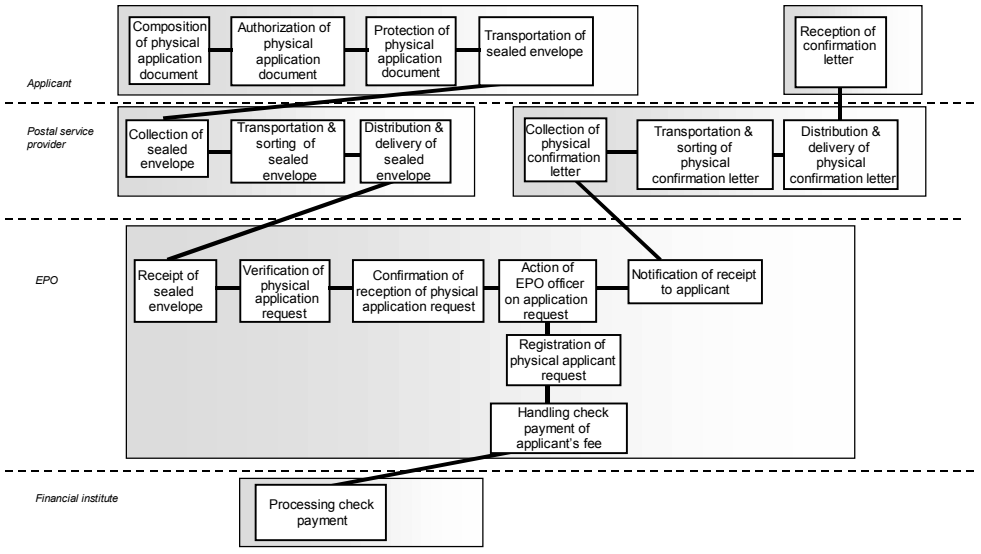


Figure 6.2: Schematic of process module network of current BN design (order 5)

The actual application process is built on a paper-based transaction process. The first step is the composition of the application document. The applicants' representative (i.e., the NPO, which in this case is the DPO) prepares a document for the EPO. The process nearly always starts on a personal computer. The second step is the authorization of the applicant's document; the document is signed (unsigned documents are invalid). The third step is security, which is based on trust; the document is sealed in an envelope. The fourth step is transport of the document; it is entrusted to the postal services (i.e., PTT Post). Typical transportation delays are two or three days. The fifth step is receipt of the document; it is received at the EPO, opened, and distributed. The sixth step is verification. This means checking the file for completeness: authorization, signature, and date. Proper verification is vital to protecting legal interests. The seventh step is confirmation: receipt is acknowledged so that the client has confirmation. This means yet another letter. The eighth step is action; the EPO officer processes the letter. This is done thousands of times per day. The ninth step is registration; every transaction must be properly recorded in a file or in a database. This is done by scanning or indexing the physical document.

6.2.6 Step 6: Ex post margin assessment of the current BN design

Based on the list of data collection activities (see table 5.2), input data were gathered and entered into Business Network Navigator. BN margin and flexibility were then computed, as illustrated in table 6.1. During this process, key participants, often business controllers, verified the collected data and the data sources before they were entered in Business Network Navigator.

Table 6.1: The distribution of BN margin and BN flexibility of order 5 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in numbers
DPO	52	0	– 52	101	-
PTT Post	7	2	– 5	2682	-
EPO	25	58	33	152	-
ABN/AMRO	10	3	– 7	1398	-
Total	94	63	– 31	4333	3

Assessing BN costs

How did we link the filling of order 5 to the assessment of BN costs? An attempt was made to carry out a *customer order cost analysis* on the level of the entire business network. ABC techniques, together with the MND assessment procedure, defined previously (see chapter 2), were used to assign customer costs to activities. Initially, the EPO, DPO, and ABN/AMRO could not provide the required activity-based costing data. The EPO solved this problem during the project by setting up a management accounting department and hiring new personnel to gather the necessary data at the actor and BN level. Neither the DPO nor ABN/AMRO could always provide 'hard' data on inter-organizational business processes; therefore, 'soft' costing data, based on either benchmarking of similar processes in other actors or cost assumptions made by the researcher and participating business controllers, were sometimes used after applying a sensitivity analysis. The data related to the payment procedure were based on the benchmarking of similar banking processes (Arthur Andersson, 1997). Eventually, the costs were assessed as follows: the resource consumption of the relevant sets of production elements **x** the specific resource tariffs.

Assessing BN revenues

How did we link the filling of order 5 to the assessment of BN revenues? An attempt was made to analyze customer order revenues. The BN revenues generated were computed from the selling prices of the selected sets of service elements traded either internally (among actors) or externally (with customers) and the total amount of sets traded.

Assessing BN margin

BN margin was computed from the BN revenues and costs related to order 5. As depicted in table 6.1, the filling of order 5 resulted in a negative margin contribution for the entire business network.

Assessing BN agility

How did we link the filling of order 5 to the assessment of BN agility? Once the duration driver for each unit of work for order 5 was derived from the actor data available, the total

operating time of the business network was calculated. It is expressed in the number of minutes it takes to perform the necessary production tasks.

Assessing BN versatility
How did we link the filling of order 5 to the assessment of BN versatility? The assessment of versatility was based upon the measurement of the total amount of relevant sets of service elements available to the BN customer. BN versatility was derived from the total database of 50 service elements from the different actors and the combinations of relevant sets of SEs requested in the filling of order 5.

6.2.7 Step 7: Discussing the performance gaps in the margin flexibility of the current BN design

Based on the yearly volume of about 113,340 new patent applications, the existing process represented a yearly loss of 3,513,540 euro over the entire business network. This was a primary driver for considering a BN redesign. A second driver considered by the project team was the creation of a digital customer interface and on-line services.

6.2.8 Step 8: Identifying possibilities for improvement due to ICT

The level of ICT enabling in the current BN design is illustrated in table 6.2.

Table 6.2: Dimensions of ICT enabling in the current BN design

Business network integration	**Business process integration**		
	No integration	Internal integration with own business processes and applications	Integration with partner's business processes
DPO (as the applying customer)	Stand-alone applications for patent writing		—
EPO	Stand-alone applications: - CAESAR - CASEX - PHOENIX - Datimtex	Administrative applications integrated with financial process application: - Easy	—
PTT Post	Stand-alone EDI	EDI Integrated with other internal processes, e.g., sales marketing, finance production via TVI network	—

Analysis of the current BN network design shows:

- A 'paper gap': the exchange of documents between the customer (applicant) and the EPO is done by moving physical documents. There is no ICT enabling between the

DPO computer system and the EPO computer system, although the application is written electronically.

- Within the EPO, there are automated island solutions for internal processes. Independent areas of IT development include the following, for example:
  - CAESAR for search reports with cited documents;
  - CASEX for substantive examiner communications;
  - EASY for on-line filing;
  - PHOENIX for administrative support;
  - Datimtex for publications.
- The handling fees are paid by check; therefore, the financial procedure is designed for manual check processing instead of an electronic banking service, for example.
- There is no direct ICT-enabled access for the customer of the EPO, and integration of back-office systems has low priority.

It was deemed possible to optimize the current BN design by converting the paper-based transaction process into an electronic transaction procedure and to provide direct access for applicants. However, the ICT solution would have to:

- be built on existing EPO systems and use trilateral World Intellectual Property Organization (WIPO) and market standards;
- use a single technical infrastructure;
- provide a single point of contact to the customer;
- require a single secure environment;
- require a single legal framework.

6.2.9 Step 9: Modeling alternative BN designs

The current design was taken as the starting point for modeling an alternative BN design, here labeled as order 6. Eventually, the epoline® concept was developed. It is built on EPO's internal automation systems, making everything face outwards and making secure public access via the Internet possible. The epoline® portal is a secure environment on the Internet that allows EPO customers to perform administrative tasks and manage and retrieve patent information on-line and makes interaction with EPO easier and faster. This system is designed to handle the entire procedure, from filing to granting a patent application. With this electronic communication system, the mail-based transaction is converted into an electronic procedure. In setting up the market test, the following issues were faced:

- The legal department of EPO provided a solution to the requirement of 'one single legal framework.' Eventually, the legal framework was based on the following basic principles: (1) no paper backups, (2) valid signatures and dates, (3) specific time limits, (4) procedures based on the interpretation of article 80 of the EPC, (5) separate and parallel implementing rules, (6) consultation with national offices, and (7) consideration of relevant EU legislation.

- The implementation team solved the issue of a single customer contact point in the following way: the interface with EPO is based on (1) an Internet browser interface, (2) a Website, (3) several Internet applications available from the Website, and (4) an EPO mailbox for sending and receiving communications. The hardware required is a standard PC with the following specifications: Pentium II, 64 MB RAM, 2GB hard disk, an internet connection, a scanner to scan paper drawings, software for filing on-line, a smart card, and a smart card reader. The last two products were offered by the EPO to the participants of the market test.
- Security being the cornerstone of the epoline®, the following four principal requirements were met:
    1. Authentication: Smart cards uniquely identify customers. They are issued by trusted parties and contain certificates.
    2. Nonrepudiation: Digital signatures are built inside smart cards.
    3. Confidentiality: Encryption offers secure links between network partners.
    4. Accountability: All transactions are recorded and long-term storage is offered.

Based on the dependencies between the different modeling elements in this BN scenario, the process module network could be drawn as depicted in figure 6.3.

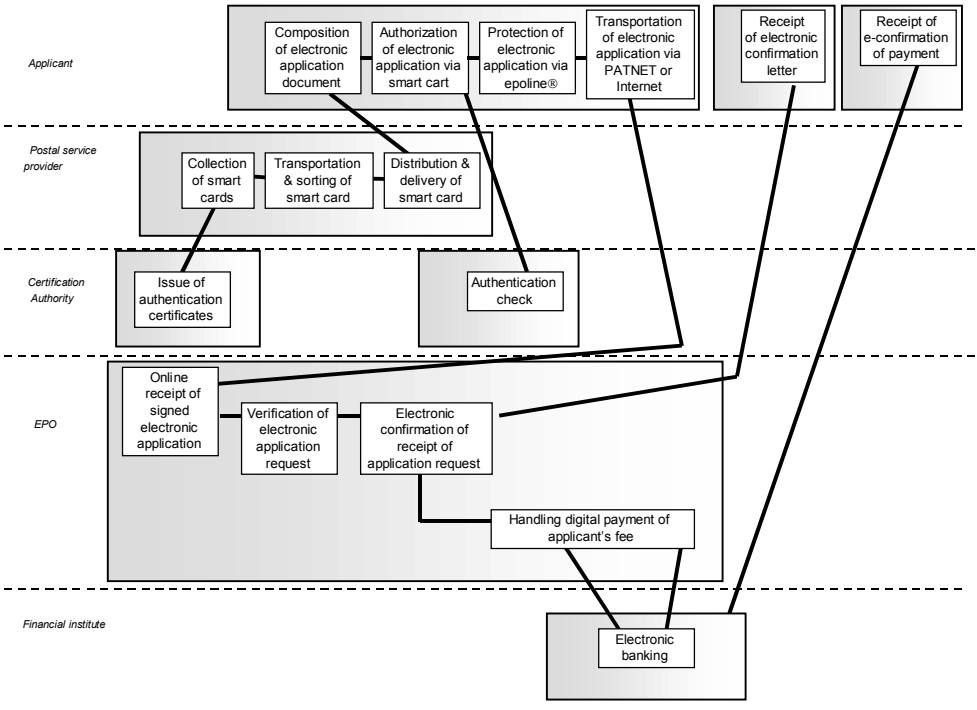


Figure 6.3: Schematic process module network of the redesign (order 6)

The process module network describes the order in which the actors perform their tasks in filling the order, while the paper-based transaction is replaced by a single, secure, electronic transaction through the epoline® portal. In the electronic process, the document is composed electronically and does not require any printing of a paper copy. The authorization of the document is also done electronically with a smart card, which is comparable to a bankcard protected with a pin code. It contains a certificate that uniquely identifies an authorized person and is used to build a digital signature. A certifying authority (CA) such as a bank, government office, or post office, could issue one, and it works directly on the applicant's PC. The document receives a digital signature via the smart card, thereby guaranteeing integrity and authenticity. Initially, the EPO itself will act as epoline® certifying authority, and this authorization-certification procedure will be required for all secure communication with the EPO.

The document is protected by being bundled in an electronic envelope, which is based on international standards – the SGML Data Interchange Format (SDIF) used to bundle text and images for exchange. (XML is the emerging de facto market standard and will eventually replace SGML for IP documents.) Other standards used are PKC# 7 or international digital signature standards. The content is in TIFF (an image archive format) and portable document format (PDF), which is the market standard for documents and guarantees that "what you see is what I sent." Transportation of the digital document is done via the Internet and the virtual private network that connects all users. The securest possible encryption is used by epoline® and in all processes. Transportation is done via PATNET, which connects all parties of the business network, such as customers (small and large companies), national patent offices, the American and Japanese patent offices, WIPO, and Internet banking.

The digital document is received at the EPO, opened, verified, and distributed completely automatically. During the verification process, the digital signature on the digital document is compared with the EPO master certificate and is accepted or rejected. Confirmation is also done electronically. No human action is required. Receipt is acknowledged directly to users. The EPO officer processes the remaining letters. Registration of all in-coming and outgoing communication is archived electronically and no more scanning or indexing of the physical document is required. The level of ICT enabling, with respect to filling order 6, is summarized in table 6.3.

Table 6.3: Dimensions of ICT enabling after the redesign

Business network integration	Business process integration		
	No integration	Internal integration with own business processes and applications	Integration with partner's business processes
DPO (as the applying customer)	Stand-alone application for patent writing	—	**Secured electronic filing via PATNET at EPO and CA**
EPO	Stand-alone applications: CAESAR CASEX PHOENIX Datimtex	Administrative applications integrated with financial processes: - Easy	**Secured electronic messaging with CA and electronic banking with financial institute**
Certifying authority			**Secured electronic messaging with customer and EPO**
PTT Post	Stand-alone EDI	EDI Integrated with other internal processes, e.g., sales marketing, finance production via TVI network	

6.2.10 Step 10: Ex ante margin assessment of the alternative BN design

Data validity

The pitfall of working with unreliable and inaccurate data was avoided the same way as it was in the first case study (see section 5.4.10).

Ex ante margin assessment of the redesign

Based on procedures similar to those discussed in step 6, the BN margin and flexibility level of the redesign could be assessed, as illustrated in table 6.4.

Table 6.4: The distribution of BN margin and BN flexibility of order 6 among actors

	BN costs in Euro	BN revenues in Euro	BN margin in Euro	BN agility in minutes	BN versatility in numbers
DPO	38	0	– 38	47.5	-
PTT Post	3.5	0.72	– 2.78	915	-
EPO	6	58	52	30.5	-
ABN/AMRO	5	2.28	– 2.72	7	-
CA	8.5	5	– 3.5	8	-
Total	61.45	66	5	1008	5

Compared to the current BN design, the redesign shows:

- a cost reduction of approximately 35% for the entire BN;

- a revenue improvement of approximately 4.7%;
- a shift from a negative BN margin to a positive BN margin (Extrapolating this to the yearly volume of about 113,340 new patent applications indicates a yearly profit of approximately 556,6700 euro instead of a loss of 3,513,540 euro for the entire business network.);
- an agility improvement of approximately 76%;
- an increase in BN versatility (2 new sets of SEs).

6.2.11 Step 11: Comparing the various BN designs

As stated in section 6.1, the various BN designs can be compared in terms of (1) the type of patent services requested, (2) the relationship between types of patent services and ICT-enabled processes required to perform these services, (3) the relative change in margin-flexibility levels, and (4) the distribution of expected benefits among the actors. Since the latter two also refer to the use of the research model, we will discuss them in detail in chapter 7. Here, the discussion is focused on comparing the first two criteria of the BN designs.

Benefits of ICT use in business network optimization

The comparison of the mail channel scenario versus the Internet channel, as viewed in table 6.5 reveals the following:

- *Change in service design:* versatility and agility in terms of new online products, instant feedback and confirmation of receipt, faster delivery of search and examination results, immediate access to information on application status, etc.;
- *Change in level of back-office integration within an actor:* a higher level of back-office integration due to ICT is realized at the EPO in filling order 6.
- *Change in level of front-office integration between actors*: a higher level of front-office integration due to ICT is realized between the EPO and the DPO (applicant) in order 6;.
- *Change in level of back-office integration between actors*: a higher level of back-office integration due to ICT is realized between the CA and the DPO (applicant) and between the EPO and DPO (applicant) in order 6;
- *Change in roles of the actors*: the entry of a new actor, i.e., the certifying authority.

Table 6.5: Comparison of the mail channel scenario versus the Internet channel

Distribution channel	Business network scenarios	Change in service design	Change in front - office integration between actors	Change in back -office integration between actors	Change in roles of actors
Mail channel	Order 1	No change	No change	No change	No change
Internet channel	Order 2	Extra service channel and digital customer interface	Change (digital customer interface)	Change	Entry of CA

The roles of the actors in the two business network scenarios of case study 2 are depicted in table 6.6:

Table 6.6: Cross-scenario analysis of roles of actors in case study 2

Actors	Roles of actors in order 1	Roles of actors in order 2
DPO	Patent organization	Patent organization
EPO	Patent organization	Patent organization Electronic filing center
CA		Trusted third party
PTT Post	Logistic service provider	Logistic service provider

Use of the ICT redesign guidelines

In the redesign, the use of Davenport and Short's (1990) ICT guidelines can be evaluated, as shown in table 6.7:

Table 6.7: ICT redesign guidelines of Davenport and Short (1990) used in case study 2

Redesign guidelines	Order 6
1. Support information storage and processing	√
2. Automate information exchange (internal and external)	√
3. Reduce human labor in a process	√
4. Treat geographically dispersed resources as though they were centralized	√
5. Execute processes simultaneously	√
6. Put the decision point where the work is performed and build control into the process	
7. Reallocate activities among organizations	√

Based on the case study results, these ICT redesign guidelines can be refined as:

- a switch from physical mail-based customer transactions to transactions based on digital documents in the business network;
- a search for earlier availability of customer transaction information that enables a more equal production flow in the business network;
- synchronizing customer data processing between actors in the business network;
- facilitating electronic banking instead of manual check processing.

6.2.12 Step 12: Discussion of results

The margin results of the two BN designs are compared in table 6.8.

Table 6.8: The distribution of BN margin among actors per order in case study 2

	Order 5	Order 6
DPO margin	– 52	– 38
PTT Post margin	– 5	– 2.78
EPO margin	33	52
ABN/AMRO margin	– 7	– 2.72
CA margin	0	– 3.5
Total BN margin	– 31	5

The Web-enabled redesign of the process of applying for a European patent turned the margin contribution from a negative into a positive result for the entire business network. The distribution of the BN margin improvement among actors reveals that:

- in the current design (order 5), only the EPO margin is positive, while the margins for all remaining actors are negative;
- in the Web-enabled redesign, all the current BN actors benefit from the margin improvement.

6.2.13 Step 13: Actual decision making

The EPO decided to extend the market test of epoline® from 25 participants to 1200 by the end of August 2001 and to continue the promotion of Web-based services both internally and externally. Based on the insights gained into the functioning of the existing business network, the project team discussed the impact of this decision on the individual actors:

- One would expect the EPO to further increase the development of new on-line services. However, one could argue whether the issuing of smart cards and the role of EPO as electronic document filing center in the redesign scenario should be regarded as a core activity or whether it would be better outsourced.
- One would expect that the Dutch (i.e., national) Patent Offices would start questioning their future business survival. With the creation of direct Internet-enabled access to its customers, EPO could easily provide (software based) services similar to those now provided by the national patent offices. Together with a broader acceptance of digital signatures, the rise of Internet patent brokers, etc., the basis of competition within the entire intellectual property industry is due great changes.
- One would advise PTT Post to reconsider the EPO as an interesting leading customer for future electronic business because of the document-intensive character of its business processes. Another business opportunity lies in a potential role for PTT Post as certifying authority.
- One would advise ABN/AMRO to generate more customized financial solutions to support the EPO's financial transaction procedures.

6.2.14 Step 14: Implementation decision making

In February 2002, 900 on-line patents had already been filed via epoline®. The EPO continues to look for other ways to take full advantages of Web technology to rejuvenate their core business applications by minimizing the impact on established systems and optimizing costs. They have adopted '*Web process integration*' (Gartner, 2001, p. 7) as a strategy for integrating the Web with legacy applications to extend their life cycles by also reusing them for developing new composite applications and Web services. Web process integration provides more advantages than simple 'Web-ification' (Gartner, 2001, p. 4), which renders a terminal-oriented user interface in a 'Web form' while leaving the presentation of the application unchanged, although it can add some beautification, making it practical to deploy the application to additional, non-skilled users. Web process integration consolidates the presentation of multiple applications into a single interface, supporting the integration of specific business processes (both interactive and real-time). It looks like Web-ification but involves more complex infrastructure and development efforts.

7 EVALUATING THE USE OF THE METHODOLOGY IN REAL LIFE SITUATIONS

7.1 Introduction

In order to investigate to what extent and under what conditions the use of ICT-enabled modularity in BN redesign can realize an improvement in margin and flexibility, a research model was introduced in chapter 3 (figure 3.2). The research model is shown once again below (figure 7.1).

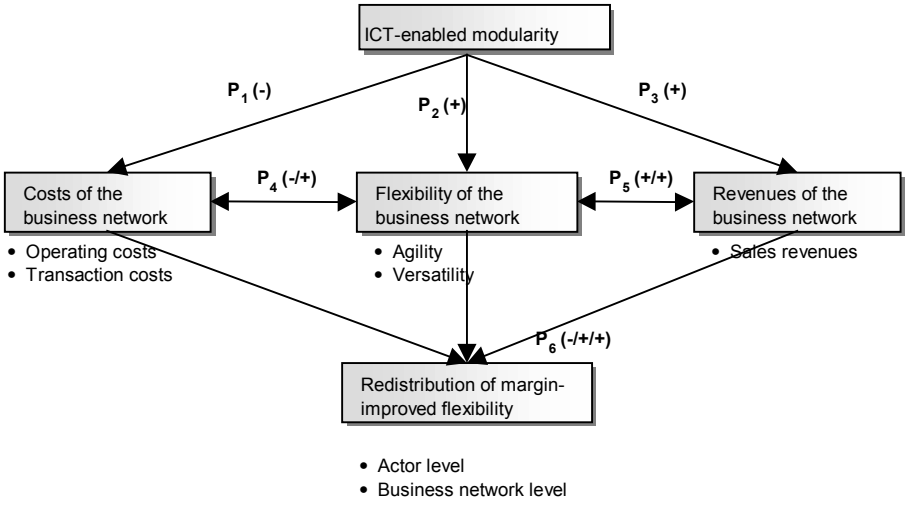


Figure 7.1: The research model

Based on the overall findings from the case studies, the six related propositions of the research model can now be validated, and the 14-step research protocol can be discussed in relation to its use in real-life situations. Both these topics are discussed in this chapter.

7.2 Validation of the research model

The criterion for interpreting the findings of the case study research is based on Campbell's (1975) idea of 'pattern-matching' (i.e., no effect/effect analysis). We looked for analytical validation and generalization (Yin, 1994) in which the previously developed theory (i.e., the research model) was used as a template against which the empirical results of the case studies could be compared. The propositions formulated in chapter 3 and summarized in table 7.1 can now be accepted or rejected based on the results of the case studies.

Table 7.1: The six propositions related to the research model

Nr	Nature	Propositions
P_1	(-)	The use of ICT-enabled modularity in the business network lowers the costs of the business network
P_2	(+)	The use of ICT-enabled modularity in the business network increases the flexibility of the business network
P_3	(+)	The use of ICT-enabled modularity in the business network contributes to increased revenues in the business network
P_4	(-/+)	The use of ICT-enabled modularity in the business network lowers the costs and increases the flexibility of the business network at the same time
P_5	(+/+)	The use of ICT-enabled modularity in the business network contributes to increased revenues and increases the flexibility of the business network at the same time
P_6	(-/+/+)	When all current BN actors benefit from the margin-improved flexibility created by ICT-enabled modularity, the ICT-enabled redesign option will be implemented

Propositions supported by the case studies will be accepted and refined into a proposition-related hypothesis. Propositions not supported by the case studies will be rejected.

7.2.1 Proposition 1

The first proposition is related to the relationship between the use of ICT-enabled modularity in BN redesign and a reduction in BN costs. This relationship was formulated as follows:

P_1: The use of ICT-enabled modularity in the business network lowers the costs of the business network

In sections 2.5 and 3.5, based on theoretical references, it was argued that the use of ICT-enabled modularity in the business network would have a positive effect on the total operating and transaction costs in the business network. Therefore, the use of ICT-enabled modularity in BN redesign is considered to be a strategy for decreasing total costs related to the filling of customer orders in the business network. In both case studies, the presumed relationship is demonstrated in the BN redesigns, as illustrated in table 7.2.

Table 7.2: The impact of ICT-enabled modularity on BN costs

Actor costs in euro	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
Postbank	73.63	69	60.9	52	-	-
Post Offices	5.05	5	0	0	-	-
Retail service point	0	0	2.27	0	-	-
PTT Post	4.5	8.6	5.45	30	-	-
DPO	-	-	-	-	52	38
PTT Post	-	-	-	-	7	3.5
EPO	-	-	-	-	25	6
ABN/AMRO	-	-	-	-	10	5
CA	-	-	-	-	-	8.5
Total BN costs	83.18	82.6	68.02	82	94	61.45

The research method allowed the recognition of the production tasks (PEs) of each of the actors necessary to fill the order in the current process module of the network. Using modularity (i.e., mapping customized orders onto modularly designed processes) enabled the processes used in filling orders in the business network to be optimized; for example, opportunities to reorganize production tasks and/or reallocate non-value-adding production tasks (e.g., the elimination of double PEs) in the current process module network (PMN) (Thomas and Griffin, 1996). At the same time, opportunities for collaborative production between actors (i.e., the sharing of PEs) become obvious.

The case studies provided insight into the added value in each business process and the level of electronic integration between actors in the current BN design. From there, opportunities for optimization could be discussed. The main question used in the exercise to optimize costs was: *How can ICT-enabled modularity in the business network optimize the resource allocation and utility of production elements?* The logic behind this question is the assumption that the more the use of ICT-enabled modularity facilitates collaborative manufacturing in the business network, the greater the opportunities to reduce operating and transaction costs.

The modular production concept enables the actors to base their production on actual customer demand instead of on stock. A modular business network favors a more cost-efficient bundling of the required production tasks from different interdependent actors while responding to actual customer demand. In a modular process design, cheaper parts of a process can easily be substituted for the more expensive parts while still producing the same product. So, the key lies in cost-efficient 'unbundling and rebundling' of the order-filling processes, i.e., PE/PM combinations, based on real-time information availability and exchange of actual customer demand. These 'unbundling and rebundling' trends are not restricted to the service industries researched. Hagel and Singer (1999) predicted the scenario of 'unbundling the corporation' when stating, 'as more business interactions move onto electronic networks like the Internet, basic assumptions about corporate organizations will be overturned. Activities that companies have always believed to be central to their business will suddenly be offered by new specialized competitors that can do them better, faster and more efficiently.'

However, cost-efficient 'unbundling and rebundling' of customer processes in the business network imposes strong discipline on the actors and on the communication and organization among them. The inter-organizational exchange of customer information is a time-consuming and costly process when non-electronic means are used. Even electronically, inter-organizational data communication processes can be difficult and, indeed, economically prohibiting in the absence of an ICT infrastructure that supports dynamically modifiable business processes.

In this context, Vervest and Dunn (2002) argue that 'industry will benefit from "smart processes" underpinning effective and efficient eBusiness practice.' The technical feasibility of exactly specifying the information exchanged in the business network (i.e., PMN) allows crossing the organizational borders without incurring high interaction costs and management risk. As the case examples show, it is the electronic integration in the business network that becomes the major driver behind the unbundling and rebundling of customer-related processes. In the case examples, it is the very nature of the automated data flow in the business network that allow the customer-related processes to be split up and handled by several actors. This electronic coordination mechanism makes the modularity in the business network economically sound. As process owners obtain such an inter-operable technology (i.e., the Internet), the marginal costs of transactions are diminished to almost zero, which is in line with Bakos and Brynjolfsson's (1997, 1999) extensive research on aggregation and disaggregation of information goods. Such low marginal costs are a major incentive for unbundling at the level of micro-processes where process owners can realize low operational costs.

Another hurdle confronting redesign managers when analyzing the unbundling of business processes among different actors lies in the definition of the granularity of disaggregation where unbundling occurs. At a certain level, the processes (i.e., PE/PM combinations) must be performed by the same actor. The close interaction and interwovenness of PE/PM combinations can make the separation of processes economically unjustifiable or even technically infeasible. In such situations, the transaction costs associated with coordinating each PE/PM combination between different actors are too high; therefore, these PE/PM combinations are better remaining within the same actor. Also, government regulations may require certain processes to be performed exclusively by specific actors. So, the unbundling of the customer processes in the business network scenarios were broken down to a level where each PE/PM combination could (theoretically) be provided by a single actor, regardless of whether that actor actually provided other adjacent processes.

Business network management is interested in identifying the value added per process and aims at feed-forward systems. Information on the transparency in the organization and coordination of production tasks within each actor and between actors is vital to redesign managers. Business networks rely heavily on real-time and full access to information, especially about those activities that cross organizational boundaries. Single actors operate in an environment of partial information. The information available to actors in the business network concerning consumer demand and production schedules, and the speed and frequency at which it is available, has the potential to radically reduce non-value-adding PEs or to share relevant PEs. A business network that is enriched by this information can use it to optimize its cost structure. Single actors who integrate their processes with other actors in the business network will benefit from drawing upon the

shared infrastructures – not only the ICT infrastructure but also the shared resources such as human resources, project management, shared customer and production knowledge, etc.

In the case studies, the way the ICT redesign guidelines were used to optimize the costs of the different PMNs was demonstrated (see sections 5.4.11 and 6.2.11). The redesign scenarios demonstrate that ICT-enabled modularity in the business network lowers BN costs by lowering either:

- the cost of the production elements within the actor (e.g., switching from manual transport labor into digital processing) or between actors in the business network (e.g., switching from physical mail-based transactions to digital transactions in the business network) and/or
- the cost of managing dependencies between production elements in the process module network, e.g., by eliminating double production elements or sharing relevant production elements.

Therefore, proposition P_1 is accepted and refined as follows:

$H_{1:}$ *The use of ICT-enabled modularity in the business network lowers the costs of the business network when it lowers either (1) the costs of the production elements within an actor or among actors or (2) the costs of managing dependencies between production elements*

7.2.2 Proposition 2

The second proposition refers to the relationship between the use of ICT-enabled modularity in BN redesign and the increase in BN flexibility. This relationship was formulated as follows:

$P_{2:}$ *The use of ICT-enabled modularity in the business network increases the flexibility of the business network*

In sections 2.5 and 3.5, based on theoretical references, it was argued that the use of ICT-enabled modularity in the business network would have a positive effect on BN agility and versatility. Therefore, the use of ICT-enabled modularity in the BN can be considered a strategy to increase BN flexibility in terms of increasing the ability to handle a greater variety of different products and speeding up the linkages within the BN. Both dimensions of flexibility are discussed below.

BN agility

BN agility has been defined as 'the period of time it takes to fill a customer order through the business network' (see table 4.1). In the case studies, BN agility was operationalized by measuring total operating time (see sections 5.4.3 and 6.2.3). In both case studies, BN agility was measured as illustrated in table 7.3.

Table 7.3: The impact of ICT-enabled modularity on BN agility

Actor agility in minutes	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
Postbank	3420	2578	3419	3386	-	-
Post Offices	35	35	0	0	-	-
Retail service point	0	0	35	0	-	-
PTT Post	2546	3327	2546	4056	-	-
DPO	-	-	-	-	101	47.5
PTT Post	-	-	-	-	2682	915
EPO	-	-	-	-	152	30.5
ABN/AMRO	-	-	-	-	1398	7
CA	-	-	-	-	-	8
Total BN agility	6001	5940	6000	7442	4333	1008

The research method allowed the PE/PM combinations necessary to filling orders to be recognized for each actor and between actors in the business network. It also provided a guideline to gather the duration drivers of these PE/PM combinations. Therefore, it made clear what period of time it takes to filling an order through the existing process module network. From there, opportunities to speed up linkages between processes could be derived. The main question used in the optimization of BN agility was: *How can ICT-enabled modularity in the business network optimize the (linkages of) process modules?*

Business Network Navigator provides insight into possibilities of reducing slack or dwell time because the total process module network can be visualized on the level of production elements and process modules. The case studies demonstrated that in some cases, it is indeed the use of ICT-enabled modularity that reduces the operating time within an actor and/or speeds up the linking of PE/PM combinations among the actors. Therefore, it has a positive effect on BN agility. However, there are two scenarios (orders 3 and 4) that do not result in higher BN agility despite the higher level of electronic integration in the BN processes. This is due to the fact that legal and administrative constraints (see also section 5.4.9, figure 5.4) prevented a more 'optimized' design for the handling procedures in the business network at the time. Since the other redesign scenarios demonstrated that it was indeed the higher level of electronic integration that allowed more efficient bundling of PE/PM combinations in terms of reduced operating time, we reject proposition P_2 but reformulate it as follows:

$H_{2A:}$ *The use of ICT-enabled modularity in the business network increases BN agility when it either reduces the operating time within an actor and/or speeds up the linkages of PE/PM combinations among actors*

BN versatility

BN versatility has been defined as 'the extensiveness of a product and/or range of services the business network is able to produce and deliver in a given period of time' (see table 4.1). In the case study research, BN versatility was operationalized by measuring the total amount of relevant sets of SEs related to actual customer demand that could be produced and delivered by the business network (see also sections 5.4.3 and 5.2.4). In both case studies, BN versatility was measured at the operational level, as illustrated in table 7.4.

Table 7.4: The impact of ICT-enabled modularity on BN versatility

Versatility in total number	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
BN versatility	24	25	25	25	3	5

The research method allowed the SEs of each actor in the business network to be recognized. In this method, the customer order is the starting point for the design of the process module network. Therefore, BN customers should be able to specify their requirements adequately, especially in the context of customization. In this respect, Russell-Hodge (1995, p.14)argues: 'It is vital that the customer is helped to specify its requirements in ways that are meaningful to value chain members (i.e., actors).' The research method contains guidelines for modularizing the existing product and service portfolio into relevant sets of service elements. Therefore, it makes clear how different sets of service elements are assembled within each actor and between actors in the business network. The combination of different service elements from different actors in the business network and the information about assembling these sets of service elements within the business network allows relevant new sets of service elements to be derived. The main question when optimizing versatility in the business network is: *How can ICT-enabled modularity in the business network optimize the bundling of new relevant sets of service elements?* The logic behind this question is the assumption that the more the use of ICT-enabled modularity enables the assembly of different sets of service elements in the business network, the greater the differentiation in BN products and services.

All redesign scenarios demonstrated that the ability of the business network to assemble more differentiated modules (i.e., sets of service elements) increased. Both case studies showed how reengineering modular products through innovative use of ICT in a business network could lead to the joint development of new electronic services. Examples of these services are document-input services (see als appendix II), CA services, on-line patent services, electronic filing, and electronic banking services. So, the key lies in the customized bundling of relevant sets of service elements in the business network, based on the exchange of information about actual customer demand. Grűnwald and Fortuin (1992, p. 386) describe: products as 'composed of basic units (modules) which can be assembled in various ways to meet different customer specifications.' Pine (1993, p. 196) argues that

the best method for achieving mass customization – minimizing costs while maximizing individual customization – is by creating modular components that can be configured into a wide variety of end products and services. Finally, McCutcheon et al. (1994, p. 94) say, 'The best way to achieve product variety and speed is through modular product configurations. A modular approach can reduce variety of components while offering a greater range of end products.'

The modular production concept gives the business network the opportunity to combine economies of scale with increased choice; standard components (i.e., service elements) can be produced in large series, while a variety of products can be assembled through changes in the configuration of components (combinations of service elements). The cooperative attitude of the actors participating in the business network, together with increased linking speed enabled by ICT, make it easier to establish demand chains for new products. As a result, more products and services can be offered simultaneously, while new products can be introduced more rapidly. As the ICT-enabled redesign scenarios demonstrate, the ICT capabilities of the business network enable simple modification of products to meet actual customer demand.

Therefore, proposition P_2 is rejected but reformulated as follows:

H_{2B}: *ICT-enabled modularity in a business network increases the versatility of the business network when the ICT infrastructure in the business network supports the bundling of new sets of SE's*

7.2.3 Proposition 3

The third proposition relates to the relationship between the use of ICT-enabled modularity in BN redesign and the increase in revenues in the business network. This relationship was formulated as follows:

P_3: *The use of ICT-enabled modularity in the business network contributes to increased revenues in the business network*

In sections 2.5 and 3.5, based on theoretical references, it was argued that the use of ICT-enabled modularity in the business network has a positive effect on revenues because it supports the modular design of goods and services and more customer-specific pricing strategies. In the case studies, measuring the sales revenues (see sections 5.4.3. and 6.2.3), as illustrated in table 7.5 operationalized BN revenues. Note that only three of the four redesign scenarios demonstrate higher BN revenues for the entire BN.

Table 7.5: The impact of ICT-enabled modularity on BN revenues

Actor revenues in euro	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
Postbank	0	0	0	0.5	-	-
Post Offices	15.9	15.9	0	0	-	-
Retail service point	0	0	2.41	0	-	-
PTT Post	4.1	7.35	3.86	27.27	-	-
DPO	-	-	-	-	0	0
PTT Post	-	-	-	-	2	0.72
EPO	-	-	-	-	58	58
ABN/AMRO	-	-	-	-	3	2.28
CA	-	-	-	-	-	5
Total BN revenues	20	23.25	6.27	27.77	63	66

The research method allowed all sets of service elements traded among BN actors and related to a specific customer order to be recognized. The trading processes in the business network were broken down into 'micro-processes,' which can be assigned to different actors. The trade data could be attributed to nominated customers and nominated actors, and from there, opportunities to optimize revenues could be derived. The main question in the optimization of revenues in the business network is*: How can ICT-enabled modularity in the business network optimize the trade of relevant sets of SEs?* The logic behind this question is that if a number of actors are involved in the trading process of a specific customer order, then each actor will seek payment for the performance of its services. So, different actors will compete for the exclusive provision of a particular set of SEs. Optimization of the trading 'micro-processes' will have an immediate effect on the organizational design of the business network because it will have a significant impact on the back-office functions traditionally performed by a specific actor. Examples of this impact are the removal (order 2, 3, 4) or reintroduction (order 4, 6) of actors.

The modular design and production of sets of SEs also enables the actors to price to customer value instead to just price to cost. An ICT-enabled business network has the ability to do more efficient and effective matching of seller's offerings with buyer's preferences from (1) the customer's perspective, (2) the actors' perspective, and (3) from the perspective of connected relationships. Or, as Davidson (1993) puts it, 'the incorporation of new technologies enables the identification of customer preferences and customer precision pricing.'

As argued in section 2.4, the BN's trade or selling effectiveness can be analyzed through the consideration of three aspects: (1) the customized goods and services traded, (2) the revenues and costs associated with transactions, and (3) the BN process itself. With respect to the first aspect of analysis –determining the level of customization in terms of the configuration of the offering (i.e., service elements) – the quantity, breadth (aggregation),

and depth of the product and the available variations (sets of SEs) are relevant. With respect to the second aspect of analysis, the amount and price of the goods and service traded and the operating and coordination costs are relevant. Next to the definition of the selling price (as opposed to cost price) for a good or service, the access method (distribution method) of the business network is important in determining the final selling price of a good or service received. With respect to BN processes, the number, flexibility, and efficiency of actors participating in the business network and the customer access to the business network are important. The same three aspects can be considered when analyzing the impact of ICT on the BN's selling effectiveness.

Selling effectiveness comes from (1) the ability to design the 'appropriate' products, (2) the ability to identify the moment when a customer's purchasing decision is most likely to occur, and (3) the ability to be prepared for that moment, one step ahead of the competition. 'When determining their product mix, sellers must decide which product components or features will be included in each product offering. Changes in production technology, such as developments in computer-aided technology and information systems, promote the production of tailor-made products and services without the loss of economies of scale. This possibility also applies to service organizations, which may now extend and diversify their packages of services, instead of just applying universal services, because of information systems technology (Toffler, 1985). The advantage of ICT use is that one can economically capture the details of customers' needs and transmit them to the customer contact point-of-sales and still benefit from the company's economies of scale.

The redesign scenarios that result in higher BN revenues (orders 2, 4, and 6) demonstrate an increased trade of modularly designed electronic services among actors in the business network. The exchange of information on available SEs and the cooperation among actors allowed the (re)design of appropriate services for the benefit of all BN actors. The entire BN can then benefit from customer-based pricing. On the demand side, the customers expect the flexibility to choose the most appropriate bundling of sets of service elements. On the supply side, the customer-specific bundling due to ICT use allows the actors to set customer-specific prices. This pricing strategy avoids the trade-off between customization and price in the business network and therefore increases selling effectiveness, a claim that is supported by the findings of other authors (Anderson, 1997; Pine, 1998; Van Asseldonk, 1998).

The web-enabled redesign scenarios (orders 4 and 6) demonstrate how on-line customer access at the focal actor provides increased possibilities for service and process bundling with other actors in the business network at lower transaction costs, making 'micro-pricing' arrangements for transactions between actors available. Other authors (Bakos 1997) also support the practice of cost-efficient bundling and micro-pricing based on the Internet use. Bauer et al. (2000) consider the automation of flows of information (and data)

between entities, the decrease of transaction costs of electronic transactions, the availability of micro-pricing arrangements, and the obsoleteness of legislative regulation as the major characteristics of on-line services working in favor of unbundled business models. These drivers differentiate on-line trading from traditional trading through the technical feasibility of new solutions and/or the economic changes of market structure and power.

In summary, it seems that the key to increasing BN revenues lies in more 'customer-specific' bundling, pricing, and trading of relevant sets of SE's. So, proposition P_3 is rejected but reformulated as follows:

H_3: *ICT-enabled modularity in a business network contributes to higher BN revenues when customer-specific bundling, pricing, and trading of electronic services among actors is realized*

7.2.4 Proposition 4

The fourth proposition relates to the relationship between the use of ICT-enabled modularity in BN redesign and the increase in 'cost-efficient flexibility' as found in the work of Hoogeweegen (1997) in the air cargo industry. This relationship was formulated as follows:

P_4: The use of ICT-enabled modularity in the business network lowers the costs and increases the flexibility of the business network at the same time

However, our case studies demonstrate a different relationship. Note that in Hoogeweegen's work, 'flexibility' was only operationalized in terms of BN agility. Since our research considered both agility and versatility as dimensions of flexibility in the business network, one cannot draw the same conclusion Hoogeweegen did.

The research method allowed BN agility and versatility to be recognized, along with their effect on the distribution of costs within each actor and between actors in the business network. In our case studies, only two redesign scenarios (orders 2 and 6) demonstrated under which conditions greater customization and speed in the business network could be realized at lower costs (table 7.6).

Table 7.6: The impact of ICT-enabled modularity on BN costs and BN flexibility

	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
BN costs	83.18	82.6	68.02	82	94	61.45
BN agility	6001	5940	6000	7442	4333	1008
BN versatility	24	25	25	25	3	5

However, one can draw the conclusion that ICT-enabled modularity lowers BN costs and increases BN versatility at the same time, since this relationship is demonstrated in all four redesign scenarios.

Apparently, the key lies in the fact that ICT-enabled modularity favors collaborative manufacturing among certain actors in the business network, resulting in increased product differentiation and lower costs. This is supported by Bauer et al. (2000) who state that 'the unbundling of services will support the creation of entities that specialize in the provision of certain services. This specialization leads to lower costs or qualitative differentiation.'

Therefore proposition P_4 is rejected but reformulated as follows:

H_4: *ICT-enabled modularity in a business network lowers costs and increases versatility in the business network at the same time*

7.2.5 Proposition 5

The fifth proposition is related to the relationship between the use of ICT-enabled modularity and the increase in both revenues and flexibility in the business network at the same time. This relationship was formulated as follows:

P_5: *The use of ICT-enabled modularity in the business network contributes to increased revenues and increases the flexibility of the business network at the same time*

The research method allowed the recognition of both agility and versatility in the business network, along with their effect on the distribution of revenues within each actor and among actors in the business network. In our case study research, only two redesign scenarios (orders 2 and 6) demonstrated under which conditions the increase in BN revenues and flexibility could be realized at the same time (table 7.7).

Table 7.7: The impact of ICT-enabled modularity on BN revenues and BN flexibility

	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
BN revenues	20	23.25	6.27	27.77	63	66
BN agility	6001	5940	6000	7442	4333	1008
BN versatility	24	25	25	25	3	5

It is not possible to conclude that higher versatility in the business network and higher sales revenues can be realized at the same time because order 3 demonstrates the opposite relationship. Nor can it be concluded that higher agility (i.e., lower total BN operating time) and higher sales revenues can be realized at the same time because order 4 demonstrates the opposite relationship. When considering the two Web-enabled redesign scenarios (orders 4 and 6), one can only conclude that the use of ICT-enabled modularity

in the business network leads to the modular design of new on-line services, thereby increasing BN versatility and generating additional revenues at the same time.

The ICT-enabled modularity of the new product designs (i.e., combining sets of SEs) supports the skills required for achieving micro-segmentation (Peppers and Rogers, 1997) and precision pricing (Davidson, 1993). Micro-segmentation is the ability to segment markets with higher levels of depth and detail, e.g., at the level of the individual customer. Micro-segmentation is critical in allowing actors to identify, select, and customize offerings for finely defined customized sets of SEs. Precision pricing allows sellers to identify customer costs and to customize prices for individual configurations. The customer order revenue-and-cost analysis that was carried out in the case studies is a concrete example of how to embed the two marketing practices in real-life situations.

However, given the diverse outcome of the case results, no general conclusion can be drawn about the conditions under which both increased revenues and increased flexibility can be realized at the same time. Therefore, proposition P_5 is rejected.

7.2.6 Proposition 6

The sixth proposition is related to the presumed relationship between the redistribution of margin-improved flexibility and actual redesign decision making. This relationship was formulated as follows:

P_6: When all current BN actors benefit from the margin-improved flexibility created by ICT-enabled modularity, the ICT-enabled redesign option will be implemented

The research method allowed the margin flexibility created by linking all the relevant key performance indicators to the redesign variables to be recognized:

1. It allowed the recognition of all the relevant sets of production elements and process modules and their related costs, thus providing insight into the distribution of costs among actors.
2. It allowed the recognition of all relevant sets of service elements that were traded in the business network, both internally and externally and at what price, thus providing insight into the distribution of revenues among actors.
3. Based on these insights, it allowed the recognition of the margin contribution of each customer order in the business network, thereby demonstrating how the impact of ICT-enabled modularity on margin was distributed among the actors.
4. It allowed the recognition of the total amount of all different sets of service elements available to BN customers, thus providing insight into the level of versatility in the business network.
5. It allowed the recognition of the time it takes to fill orders through the business network, thus providing insight into the level of BN agility.

In summary, the method allows a multi-dimensional and ex ante assessment of margin-improved flexibility created by ICT-enabled modularity to be made. The case studies revealed under which conditions margin flexibility can be improved by ICT-enabled modularity, by allowing the business network to optimize the following:

- the allocation of resources and use of production elements within and among actors;
- the bundling of new, customer-priced sets of service elements within and among actors;
- the linking of PE/PM combinations within and among actors;
- trade effectiveness within and among actors and customers.

Focusing on the relationship between the redistribution of margin-improved flexibility among actors and the actual implementation of an ICT-enabled redesign option, as illustrated in table 7.8, one can draw following conclusions:

- The first case study demonstrated that the benefits of margin-improved flexibility were not equally divided among the current BN actors. In the various redesign scenarios, it was the focal actor (i.e., Postbank) that gained most of the improvement in BN margin. The PTT Post and Post Office margins were worse. Despite the improvement of overall BN margin, none of the redesign scenarios were implemented.
- The second case study demonstrated a more equal distribution of margin-improved flexibility among the current BN actors. The margins of the EPO, DPO, PTT Post, and ANB/AMRO were increased considerably after the redesign. In this case, the BN margin improved from a negative to a positive level. This redesign scenario was implemented.

Therefore, proposition P6 is accepted.

Table 7.8: The impact of ICT-enabled modularity on BN margin and its relationship with implementation of the redesign

Actor margin in euro	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6
Postbank	–73.63	–69	–60.9	–51.5	-	-
Post Offices	10.85	10.9	0	0	-	-
Retail service point	0	0	0.14	0	-	-
PTT Post	–0.4	–1.25	–1.59	–2.73	-	-
DPO	-	-	-	-	–52	–38
PTT Post	-	-	-	-	–5	–2.78
EPO	-	-	-	-	33	52
ABN/AMRO	-	-	-	-	–7	–2.72
CA	-	-	-	-	0	–3.5
Total BN margin	–63.18	–59.35	–62.35	–54.23	–31	5
Implementation decision	Yes	No	No	No	Yes	Yes

The redesign scenarios also demonstrated that the greater the BN transformation (orders 4 and 6), the higher the margin improvement from ICT deployment. However, greater BN transformation indicates potentially higher benefits from margin performance, but it also requires a correspondingly higher degree of change in managerial routines. Whether an ICT-enabled transformation in a business can be realized profitably depends on several conditions: e.g., the cooperative attitude of all stakeholders involved in the business network. Designing business networks with various levels of transformation seems feasible with the enhanced redesign and assessment method. Our empirical findings also support the initial idea that higher levels of transformation generate greater margin benefits. For example, the redesign scenarios in which the Internet was used to integrate both the front- and back-office processes of the BN actors showed not only high margin improvement but also the greatest change in the roles of the various actors. What is enhanced by the change in managerial routines became very obvious in our case studies.

What the case studies demonstrated is how the use of ICT in the business network supports the modularity of goods, services, and processes, although ICT use is strongly conditioned by the managerial and technological capabilities of the individual actors. ICT enabling in the trade and production processes, either at the level of the actor or the business network, supports a more dynamic bundling of the goods, services, and processes of different actors, resulting in the collaborative manufacturing of highly customized orders. Understanding customer demand allows customer-specific bundling and pricing of a set of service elements into customized orders, thereby optimizing versatility and, in some cases, revenues. Collaborative manufacturing allows the business network to produce to order instead of to producing to stock, thereby optimizing BN costs and agility. So, the key for improving margin flexibility in a business network seems to lie in ICT-enabled modularity

supporting a strategy of '*build and price to customer order.*' This strategy allows the business network to improve its flexibility and its profitability at the same time.

The recent findings of Holweg and Phil (2001) in their article on 'Successful build-to-order strategies start with the customer' support our claim. The authors urge managers not to settle for half-hearted transitions to build to order. They recommend two critical first steps: 'First, understand key aspects of customer demand; second, adjust all processes accordingly, . . . only then can companies truly implement responsiveness across the value chain. . . . Some companies attempt to offset those effects by optimizing pieces of the value chain. They create island solutions, such as lean factories, believing that such initiatives will make them more responsive. Those efforts ultimately fail because they are not customer-centered and . . . island solutions sometimes backfire because they degrade other parts of the value chain. Instead, we urge companies to aim for a true build-to-order strategy, in which managers systematically improve the value chain's flexibility in three areas: process, product, and volume. Because the emphasis at each stage is on how to meet customer demands efficiently, optimization becomes more holistic and ultimately more profitable. To improve process flexibility, companies can link customer requirements directly to production, synchronizing customer-oriented production schedules in real time with suppliers. To improve product flexibility, they can push customization closer to the customer and can use common support structures to reduce the impact of product variety. To improve volume flexibility, companies can reduce reliance on full capacity or use differentiated pricing.'

7.2.7 The verified research model

Based on the case studies, the six propositions have been validated as follows (summarized in table 7.9):

- the refinement of P_1 into hypothesis H_1
- the reformulation of P_2 into H_{2A} and H_{2B}, of P_3 into H_3, and of P_4 into H_4
- the rejection of P_5
- the acceptance of P_6

Table 7.9: Overview of the proposition-derived hypotheses and conclusions

Nr	Proposition	Hypotheses	Conclusion
1.	The use of ICT-enabled modularity in the business network lowers the costs of the business network	H_1: The use of ICT-enabled modularity in the business network lowers the costs of the business network when it either lowers (1) the costs of the production elements within an actor or among actors or (2) the costs of managing dependencies between production elements	Refined
2.	The use of ICT-enabled modularity in the business network increases the flexibility of the business network	H_{2A}: The use of ICT-enabled modularity in the business network increases BN agility when it either reduces the operating time within an actor and/or speeds up the linkages of PE/PM combinations among actors H_{2B}: ICT-enabled modularity in a business network increases the versatility of the business network when the ICT infrastructure in the business network supports the bundling of new sets of SEs	Reformulated
3.	The use of ICT-enabled modularity in the business network contributes to increased revenues in the business network	H_3: ICT-enabled modularity in a business network contributes to higher BN revenues when customer-specific bundling, pricing, and trading of electronic services among actors is realized	Reformulated
4.	The use of ICT-enabled modularity in the business network lowers the costs and increases the flexibility of the business network at the same time	H_4: ICT-enabled modularity in a business network lowers the costs and increases the versatility in the business network at the same time	Reformulated
5.	The use of ICT-enabled modularity in the business network contributes to increased revenues and increases the flexibility of the business network at the same time		Rejected
6.	When all current BN actors benefit from the margin-improved flexibility created by ICT-enabled modularity, the ICT-enabled redesign option will be implemented	H_6: When the current BN actors benefit from the margin-improved flexibility created by ICT-enabled modularity, the ICT-enabled redesign option will be implemented	Accepted

This validation has consequences for the research model depicted in figure 7.1. Therefore, the research model has been adapted, as illustrated in figure 7.2.

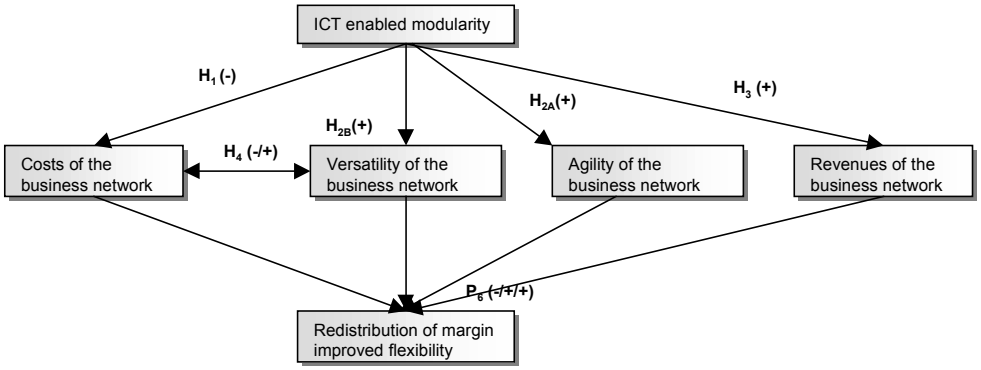


Figure 7.2: The verified research model

7.3 Discussion of decision making on ICT adoption in business networks, based on the overall case findings

The diverse outcomes from the case studies make us reflect on what else may lie beneath the decision-making process in regard to ICT adoption in business networks. Are decisions regarding ICT adoption related to the governance structure in the business network? Are they related to the dependency of the business network on ICT to (a) improve market access, (b) provide product differentiation, (c) facilitate the introduction of new products and services, or (d) introduce operational efficiencies? Or are they related to the decision-making power of redesign managers? Or are they related to the proven ICT knowledge or expertise of the participating managers?

A first observation from the case studies, is that if made solely from the focal actor's perspective, decision making about ICT may handicap the BN in making the wisest investment decisions. In the first case study, the technological superiority of the Postbank handicapped the other actors in the adoption of new ICT-enabled redesigns rather than aiding in the exploitation of complementary strengths for the mutual benefit of the entire BN. In the second case study, all the current actors benefited from the investment of the EPO in upgrading its ICT infrastructure to enable 'Web process integration.' Given the fact that the Web-enabled redesign contributed to the common interest of all current actors, the implementation of the redesign scenario, i.e., the market test, was realized in eight months' time.

The vision, objectives, management goals, and opportunities of the entire BN should drive the use of ICT. A process for describing, measuring, and communicating the business potential of ICT use to BN management is crucial if the wisest investments in ICT (from a BN perspective) are to be made. Technology-oriented approaches with a limited grasp of the potential value of ICT and its economic impact for the business network are insufficient. BN decisions about ICT investments should be made in favor of the areas

with the greatest impact on the relevant key performance indicators of the business network.

A second observation from the case studies is the difference in governance structure in the two business networks studied. In the first case study, the business network contained two actors with equal equity shares (50/50) in the third actor (i.e., the Post Offices). So, both actors would primarily be interested in ICT-enabled redesigns that contributed to improving the margin performance at the Post Offices. Increased margin in the Post Offices would result in higher returns on investments for the other two actors. So, an ICT-enabled redesign that leads to removing the Post Offices from the process would require a divestment by the two other actors in Post Office infrastructure and new investments in a different (physical or digital) retail infrastructure. Therefore, the quick implementation of such a redesign would be more difficult to realize. In the second case study, the initiative of the focal actor (i.e., EPO) led to an improvement in margin for each of the current actors, and the boundaries of the ICT solution were specified at the beginning of the redesign project. This could have favored the decision to implement.

A third observation from the case studies is the difference in decision-making power of the redesign team. In the first case study, project members were mainly operational managers who could not mobilize enough power and influence around the more strategic implications of innovative ICT use. The project team did not contain an experienced ICT manager but was constituted by merely marketing and management accounting expertise. As discussed earlier, some members of the project team considered that decision making on implementing ICT was reserved for the ICT department. In the second case study, project members were senior managers with more political power and influence. In the beginning, the project team contained more proven ICT expertise than marketing and management accounting expertise, but during the redesign process, a good balance was found between these disciplines. Therefore, one could argue that decision making on ICT implementation is favored when the redesign team contains members from multidisciplinary projects at the senior level, who understand the more strategic implications of innovative ICT use in the business network and have the political power and influence to act accordingly.

A fourth observation from the case studies is the difference in management accounting approaches in the two business networks. The management accounting systems at Postbank and PTT Post revealed that it was not customer requirements that were driving the line of business (LOB), but earnings before income and tax (EBIT). In the existing accountancy systems (at the time of the case study), ICT investments lowered the bottom line in the short run because they were considered as costs. Therefore, business unit (BU) managers would be reluctant to invest in new technologies just for to improve processes. When ICT investments were made in an environment where BU managers were not focused on EBIT, as in the EPO case, management and development criteria were used to

select ICT investment projects. When the management accounting system provided a solution to 'activate' part of the ICT investments, for example, this resulted in a better balance sheet, which was more interesting to BU managers focused on EBIT. Therefore, Postbank and PTT Post might benefit from a more value-based approach towards returns on investments, rather than a cost-based approach. In summary, one could argue that when actors in the business network adopt a value-based approach towards ICT investments in the business network rather than a cost-based approach, ICT adoption is favored.

7.4 Critical factors related to the use of the 14-step research protocol

Although the field research was limited to only two cases, some interesting observations can be made regarding the use of the 14-step research protocol.

7.4.1 The use of a reengineering agenda and involvement of senior management

In the first case study, senior management of the Postbank did not officially mandate the redesign project team for any actual reengineering. In the second case study, senior management of all the actors involved mandated a reengineering agenda. Given the outcome of the second case, one could argue that the use of a mandated reengineering agenda and involvement of senior BN management are critical to the success of ICT-enabled BN reengineering. This approach sets the direction for the design of the inter-organizational relationship and fosters realistic expectations within the business network. The sponsorship of senior management empowers the redesign team and facilitates the allocation of the right resources (both financial and human). Our empirical findings show similarity with the work of Bashein et al. (1994) on positive and negative preconditions for the successful redesign of business processes. These authors identified the following positive preconditions: (1) senior management commitment and sponsorship, (2) realistic expectations, (3) empowered and collaborative workers, (4) strategic context of growth and expansion, (5) shared vision, (6) sound management practices, (7) appropriate people participating full-time, and (8) sufficient budget. They also identified negative preconditions: (1) the wrong sponsor, (2) a 'do it to me' attitude, (3) cost-cutting focus, and (4) narrow technical focus. One could argue that in the first case study, the negative preconditions were:

1. the 'wrong sponsor' – i.e., no senior management commitment or sponsorship for the actual reengineering;
2. a 'do it to me' attitude – i.e., the perceived technological superiority of the focal actor (the Postbank) hindered the redesign team;
3. the lack of a strategy for redesigning the overall business network, formulated by the senior management of all the actors involved;
4. the lack of a reengineering action agenda to direct the project team's reengineering efforts.

7.4.2 Embodying the redesign objectives in the reward systems of the responsible managers

In the first case study, the redesign objectives were not part of the reward systems of the responsible managers. In some cases, the reward system (i.e., the personal targets) of the individual managers even conflicted with achieving the redesign objectives. For example:

- Product managers at the Post Offices, PTT Post, and Postbank had product-related targets such as product turnover, not customer- or process-related targets. Therefore, the product manager at the Post Office would benefit from more sales at counters and not from redesign scenarios that led to removing the Post Offices from the process, for example. The product manager of 'giro accounts' at the Postbank was focused on product turnover, not on the profit contribution of the product, for example. Hence, there was no drive to search for lower-cost ways to serve the customer.
- Account managers at PTT Post had a specific portfolio-related turnover target, not a customer profitability target. Hence, there was no drive to search for opportunities to improve the process, despite the potential benefits at the level of the business network.
- The commercial director of the Post Offices benefited from increased sales at the counters. Hence, there was no drive to search for lowering the costs of serving the customer.
- Managers at the production plant of the Postbank were focused on improving process efficiency at the level of the actor. Therefore, they did not benefit from an outsourcing scenario, despite the potential benefits at the BN level.
- Analysis of the management accounting systems at the Postbank and PTT Post revealed that it was not customer requirements that were driving the line of business, but earnings before income and tax. Hence, there would be a limited drive at the level of the actor to achieve customer objectives at the BN level.

In the second case study, empirical findings with respect to employee incentives were that:

- The responsible redesign managers at the EPO and NPO were not focused on EBIT; their reward system was based on (team) performance, not on position.
- The director of the ABN/AMRO office (located in-house at EPO) was focused on EBIT, as in the traditional 'branch-centered model.' Therefore, he personally would not benefit when EPO switched fully to an electronic channel.

Therefore, it can be argued that even when BN redesign starts with jointly defined redesign objectives at the strategic management level, realizing the redesign objective can be hindered if employee incentives at the tactical and operational (actor) level are not in line. Employee incentives at the actor level should support – and not conflict with – the drive for improving BN performance. The findings of Davenport and Stoddard (1994) support the claim that the ultimate success of reengineering depends on the people who do it and on how well they can be motivated to be creative and to apply their detailed knowledge to

the redesign of business processes. This claim is also supported by other authors. Today, it is becoming more important to get inputs from all facets of the organization since no single group, supplier, or department can be expected to know everything (Luther, 1997). One issue that is becoming more important is that not only everyone in an organization should know what activity he or she is performing or engaged in, but everyone – including the supply chain – should know how these activities contribute to the big picture (Liker et al., 1995) and should be rewarded accordingly.

7.4.3 Training in the redesign and assessment method

In both case studies, the redesign managers initially lacked the necessary customer process information and tools for designing the processes along the partnership. The research method and tools solved this, but training was required. Training at an early stage in the redesign project seems to have several advantages. For example, specifying the redesign variables available in the business network:

- creates a common language between product-oriented and process-oriented managers and thereby facilitates understanding between the two disciplines;
- permits the use of modularity principles in the design of product, process, and supply chain (see also section 2.5.2) and thereby speeds up the creative process of finding 'Neue Kombinationen.' The debates with the redesign teams on product and process design seemed to be of great value. In case study 1, the debate resulted in joint development of modularly designed products;
- guides the data-collection process at the actor level when customer-process information at the BN level is not available.

The discussion of results in itself appeared to be of value to the project members because of the following:

- the large number of alternatives generated and assessed (case study 1);
- the increased insight into inter-organizational customer processes (case study 1 and 2);
- the specification of customer-related performance measures (case study 1 and 2);
- a shared vision of the implementation design between multiple disciplines (case study 2);
- less time to reach consensus (case study 2)

7.4.4 Differences in costing methods among actors in the business network

In section 2.2.4, it was argued that the existence of a business network depends on the choice of the coordination mechanism for business transactions. So if a business network exists, it is because the BN actors believe that these inter-organizational relationships are the most appropriate mechanisms for maximizing the margins associated with BN customer transactions. Therefore, the hidden assumption is that all actors in the business

network work with a costing method that is designed and equipped for analyzing customer transactions, such as methods for analyzing customer costing and customer profitability (Kaplan and Cooper, 1998). All the actors involved in the case study research claimed to be customer driven. They all claimed to work with accurate activity-costing systems to assign indirect and direct costs to activities by using multiple cost drivers. Aside from the fact that the interpretation and exchange of costing information was often characterized by individual differences, it was revealed that paradoxically, their current management accounting systems did not provide cost or profitability measures for individual customer transactions, let alone processes for filling customer orders through the business network. In their costing systems, most cost objects included products and departments instead of customers or order-filling processes. Some examples from the first case study include the following:

- PTT Post thought it was working with an accurate ABC method. However, analysis of their accounting system showed average cost prices of products and transfer pricing between organizational departments. If the costing system were really customer driven, they would have adopted a costing system based on cost per time unit of resource consumption instead of average costs. This could favor large business customers whose mail production could take place during cheaper labor hours, for example. If on top of that, the account managers' reward system would benefit from streamlining mail flows into equal production flows instead of only product turnover, both BN actors would benefit: the large customer by getting lower customized prices and PTT Post by optimizing the capacity of its production plants over 24 hours. The technique of transfer pricing resulted in cost discrimination between business unit products, which are not always logistically cost driven, let alone driven by customer orders. Some production-related activities, such as quality control, are considered as overhead and become hidden costs instead of service elements that can be sold.
- The Post Offices used direct product profitability (Kurt Salomon Associates, 1993). This approach is used to identify the profit contribution of products by taking into account the specific handling and space costs incurred by an item. In the case of opening a giro account, real order costs were augmented with a commercial margin percentage charged to the Postbank for retail services offered. The profit contribution of opening a giro account for the Post Offices was therefore positive. For the Postbank, however, the profit contribution was negative. Initiatives to lower costs by the Postbank would therefore always be regarded with suspicion by the Post Offices.
- If the Postbank had a customer-profitability system, how would the product manager 'giro accounts' benefit from raising the total number of accounts, given the negative margin of this process? Would it not be more logical for him to focus on the number of customer transactions per giro account? Or to focus on lowering 'cost to serve' by processing the opening requests electronically at an earlier stage in the process, for example, even if this meant trespassing across inter-organizational departments?

An example from the second case study:

- If ABN/AMRO had adopted customer-management principles, they would benefit from a customer-profitability system to direct development of their new product, and they would have introduced EPO-specific electronic banking services long before, given the cost savings for both actors involved. Insights into the EPO's financial processes could have resulted in profitable electronic banking services for EPO's largest customers, in automatically renewing filing fees, for example – BN management should also focus on the customers' customer.

So why didn't they use a commonly agreed-upon process for customer costing? Was it because they feared that 'open-book calculations' of customer orders would weaken their negotiating power? Was it lack of trust or was it, indeed, a lack of knowledge about an accurate assessment method?

In adopting an accounting system that recognizes customer cost hierarchies, BN managers can determine the cost of a customer through the entire business network. They can also identify which customers and actors are potential value creators or destroyers. With this insight, managers can develop redesign strategies and plans for improving processes and renewing products and services, focusing directly on improving the overall profitability of the business network. They can either bring existing customers or actors into profitability or they can replace them with others more likely to be profitable. This includes the ability to change levels of activity (and therefore resources) in response to changes in customer demand and to measure the effectiveness of business network processes. Reallocating resources in the business network from the 'losing customers' to the 'gaining customers' can improve the value creation of the business network quite dramatically. Increasingly, companies are going to menu-based pricing where the costs to the customer are determined not only by volume and mix of products purchased, but also by the method of delivery and service to the customer. If separate prices are quoted for each activity, the assumption is that customers select those activities that they view as cost effective. By reducing the cost of each activity, the profitability of customers using those activities should increase.

7.4.5 Differences in pricing methods among actors in the business network

All actors claimed to work with a cost-based plus pricing method for the current product portfolio. Cost-based plus pricing (Kotler, 1988) is a pricing model where pricing is based on the cost of a product. The procedure is used in estimating all variable costs, a considerable part of the relevant fixed costs, and in adding a 'normal' profit margin.

The reasons given for using this method are the following:

- The level of segmentation: segmenting the market into customer segments increases segmentation costs and does not add value to the customer; therefore, standard products are distributed at standard prices (occasionally minus standard discounts);
- The lack of a method to measure real customer value.

This cost-based plus pricing method is a 'safe' method – if the estimation of costs is done correctly, the revenues of the company are more or less secured. However, this method has several shortcomings: (1) an allocation problem can arise when several products share certain fixed costs, (2) justification for the profit margin used is not always clear, (3) this method does not try to measure fundamental market response. It often starts from an incorrect premise about the competitive behavior and cost structure of the competitors (which are often considered to be 'identical'). Therefore, in the redesign scenarios with joint product development in the business network (order 2, 4 and 6), a more value-based pricing model was used (Morgan, 1992). This model was used to price the new electronic services and the on-line services being developed. Various arguments for this pricing tactic were given:

- the higher degree of product modularity enabled customer-based pricing in the case of document-input services and on-line patent applications;
- so-called 'lead–user' pricing in the case of the CA services (key-mail certificate) where PTT Post worked closely with the Postbank in an early stage of product development.

The modular design of these new ICT-enabled services is better adapted to meeting different customer requirements and enables customer-based pricing by using menu pricing for individual components.

7.5 Summary and conclusion

The results of the case studies validated the 6 propositions of the research model introduced in chapter 3 and led to the model's adaptation, as illustrated in figure 7.2. It also allowed the identification of several critical factors related to the use of the 14-step research protocol in real-life situations, along with a reflection on decision making regarding ICT in business networks. As discussed in the case study reports (step 6), the 'cost and revenue stream' of a specific customer transaction in the business network could be identified for each redesign scenario. Based on the assessment procedures of the research method, the appropriate performance data were generated at the level of both the actor and the business network. When reporting to management, presenting the performance results on multiple levels of analysis – (1) per key performance indicator, (2) per actor, (3) per redesign scenario – appeared to be of great value.

With respect to the proposed research methodology, one can argue that although there were only two case studies, the methodology allowed:

- the multi-dimensional and ex ante assessment of margin and flexibility in ICT-enabled business networks;
- the ex ante assessment of relative changes in margin for the business actors involved;
- the investigation of the relationship between the use of a formal redesign and assessment method and actual ICT adoption in the business network.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

The research reported here originated from the desire to make ex ante assessments of margin related to ICT adoption in business networks, along with its distribution among the actors involved. Our first research objective was to develop a reliable, formal method for the ex ante assessment of the effect of ICT adoption on BN margin. The first research question was formulated as follows:

RQ_1: *Can we develop a method for ex ante assessment of margin to be applied in ICT-enabled redesign of business networks – in particular, a method that can assess the relative changes in margin for the business actors involved?*

Based on the research findings, one may conclude that yes, it is indeed possible to develop a method for ex ante assessment of margin to be applied in ICT-enabled redesign of business networks – specifically, a method that can assess the relative changes in margin for the business actors involved. How did we proceed to develop such a method?

First, the literature on business networks and on ICT-enabled BN redesign methods and tools was reviewed. This review revealed that Porter's (1985) traditional view of the value chain is inadequate for such an assessment. A method is required that can give a more detailed assessment on a variety of criteria, or key performance indicators: (1) cost reduction, (2) revenue generation, and (3) increased flexibility. The modular redesign method (MND), originally developed by Hoogeweegen (1997) provided a sound basis for assessing BN rearrangements made possible through the use of ICT. Therefore, this method was taken as a starting point. It does not, however, address the concept of 'margin' as an assessment criterion, so this needed to be developed and tested. Therefore, a research model was developed in chapter 3 with three basic constructs: (1) ICT-enabled modularity, (2) margin-improved flexibility, and (3) redistribution. The MND method does not provide a methodology to apply the method in real-life situations, either; therefore, a 14-step research protocol was developed in chapter 4, together with a related decision support system (DSS), named the Business Network Navigator. The research model, research protocol, and DSS were then tested in real-life situations (see chapters 5 and 6). These research tools allowed the development of a method for BN redesign and assessment that can be used in real-time situations. Its strength lies in the combination of strategic analysis of the business network with a very detailed operational assessment, thereby avoiding confusion and lack of definition about the precise objectives of the redesign and the range of applications of the method. The more the method is used within a specific business network, the more operational (process) information can eventually be made available to the actors on a daily basis. Its weakness, however, lies in its dependence on reliable costing and revenue data and the fact that the method is cumbersome to use.

One may conclude that method is reliable and generally valid for the following reasons:

a) for the constructs being studied the correct operational measures at the level of the actor can be derived from the existing profitability systems. With respect to the establishment of correct operational measures at the BN level, however, one has to be more cautious since the derivation of the margin-related performance indicators at this level first required the inter-organizational performance indicators to be defined specifically, thereby making them subject to interpretation.
b) the method creates transparency in regard to the effect of ICT on the redistribution of margin in the business network and delivers sufficient quantitative and qualitative details about the potential impact of the use of ICT on the redesign of products and processes in the business network under study.
c) The use of the method and the DSS can be repeated in different empirical settings as demonstrated in the case studies. It allowed us to reject the hypothesis that the use of ICT-enabled modularity in the business network would contribute to increased revenues and would increase the flexibility of the business network at the same time (= P_5). This is probably one of the reasons for the failure of so much ICT investments in inter-organizational systems.

The second research objective was to analyze the ability of the method to support decision making in regard to the adoption of ICT in a business network. The second research question was formulated as follows:

RQ_2: *What impact does the use of such a method have on the decisions of the actors involved to adopt a specific ICT-enabled redesign of the business network?*

The use of the assessment method impacts decision making in the way that:

- it quantifies the contribution to business performance improvement of new ICT applications in the business network;
- it allows the classification of different redesign scenarios in terms of the estimated margin-flexibility improvement at the business network level and its redistribution among actors.

However, the case findings demonstrate that the use of the method as such will not automatically lead to actual ICT implementation of a specific redesign. One dominant pre-condition to the acceptance of the results seems to be that the use of structured methods as such has to be inhibited in the characteristics of the different actors. Moreover is there a difference in use of the method as an instrument for analysis or for implementation (cf. use in case 1 versus use in case 2).

8.2 Limitations of the study

Although the results obtained may be useful to scientific researchers and redesign managers, the research is nevertheless subject to a number of limitations. These limitations will be discussed on the basis of the research design (see figure 1.1). The research followed an inductive-deductive research cycle in which literature review and multiple

embedded case studies were used to test the preliminary theory building. According to Yin (1994) such case studies can be generalized for theoretical propositions but not for populations or universes. We realize that since only two cases in the service industry were investigated, one may only speak of a first validation of the research method. For a larger validation, a multi-client research comparison would be required. Therefore, the focus here is on the degree to which the research framework can be generalized and not on the exact findings related to its application in the two case studies (since this has already been discussed in chapter 7).

8.2.1 Selected cases

Business networks in two different sectors of the service industry were investigated from a focal actor's perspective in this dissertation: namely, the financial service industry and the intellectual property industry. Although recognizing the possibility that the findings might differ significantly if business networks in other industry sectors were investigated, one may argue that the proposed research method would not necessarily be different. Business networks striving to achieve leadership and confronted with new ICT possibilities will benefit from a method to evaluate their current and future positions. The redesign and assessment procedures do not depend on the specific characteristics of the business network. Of course, it is possible that actors in other business networks would define additional key performance indicators, e.g., more intangible KPIs than financial indicators, such as product innovation, quality, or serviceability. Given the modular characteristics of the method, this could be handled, although it would require further elaboration of the simulation software.

8.2.2 Business network scenarios

In order to capture the dynamic behavior of a business network, a 'business network scenario' was modeled, investigating only parts of the total business network processes in the case studies. However, one may argue that this approach is also applicable to larger business network designs in which more actors are incorporated and in which multiple business networks interact. For example, case study 1 in which multiple business processes were simulated in a multi-channel setting at the same time supports this argument.

8.2.3 Requirements of stakeholders

The requirements of other stakeholders in the business network, such as the government, legal entities, and trade unions, are not explicitly considered. These stakeholders might, however, be important in trade-offs between several business network redesigns. Again, given the modular characteristics of the method, this could be handled. For example, the government might pass regulations that cancel the requirement for physical identification in opening an account. In that case, the entire basis of the combined Internet scenario would become less interesting. However, with the existing database of modular BN components, every alternative design can be modeled and assessed. For example, if an

actor has employees that refuse to work on Saturdays, this could be incorporated into the resource availability of the required production elements.

8.3 Theoretical implications

With respect to the theoretical side of this dissertation, the research could have implications in a number of research areas (see below).

8.3.1 Transaction costs economics versus business network economics

Williamson (1981) provides a good theoretical foundation for analyzing coordination mechanisms by markets or hierarchies by focusing on transaction costs. His primary focus is on the individual organization making the trade-off between outside procurement (= *market*) and internal production (= *hierarchy*). He argues that based on the comparison of the cost levels of in-house production versus outside procurement, an organization chooses the cheapest alternative. In his approach, however, he forgets the benefits of ICT-enabled business networks as interesting alternative governance structure since he focuses on the individual organization and not on the total value network. This omission has been noticed by Clemons et al. (1993) when introducing the 'move to the middle' hypothesis. They state that 'IT use will influence the balance between in-house production and outside procurement by decreasing transaction costs'. And they argue that' … a higher degree of outsourcing will take place … but the firm will rely on fewer suppliers than before, with whom the organization will have close and long-term relationships' (Clemons et al. 1993: 13). The research presented here demonstrates how ICT use in a business network affects the level of transaction costs in an inter-organizational context and that ICT-enabled business networks can benefit from a higher level of organizational flexibility at a lower level of transaction costs at the same time. This result may be useful to other research on the trade-off between coordination mechanisms.

8.3.2 Defining and measuring margin at the inter-organizational level

One of the early observations in this dissertation was the lack of a clear and useful definition of margin at the inter-organizational level. On the one hand, there is Porter's (1985) concept of margin in a supply chain and, later, of the more dynamic organizational form (i.e., of a value system); on the other hand, there are the various concepts of the 'dynamic network.' But there does not seem to be a clear definition, let alone a detailed assessment, of inter-organizational process redesigns in terms of margin. In chapter 2, margin was defined in terms of a business network, and an attempt has been made to operationalize this definition, which was used in the case studies (see chapters 5 and 6). Both the definition of margin and its operationalization may be useful for research on business networking, the insight into cost and benefit repartition in business networks being crucial for effective BN management.

8.3.3 ICT-enabled modularity and business network performance

In the work of Lee and Tang (1997) and O'Grady (1999), the benefits of modularity on the generic characteristics of a firm's performance are widely discussed. Other authors (e.g., Bakos, 1998; Davenport and Short, 1990) added the 'multiplier effect' of modularity on the firm's performance when combined with the use of ICT. However, an operational method to assess this multiplier effect in an inter-organizational constellation such as the business network was not found. Therefore, in chapter 3, a research model was developed to investigate to what extent and under what conditions ICT-enabled modularity in a business network can realize a margin and flexibility-improved transformation in the business network. The case studies in chapters 5 and 6 demonstrate how individual actors apply modularity in their own products and processes and what effect this has on a business network striving towards margin and flexibility improvement at the same time.

8.3.4 ICT-enabled business network transformation

Our research is complementary to Venkatraman's (1994) findings on ICT-enabled business transformation. As demonstrated, higher levels of business transformation indicate potentially greater benefits from margin performance, but they also require correspondingly higher degrees of change in managerial routines. Also, the case studies demonstrate that *business network integration* is an additional level that BN actors can consider while improving the performance of the entire network. The case studies show that electronic integration in a business network not only change business processes but can also change the entire basis of competition in the business network. They demonstrate how the roles of the BN actors change before and after electronic integration and suggest ways to exploit new opportunities for the business network. Therefore, they provide a useful analysis for BN managers who are or will be affected by electronic integration in the network. Derived from the case results, the strategies for exploiting electronic integration in optimizing the business network can be summarized as (1) business process integration, (2) business network integration, and (3) business network transformation.

8.4 Practical implications

Business managers may want to use the following practical applications of the research.

8.4.1 Using the method and case examples to design new modular products

The method allows modularization of the actor's product and service portfolio as well as that of the other actors in the business network. From this basis, the actor can seek opportunities to design new products. The case studies can be used as references for the joint development of new modular, customized products while maintaining economies of scale in production.

8.4.2 Using the method to set clear objectives for a business network

Business managers could also use the method to set clear objectives for the business network through the definition of unique, integrated, customer-oriented performance

measures across the network. Integrated, customer-oriented performance measures offer more control over BN behavior because they give key managers ways to reflect actions across the business network. Without information on integrated, customer-oriented measures, BN members have little incentive to work with other members. Their only concern is to perform well on their own activities, even if that performance is at the expense of other BN actors. Our research provides solutions for the lack of appropriate performance measures at the level of the business network.

8.4.3 Using the method as a framework for a new customer profitability system

An attempt was made to introduce customer costing and customer pricing principles into the method. This can help business managers to identify and measure key drivers of customer costs and profits in the network, and from there, to seek opportunities to optimize the various criteria, thereby facilitating the introduction of a second-generation profitability system into the own organization.

8.4.4 Using the method to discipline ICT-enabled redesign projects

The 14-step plan of approach helps managers to discipline project members about ICT-enabled BN redesign by leading them through the BN's profit and cost drivers, while involving multiple disciplines (product management, ICT managers, business controllers, process modelers) in the organization at the same time.

8.4.5 Using the refined ICT redesign guidelines

The case studies allowed the refinement of 10 ICT redesign guidelines that can be used as references in redesign projects that aim to improve the performance of a business network, as summarized in table 8.1. These guidelines are valuable enough to be further investigated in multi-client research in different industries.

Table 8.1: Refined ICT redesign guidelines

Redesign guidelines	
1.	Create virtually linked production plants for handling and processing physical documents between BN actors
2.	Switch from physical mail-based customer transactions to digital customer transactions in the BN
3.	Search for earlier availability of customer-related production information that enables a more equal production flow in the BN
4.	Transmit digital customer data from an ICT-enabled point of sales to streamline the back-office processes between BN actors
5.	Investigate the possibilities for bundling Web-based services between BN actors
6.	Synchronize customer data processing and electronic messaging between actors in the BN
7.	Facilitate electronic banking instead of manual check processing between BN actors
8.	Develop modularly designed electronic services in the BN
9.	Adopt customer-based pricing of modularly designed services in the BN
10.	Increase the selling effectiveness in the BN by bundling Web-based services between BN actors

8.4.6 Using the Business Network Navigator in the ongoing evaluation of business (process) change

The working software prototype, i.e., Business Network Navigator, can support the ongoing evaluation of inter-organizational process and business redesign because the simulation model is facilitated by generic redesign variables. By constructing a database of generic redesign variables at the level of individual business processes, efficient and effective modeling of new business scenarios can be done easily and can be repeated. Business Network Navigator also highlights the importance of the roles and linkages of various BN actors. The role of partnerships is central to competing effectively in fast-changing marketplaces. Individual business actors do not have all the resources required to effectively compete, nor should they take all the business risks alone. Value creation for the customer can be leveraged better through pooling of BN assets. This is more than just outsourcing for operational competencies that can be controlled through standard contracts. Every assessment of BN opportunities and threats triggers new roles and positions for network actors. And every new role and position subsequently requires an assessment of BN performance. In Business Network Navigator, linkages and roles become transparent and can be simulated, allowing BN performance to be monitored.

8.5 Recommendations for further research

One can enumerate a number of research directions that might be interesting in the future. Some research directions have already been introduced in the previous section. A few more are elaborated below.

Given the steady growth in 'customer process-centric' business models, a first interesting area for further research could be the construction of a 'toolbox' of formal methods, techniques, and working applications that could be used to analyze, monitor, and improve the management of complex, ICT-enabled, reconfigurable ad hoc value chains. Relevant topics could include the following:

- methodologies and tools for modeling dynamic, customer-centric, intra-organizational processes;
- infrastructures for supporting the implementation of dynamically modifiable process models;
- business cases illustrating innovative solutions to e-business management processes in existing business networks.

A second interesting area for further research would be a different perspective of analysis. In our research, as in most of the literature, the analysis of a business network has taken the perspective of the focal actor who is usually the 'strongest' member of the network. It would be interesting to take an opposite perspective of analysis. What does dynamic networking mean for the BN actor who is positioned more downstream from the customer? Should the BN actor wait to be told of how it fits into the new scheme of things or can it

plan its course of action proactively, which would not only distance it from its competitors but would also ensure growth in value-added in the company's business network? In that case, the proposed approach would benefit from the development of a specific actor's opportunity tool. This tool should help the BN actor to analyze the business networks to which it contributes in order to identify those networks that offer long-term partnerships and the potential for more added value per customer by leveraging the actor's core competency. An analysis from a non-focal actor's perspective might include the following:

- *The actor's strategy and structure* would deal with characteristics of the actor's product and services (including the manner of customer use, the potential for increased value addition to the actor's products, and the competency/skills required if the increased value addition were provided), the actor's current organizational structure, and possible future structures;
- *The actor's characteristics* would deal with such areas as forms of partnerships or relationships, long- and medium-term objectives, customer metrics, and customer costing and pricing methods, information-sharing modes etc.;
- *The actor's core competencies* would include the identification of the actor's current core competency, if any, and competencies/skills that could be developed;
- *The actor's existing and potential competitors* would include an analysis of existing and potential competitors, including what products and services they supply and any advantage enjoyed by the competitors with respect to any of the BN characteristics mentioned above, etc.;

This analysis could provide the necessary information to enable a non-focal actor to influence the focal actor of an existing business network and to reposition itself.

A third interesting area for further research would be to compare the use of ICT-enabled modularity in business networks throughout the service industry. The case studies revealed significant differences in the knowledge and practice of modularity between participating actors. Some actors combined high product modularity with high process and supply-chain modularity, whereas with other actors, the three dimensions were low. A relevant topic of research would be to develop a typology of service industries that benefit most or least from ICT-enabled modularity on these three dimensions.

A fourth interesting area for further research would be further validation and refinement of the proposed method and elaboration of Business Network Navigator. Suggestions for further development of the simulation tool are:

- refinement of the customer cost hierarchies for more precise customer costing;
- incorporation of a sensitivity analysis module;
- incorporation of the requirements of stakeholders other than process modelers or account managers;
- incorporation of a conjunct analysis module for simulating pricing scenarios.

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ABBREVIATIONS

ABC	Activity based costing
ABCM	Activity based cost management
BN	Business network
BPR	Business process reengineering
BNR	Business network reengineering
CPA	Customer profitability analysis
CSF	Critical success factors
DSS	Decision support system
EBIT	Earnings before income & tax
IE	Information economics
IS	Information systems
ICT	Information and communication technology
IOR	Inter–organizational relationship
KPI's	Key performance indicators
MND	Modular network design
OFP	Order filling process
PE	Production element
PM	Process module
PMN	Process module network
SE	Service element
TCE	Transaction costs economics
VAP	Value added partnership

GLOSSARY

Actor costs

All the costs of operations and transactions related to customers orders that are performed by a single actor in the process of filling customer orders in the business network

Actor flexibility

The ability of a single actor in the business network to respond quickly to a diverse set of customer orders. Actor flexibility contains two elements: actor versatility and actor agility.

Actor versatility

The extensiveness of a product and/or service range a single actor of the business network is able to deliver

Actor agility

The period of time it takes a single actor of the business network to fill customer orders

Actor revenues

All the sales revenues --related to customer orders-- generated by a single actor in the business network

Actor margin

The end- result of all actor revenues generated minus all actor costs.

Business network

The structure of inter-organizational relationships between the focal actor and interdependent external actors closely linked and working co-operatively together to fill customer orders

Business network costs

All the costs of operations and transactions --related to customers orders-- performed through the business network in the process of filling customer orders

Business network revenues

The sales revenues-related to customer orders-generated by the business network

Business network flexibility

The ability of the business network to respond quickly to a diverse set of customer orders. BN flexibility contains two elements: business network versatility and business network agility

Business network versatility

The extensiveness of a product and/or service range the business network is able to deliver

Business network agility

The period of time it takes to fill a customer order through the business network

Business network margin

The end-result of the business network revenues generated minus all business network costs

Business network performance

The degree to which a business network meets customer requirements effectively and efficiently at any point in time

Business network scenario

A business network scenario is an aid in the analysis that will define the boundaries of the business network under study.

Focal actor

The focal actor in the business network is the organization that analyzes the customer order on its service requirements and from there allocates the business activities necessary to fill that particular order to other actors in the business network.

Information & Communication Technologies

Information and communication technologies are devices that transmit, manipulate, analyze or exploit information, in which a digital computer processes information integral to the user's communication or decision task (Huber, 1990).

Service elements (SE's)

Describe service attributes of modularly designed customer orders, produced – (and delivered)- to -order in the business network in a certain period of time

Performance Indicators

Performance indicators are operationalized process characteristics, which compares the efficiency and/or effectiveness of a system with a norm or target value

Production elements (PE's)

Describe the modular set of business activities of various BN actors required to produce the customer orders

Process modules (PM's)

Describe an atomic or elementary unit of work; which has no externally visible substructure; which can be operated in various production elements, and which produces the same output when replicated and repeated

Process module network (PMN)

Indicates in what order specific sets of process modules - generated by various BN actors – need to be executed in order to fill a customer-specific order

APPENDIX I

Performance metric evaluation and key performance indicators

In the discussion in section 2.3 on relevant key performance indicators in the business network, multiple performance elements, which need to be measured simultaneously, were identified. For the purpose of our research, the technique of 'multiple-objective decision-making analysis' is considered to be the most appropriate technique for measuring these performance elements. Caplice and Sheffi (1995) give an overview of the literature on performance metric evaluation. They conclude that eight criteria fully capture the essential characteristics of individual performance metrics and examine their interactions (table I.1).

Table I.1: Eight evaluation criteria for performance indicators

Criteria	Description
Validity	The metric accurately captures the events and activities being measured and controls for any exogenous factors.
Robustness	The metric is interpreted similarly by the users, is comparable across time, location, and organizations, and is repeatable.
Usefulness	The metric is readily understandable by the decision-maker and provides a guide for the action to be taken.
Integration	The metric includes all relevant aspects of the process and promotes coordination across the functions and divisions.
Economy	The benefit of using the metric outweighs the costs of data collection, analysis, and reporting.
Compatibility	The metric is compatible with the existing information, material and cash-flow systems in the organizations.
Level of detail	The metric provides a sufficient degree of granularity or aggregation for the user.
Behavioral soundness	The metric minimizes incentives for counter-productive actions or game playing and is presented in a useful form.

Source: Caplice and Sheffi (1995).

The selection of the metrics should be carefully analyzed using these criteria to ensure that they support the selected strategy. Due to interactions or trade-offs between some of the criteria, it is neither practical nor possible to develop metrics that excel in each of the criteria. When evaluating business network scenarios, a trade-off is required between multiple measures of performance, which usually have different dimensions and which often cannot be optimized simultaneously. There are three approaches to this dilemma:

1. Make explicit trade-offs among the measures.
2. Make explicit trade-offs by combining all the measures using a common dimension, such as cost, or by installing weighing factors for each of the measures in an aggregating function. The techniques for making explicit trade-offs among several measures of system performance are designated as 'multiple-attribute' or 'multiple-objective decision-making analysis.'

3. Optimize the measure of greatest concern while constraining the others within some acceptable minimum range. Once an optimal solution is found, one or more of the constraints can be relaxed. The decision-maker can then weigh the cost of relaxing the constraint against the resulting improvement in the objective function.

We have applied the third approach in our case studies.

The development of Business Network Navigator

As mentioned in chapter 4, a decision support system – *Business Network Navigator* – was developed to allow flexible access to the research model and the research protocol. For its development, the requirements were first analyzed and the advantages and disadvantages of the use of analytical models versus simulation were compared. Eventually, the software prototype of the simulation tool was built, over a period of 61 weeks.

Programmable decisions

A decision is unstructured when no predetermined and explicit set of ordered responses exists (information is missing or new variables have entered the problem field). Decisions are programmable to the extent that they are repetitive and routine, and to the extent that a definite procedure can be worked out for handling them (Simon, 1976). Keen and Scott Morton (1978) conclude that there are five approaches to managerial decision making:

1. the rational way of decision making, in which the manager is completely informed, knows all the decision alternatives, and can make an optimal choice ('objective rationality');
2. the satisfying way of decision making, in which a decision alternative is sought that satisfies all participants ('bounded rationality');
3. the organizational procedures way of decision making, which sees decisions as the output of standard operating procedures used by organizational sub-units;
4. the political way of decision making, in which a decision is seen as the result of negotiations between actors; power and influence determine the outcome of any given decision;
5. the individual differences way of decision making, which presupposes a very important role for the character of the individual, and in which personality and style are of great importance.

The rational way of decision making could be used to reorder standard products, and the political way of decision making could be used when selecting another supplier. But in general, a mix of these approaches is used when a decision is made (Benders et al., 1983). According to Simon (1976), 'most human decision-making whether individual or organizational, is concerned with the discovery and selection of optimal alternatives.' Because of this bounded rationality, the choice in most decision-making situations is for satisfying decisions. Two characteristics of human decision-making processes are central to understanding decision support systems. First, decision making is not a point event. Simon (1976) observes that we often mistakenly think of a decision-making activity as

occurring only at the moment of choice. In fact, decision making is a complex sequence of differentiated activities occurring over time. Second, decision making is not monolithic. Numerous distinct paths can be followed to arrive at a decision. Often, choosing the path (determining the structure of the process) is more important and more difficult than traversing it (executing the process). The actual decision about which redesign to implement is subject to the political and individual differences approaches to decision making.

The tool for decision support that was developed for the research reported here adheres to the bounded rational (satisfying) approach of decision making. In our research method, decisions are programmable to the extent that the modeling procedures and assessment procedures (see sections 4.3.2 and 4.3.3) are worked out and that they are repetitive and routine. Therefore, support is constrained to steps 3, 4, 5, 6, 9, 10, and 11 of the research protocol. By doing this, the required decision support tool should be made capable of converting input variables into structured output while capturing the dynamic behavior of the business network. So, what is needed is a DSS in which the details of BN activities and linkages, as described in the research method, can be entered, and which, from that information, can get numbers that measure performance due to ICT use, which in turn, can be optimized and calibrated for agility and versatility, cost, revenues, and margin.

In summary, the main requirements of the decision support system are the following:

- the representation of a business network scenario in its current and future designs at three levels of analysis: process, actor, and business network;
- the assessment of multiple key performance indicators at the process, actor, and business network level;
- the visualization of order filling through the process module network;
- the simulation of change in business activities, roles, and linkages among actors;
- the comparison of results of various redesigns on the pre-defined KPIs;
- the generation of management information reports on multiple criteria.

Analytical models versus simulation

Law and Kelton (1991) distinguish ways in which a 'system' might be studied. 'It is rarely feasible to experiment with the actual system, because such an experiment would often be too costly or too disruptive to the system, or because the required system might not even exist. For these reasons, it is usually necessary to build a model as a representation of the real system and to study it as a surrogate for the real system.' In this sense, 'models' become tools for thinking (Pidd, 1999).

To model a system, we often have to make a set of assumptions about how it works. These assumptions are used to constitute a model that in turn is used to provide some insight into the behavior of the corresponding system. If the relationships that comprise the model are

simple enough, it may be possible to use analytical models to obtain exact information on questions of interest. In *analytical models* (Law and Kelton, 1991), the relationships between the elements of the system are expressed through mathematical equations. Hoover and Perry (1989) identify some advantages of analytical models: (1) conciseness in problem description, (2) closed-form solutions, (3) ease of evaluating the impact of changes in measures of inputs or outputs, and (4) in some cases, the ability to produce an optimum outcome. On the other hand, they recognize some disadvantages, such as assumptions regarding the system description, which may be unrealistic and complex mathematical formulations that defy solution. For example, many systems can be modeled as queuing networks, but either the assumptions required for analytic solution are somewhat unrealistic (e.g., exponential inter-arrival and service times) or the mathematical formulation necessary to reflect the desired degree of realism is intractable (Hoover and Perry, 1989). *Simulation models* can compensate for the disadvantages of analytical models, but not without sacrificing some of their advantages. Law and Kelton (1991) mention a number of the advantages and disadvantages of simulation (table I.2).

Table I.2: Advantages and disadvantages of simulation

Advantages	Disadvantages
Most systems with stochastic elements are too complex for analytical evaluation. Thus simulation is the only possibility.	Each run of a stochastic model produces only estimates of a model's true characteristics for a particular set of input parameters. Thus, several independent runs of the model are required. An analytical model, if appropriate, can produce the true characteristics.
Simulation allows one to estimate the performance of an existing system under some projected set of operating conditions.	It is expensive and time consuming to develop.
Alternative proposed system designs can be compared to see which best meet a specified requirement.	There is often a tendency to place too much confidence in a study's results because of the large volume of numbers produced or the persuasive impact of realistic animation.
There is better control over the experimental conditions than when experimenting with the system itself.	If a model is not a valid representation of the system under study, the results are of little use.
It allows one to study a system with a long time frame, in compressed time or even in expanded time.	

Source: Adapted from Law and Kelton (1991).

Since most analytical models take only a few variables into account, the complexity of business network design makes it much too large for analytical modeling. BN management specifically focuses on inter-organizational flows of products (materials and services) and information, along with the associated managerial and operational activities, to obtain a higher degree of responsiveness. Because of the multiple performance- and time-related processes that need to be taken into account when modeling complete BN designs and the need for the model to be credible in the eyes of the decision-makers, it seems better to focus on simulation models, keeping in mind the fact that analytical models can be useful.

Simulation models make it possible to evaluate numerous designs on countless KPIs. Note that redesign decision-makers are not necessarily looking for ways to maximize margin, but for redesigns that perform better than the current design and that are robust enough to withstand changes in market or internal circumstances.

Most real-world systems are too complex to allow for analytical modeling and are better studied by means of simulation (Law and Kelton, 1991). Silver et al. (1998) state that 'if analytical models are to be more useful as aids for managerial decision-making, they must be more realistic representations of the problem; in particular, they must permit some of the usual 'givens' to be treated as decision variables. Moreover, such models must ultimately be in an operational form such that the user can understand the inherent assumptions, the associated required data can be realistically obtained, and the recommended course of action can be provided within a relatively short period of time.' So, simulation models seem to be an adequate aid to BN decision making since they can be used to model the complete business network design at the operational level according to pre-defined modeling and assessment procedures.

One of the main disadvantages of analytical models is that they cannot precisely predict the feasibility of the modeled design in real life (in addition to the fact that such a model is only reliable if the right assumptions underlying are made). On the other hand, case study research can provide us with data on the feasibility of such designs, but case studies will not give us detailed evaluations of all performance indicators. Furthermore, because of the risks and costs involved, it is impossible to test all redesigns; therefore, it is useful to combine the simulation tool with case study research. The simulation tool allows the realistic modeling and assessment of the redesigns and the case studies provide the practical data and organizational restrictions needed to determine the feasibility of alternative designs.

Building of the software prototype
A multi-disciplinary team of scientific researchers, a manager from account management, a marketing manager, and software programmers from Erasmus University, PTT Post, and the Postbank participated in the project from February 1998 to May 1999. The process of building Business Network Navigator was carried out in four phases over a 61-week period (for a detailed description, see the project plan, Oskam (1998):

- In the *first phase* (2 weeks) of the project, the requirements were analyzed in general terms, resulting in a detailed project plan with resource requirements and time schedules.
- The *second phase* (16 weeks) contained the specifications. In this phase, a more detailed analysis took place along with an inventory of existing knowledge and software. In addition, the functional, technical, and testing specifications were

defined in general terms, based on the input of scientific researchers, software programmers, account managers, and process modelers.

- The *third phase* (39 weeks) covered the actual building of the prototype. In this phase, the functional and technical specifications were defined in more detailed terms based upon the progress of the scientific research. This phase resulted in the delivery of two versions with test reports (NN prototype 0.01, NN prototype 0.02) and, eventually, in the delivery of the Network Navigator prototype 1.00.
- In the *fourth phase* (4 weeks), the prototype was implemented. It was used for entering case data by the researcher and software bugs were corrected. This phase resulted in the production of a user's manual (Delporte and Klop, 1999) and a technical manual (Klop and de Lepper, 1999).

Data modules

The software prototype is modular, as illustrated in figure I.1,[1] designed with following data modules:

- *BND editor*: with the use of the BND editor business network scenarios can be modeled from resource level to the level of service elements;
- *BND to SIM translator*: this module translates the BND models to simulation objects. It is invisible to the end user;
- Simulator: this module was developed in Arena®. The records from the SIM translator are inserted in Arena®, so these records can be used in a given simulation run;
- *Costing/pricing*: this module combines the information from the BND editor with the results of the simulation in order to assess the cost of resources of a specific order, for example.

[1] For a more detailed description, refer to the technical manual of Business Network Navigator (Klop and de Lepper, 1999).

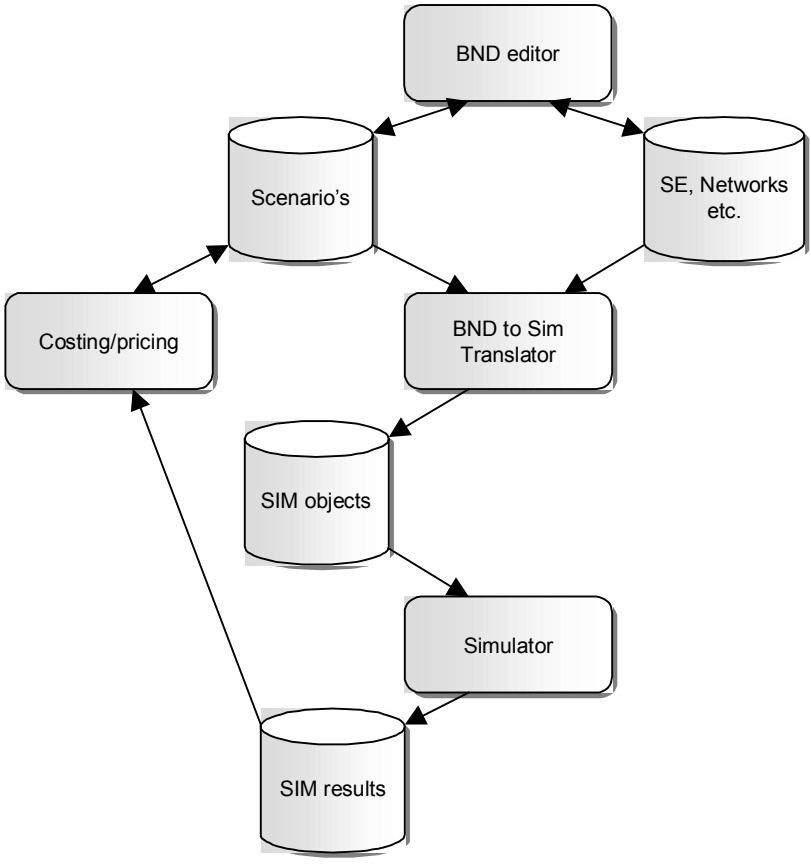

Figure I.1: Business Network Navigator modules and data

User modules

Business Network Navigator has two different user modules: (1) one for the account manager and (2) one for the process modeler.[2] This distinction is based on different user requirements. To support commercial relationship with business customers, the account manager will want to illustrate several BN scenarios and simulations, whereas the process modeler will need more detailed data entry to build the different BN scenarios and simulations. Figure I.2 depicts a screen dump of the process modelers' interface, which contains an overview of:

- all the required input variables, such as actors (*organisatie*), resources, service elements (*service elementen*), production elements (*produktie elementen*), process modules (*proces modules*), and modeled orders (*orders*);
- the structured output in the form of (graphical) reports (*rapportage*).

[2] For a detailed description of Business Network Navigator's user modules, see the users' manual (Delporte and Klop, 1999).

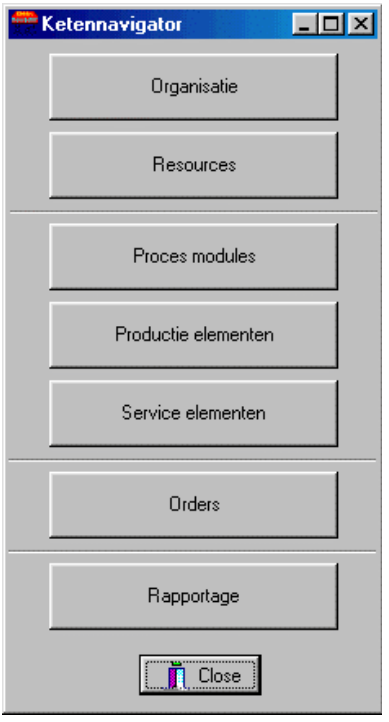

Figure I.2: Screen dump of the process modelers' interface in Business Network Navigator

The user's interface of the account managers' module contains five different screens, as illustrated in figure I.3:

- *Scenario and simulatie*: In this screen, scenarios are created and simulated (a 'scenario' is a collection of simulations; a 'simulation' is a collection of one or more customer orders). If in one simulation, multiple orders have been selected, this means that all these orders are simultaneously simulated (and computed) and that the interaction between all these orders affects the simulation results.
- *Service element*: At an earlier stage, data on the available SEs has taken place. The screen shows the selected sets of SEs per order. For each SE, a PE combination needs to be chosen. Clicking on *Organisaties*, reveals the SE/PE combination selected. It is also possible to formulate alternative SE/PE combinations, other than the one designed by the process modeler. Parts of the process module network can be changed into alternative PEs and the effects simulated, for example, a change in business activities performed by organization Y instead of organization X.
- *Simulatie*: On this screen, the simulation data are shown (translated and computed). First, the orders within the simulation need to be translated to the simulation tool by clicking the button *Vertaal*. The *Acties* field shows the translation and the 'Warnings'

field shows possible errors in the alternatively designed process module network. After the translation, the order model needs to be imported to the simulation tool to be computed.

- *Resultaten:* All computed simulations are shown on this screen. By clicking on the button *Visualisatie order*, the process module network for a particular customer order is visualized. By clicking on the button *Grafiek*, the results of the PMN are represented in graphical form. By clicking the right mouse button, one can change the lay-out or parameters of the graph and copy it to a Word document.
- *Vergelijking*: On this screen, two orders can be compared for each BN actor (*organisatie*); for example, differences in operating time can be calculated. When the differential figure is negative, the operating time of the alternative design will be shorter than that of the original design.

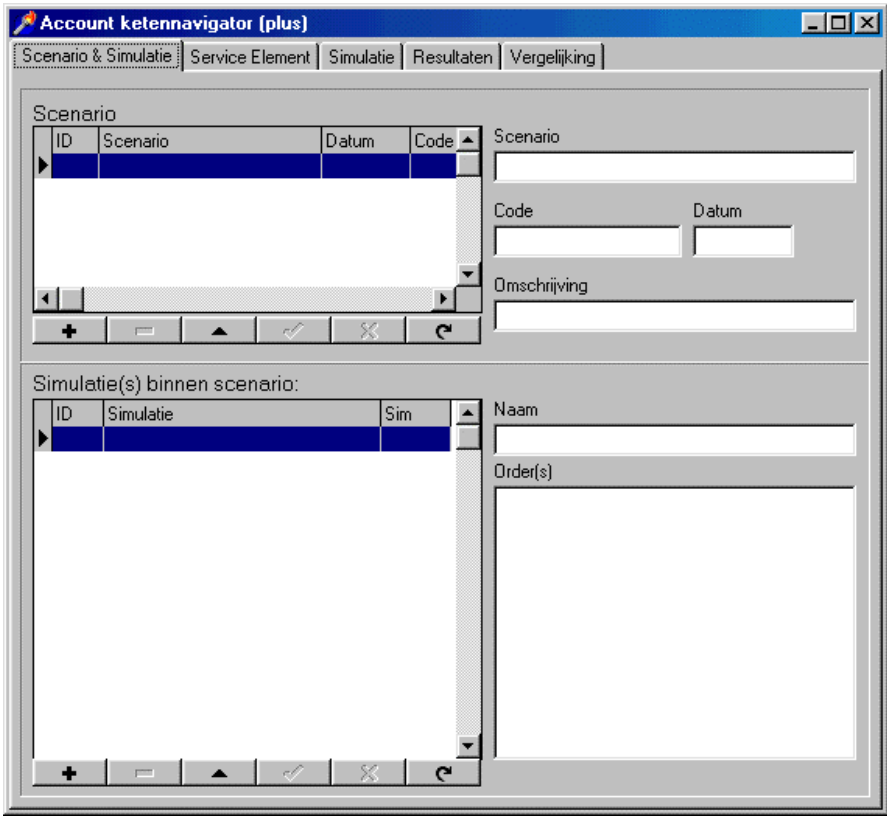

Figure I.3: Screen dump of account managers' user interface in Business Network Navigator

Validation of Business Network Navigator

To what extent is Business Network Navigator a valid research tool? Experimenting with a simulation tool takes the place of actual experimentation on an existing or proposed system. Hence, one of the most important aspects in simulation studies is the validation of the model. If the model is not valid, then any conclusions derived from it are of doubtful value. Law and Kelton (1991) refer to Balci and Sargent (1984) for a comprehensive bibliography on model validation. There are three central points to consider in model validation: verification, validation, and credibility (Law and Kelton, 1991):

- *Verification* is determining that a simulation computer program performs as intended (i.e., making sure it is debugged). Verification ensures that the conceptual simulation model (the process models and assumptions) is translated into a correctly working program.
- *Validation* is concerned with determining whether the conceptual simulation model (i.e., the modeling framework) is an accurate representation of the system under study.
- When a simulation model and its results are accepted by the problem owners as being valid, and are used as an aid in making decisions, the model is *credible*.

In their book, 'Simulation modeling and analysis,' Law and Kelton (1991) present two basic thoughts on model validation that have been adhered to in this study: it is important for the modeler

- to interact with the problem owner(s) on a regular basis throughout the course of the simulation study. The model is more credible when the manager understands and accepts the model's assumptions;
- to perform a structured walk-through of the conceptual model (prior to the beginning of coding) before an audience of all key people. This meeting helps ensure that the model's assumptions are correct, complete, and consistent (i.e., that local information obtained from different people is not contradictory).

During the first case study, an informal 'structured walk-through' was done with participants from the key actors involved. In this process, we explained the detailed logic of the simulation model. Each customer order with its related business processes was discussed extensively to capture the real system in the best possible way. When necessary, corrections or additions were made to the model. Bottom-up testing provided the verification of the simulation model. The *organisaties* and *resources* of the basic modules were tested and verified first. Integration tests were then performed, in which the interfaces between two or more modules were tested.[3] Finally the complete tool (including the input data) was tested and verified. The actual validation of the simulation model was done in various ways:

[3] For a detailed overview of the testing, see the testing report (Janmaat, 2000).

- The simulated BN scenarios were printed out and compared to manual calculations to see if the program was operating as intended.
- For verification, the output of the simulation was compared to the results of the analytical studies.
- For expert validation, the results of the multiple simulated scenarios were presented and discussed with key participants to support the validity of the model.

The project team concluded that the dynamic models:

- contained the available redesign variables and the relevant KPIs needed to evaluate the business network scenarios;
- predicted the order of magnitude of changes in the margin flexibility as new ICT-enabled business network scenarios were implemented;
- allowed the project teams to make alternative BN scenarios and compare results on multiple criteria and at various levels of analysis, since the model proved to be very robust in handling a large amount of input and output data.

The project team also found that the modeling language (Arena®) could grasp all constructs of the modeling framework in one way or another. With Arena®, the dynamic behavior of the order-filling process could be captured in the different BN scenarios. The precedence relationships between business processes were easily modeled by linking the output of one process to the input of another. Also, the timing of the business processes could be set in Arena®, using either a loop and a delay or the starting time, depending on the availability of a resource. When the entity is created in Arena®, a time stamp is added, which allows the period of time an entity exists to be monitored. This is important to the analysis of dwell time or the creation of bottlenecks in the production and distribution processes.

APPENDIX II: THE CASE STUDY RESEARCH

The case study method

According to Yin (1994, p. 49), a case study is used to examine the links between the developed theory, the selected cases, and the design of a protocol for data collection. Case study reports, cross-case conclusions, and the development of further theory are part of this method, as illustrated in figure II.1.

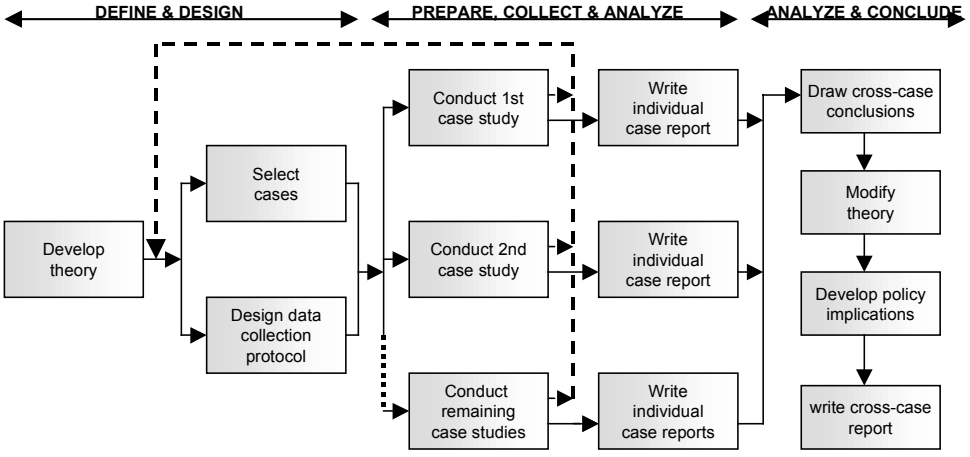

Figure II.1: Case study method (Yin, 1994)

The overall design of our case studies adheres to this three-phase approach: phase 1: setting up the case study, phase 2: collecting case evidence, and phase 3: evaluating the case evidence.

The design of the two cases reported here is illustrated in figure II.2 and figure II.3, respectively.

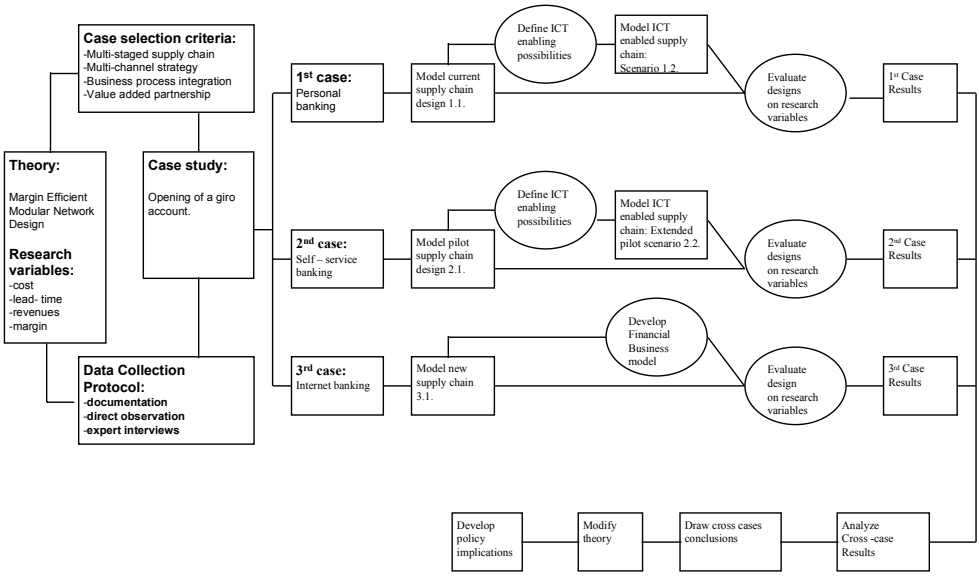

Figure II.2: Design of case study 1

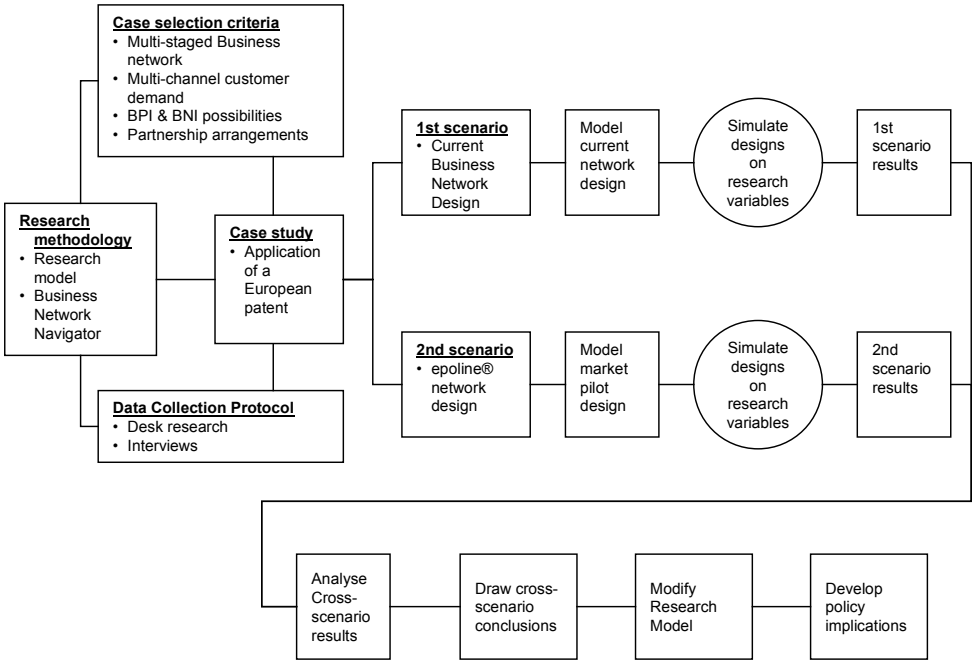

Figure II. 3: Design of case study 2

Although different customer processes were researched, the same protocol was used in both case studies to increase their reliability (c.f. Yin, 1994). To increase the quality of the case studies, we adhered to the following principles of data collection:

- *Using multiple sources of data collection* (also called 'triangulation'): Numerous textbooks and research articles discuss data-collection techniques, and six important sources of information that are often cited are documentation, archival records, interviews, direct observations, participant-observation, and physical artifacts. The sources of evidence used in the two case studies reported here used a 'convergence of multiple sources' approach (as opposed to a 'non-convergence of multiple sources of evidence' [Yin, 1994, p. 93]). Repeated semi-structured interviews with key representatives concerning the current design and opinions about possible ICT-enabled changes were used, along with direct observation during the frequent field visits. During the project team meetings, the mapping of all business processes – existing ones as well as the newly designed processes – were discussed in detail.
- *Establishing a chain of evidence:* This approach allows an external observer to follow the derivation of any evidence from initial research questions to ultimate conclusions. Moreover, an external observer should be able to trace the steps in either direction (from conclusions back to initial research questions or from questions to conclusions) (Yin, 1994, p. 98). In our case study research, this was done by drawing the case study designs (figures II.2 and II.3).
- *Reviewing of case study draft by key informants:* A third procedure is to have the draft reports reviewed, not just by peers but also by the participants and informants in the case. This as a way of corroborating the essential facts and evidence presented in the case report. In our case studies, two types of key informants collaborated in giving feedback on the reports: (a) academic researchers at the Erasmus University and (b) managers and project members from the actors involved.
- *Creating a case study database:* Every case study project should strive to develop a formal, presentable database so that in principle, other investigators can review the evidence directly and not be limited to the written reports. In this manner, a case study database markedly increases the reliability of the entire case study (Yin 1993, p. 95). Different authors have proposed numerous ways of accomplishing this, such as editing case study notes or collecting case study documents, tabular materials, or narratives (Yin, 1994, p. 96). Two different databases were created for our case studies: (1) the researcher's personal database (in Word document format) with references of all case study notes, reports, and memos, and e-mails of project members and (2) the CD/ROMs with detailed records of the data entry for the two cases in Business Network Navigator.

Illustration of product modularity at PTT Post

A modular design was used in setting up of the new document input portfolio at PTT Post because PTT Post wanted to combine different customer requirements while keeping economies of scale in its bulk processes. Customer requirements were very diverse, both on the input side and on the output side of DIS, as viewed in table II.1. The pricing tactic for the DIS portfolio was customer pricing based on the modular components selected.

Table II.1: Different customer requirements of DIS service

Focus of DIS service	Aspects	Customer requirements
Input	Receipt	at PTT DIS at customer's location
	Mail flow	some mail pieces all mail
	Envelopes	all formats standard
	Pre-handling	at PTT DIS at customer's location
	Content of scanning	all content part of the content
Output	Recognition and interpretation at PTT DIS	None Partial Full
	Manual data entry	At PTT DIS At customer's location
	Indexing and routing	At PTT DIS At customer's location
	Medium	On-line Tape Optical disk
	Format	Standard Client system
	Through-put time	Couple of hours 24 hours

Source: KPN research (1997).

Case data of case study 1

All the collected case data for the Postbank/Post Offices/PTT Post case have been entered in Business Network Navigator. Since they are electronically stored, they can be easily retrieved when necessary. Some of this information is illustrated below to give the reader an idea of the database of organizations, service elements, and production elements and the level of detail of analysis. Note that these illustrations are not complete. For a complete overview, see the case study report (Van Oosterhout and Delporte, 1999).

Table II.2: List of organizations in case study 1

Organizations (departments)
01 – Customer
02 – Post Offices
03 – PTT Post (road transport)
04 – PTT Post (DC)
05 – PTT Post (VC)
06 - PTT Post (DIS)
07 – PTT Post (document handling)
08 – Postbank (PdP)
09 – Postbank (OBV Arnhem)
010 – Retail Service Point
011 – Bureau Krediet Registratie

Table II.3: Illustration of service elements in case study 1

SE Category	Ses
1 – Transaction channel	S0 – Location of first customer contact S1 – Means of customer contact S2 – Medium of customer contact S3 – Customer contact identification
2 – Customer profile	S4 – Customer Type S5 – Customer Relation S6 – Customer Age S7 – Customer Income S8 – Customer Profession S9 – Nationality S10- Residence
3 – Customer account type	S11 – Customer Account Type S12 – Customer Partner
4 – Customer account services	S13 – Giro account – Transfer Order Book S14 – Giro account – Payment Card S15 – Giro account – First Payment S16 – Giro account – Postbank + S17 – Giro account – Credit Facility S18 – Giro account – Credit Card S22 etc.
5 – Logistical fulfillment	S23 – Place of delivery S24 – Speed of delivery S25 – Special treatment S26 – Tracking and tracing credit card S27 – Means of delivery

Table II. 4:Illustration of production elements in case study 1

Organization	Production element
Bureau Krediet Registratie	P166 – VIS check at BKR
Customer	P169 – Authentication by customer for certificate
Customer	P1 - Authentication by customer for opening
Customer	P53 - Enter data in Website
Customer	Etc.
Post Offices	P7 - Check passport
Post Offices	P5 - Handle opening request
Post Offices	Etc.
Postbank (OBV)	P38 - Produce TOB
Postbank (OBV)	P41 - Prepare mailing TOB
Postbank (OBV)	Etc.
PTT Post (DIS)	P139 - DIS processing of opening request
PTT Post (DIS)	P140 - Transformation and sending scans
PTT Post (DIS)	Etc.
PTT Post (Document Handling)	P84 - Certification processing
PTT Post (Document Handling)	P90 - Handling signed certificates
PTT Post (Document Handling)	Etc.
PTT Post (Road Transport)	P15 - Transportation of opening requests
PTT Post (Road Transport)	Etc.
PTT Post (SC)	P17 - Sorting of signed certificates
PTT Post (VC)	P50 - Delivery of TOB
PTT Post (VC)	Etc.
Retail Service Point	P75 - Controlling opening request
Retail Service Point	P80 - Data entry in Web registration system
Retail Service Point	Etc.

Case data of case study 2

As in case study 1, all the case data collected for the EPO-DPO/ABN-AMRO/PTT Post case study have been entered in Business Network Navigator, which makes them easily retrievable. To give the reader an idea of the database of organizations, service elements, and production elements and the level of detail of analysis, some illustrations are given below. Note that these illustrations are not complete. For a complete overview, see the case study report (Van Oosterhout and Delporte, 2000).

Table II.5: List of organizations in case study 2

Organizations (departments)
01 – Dutch Patent Office
02 – PTT Post
03 – European Patent Office
04 – ABN/AMRO
05 – Certifying Authority (CA)
06 – Applicant

Table II. 6: Illustration of service elements in case study 2

SE Category	SE's
1 – Application Profile	S1 - EPO application – Number of states S2 - EPO application – 1-year term S3 - EPO application – 5-year term S4 - EPO application – 10-year term S5 - EPO application – 15-year term S6 - EPO application – 20-year term S7 - EPO application – 25-year term S8 - Euro PCT application – 1-year term S9 - Euro PCT application – 5-year term Etc.
2 - Products and services	S20 - EP search 521 - Further EP search S22 - International search S23 - Filing fee S24 - Designation fees S25 - Joint designation fees S26 - Surcharges on fees S27 - Renewal fees S28 - Examination fees S 29- Etc. S201 - Patent register on-line S202 - File inspection on-line S203 - Dispatch of search report on-line S204 - Etc. S500 - Check payment S501 - Digital payment
3 - Transaction channel	S300 - Mail S3001- EPO portal
4 - Logistical fulfillment	S400 - Delivery via PTT Post mail service S401 - Delivery by personal hand-over S410 – Smart card delivery via PTT Post S411 – Smart card delivery via courier S412 – Smart card delivery -personal pick-up

Table II. 7: Illustration of production elements in case study 2

Organization	Production element
EPO	P106 – On-line reception of signed application
EPO	P107 - Verification of electronic application
EPO	P108 - Electronic confirmation of receipt
EPO	Etc.
DPO	P001 - Composition of application document
DPO	P002 - Authorization of application document
DPO	P003 - Protection of application document
DPO	P004 - Handing over sealed envelope
DPO	Etc

CA	P112 - Authentication check
CA	P105 - Issue of authentication certificates
ABN/AMRO	P0015 - Processing check payment
ABN/AMRO	P111 - Processing electronic payment
PTT Post	P005 - Collection of sealed envelope
PTT Post	P006 - Transportation and sorting of sealed envelope
PTT Post	P115 - Distribution and delivery of smart card
PTT Post	Etc.

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SAMENVATTING

Dit proefschrift heeft als Nederlandse titel 'Het verbeteren van de flexibiliteit en winstgevendheid van ICT ondersteunde bedrijfsnetwerken: een inschattingsmethode en werkinstrument.

In toenemende mate vragen consumenten, d.w.z. particulieren en bedrijven, om meer geïndividualiseerde dienstverlening tegen betaalbare prijzen. Ondernemingen zien zich genoodzaakt zich flexibeler naar de markt op te stellen om aan deze veranderende marktvraag te voldoen. Dit heeft gevolgen voor de huidige, doorgaans starre, relaties in de aanbodgestuurde waardeketen. De waardeketen die à la Porter (1985) ontworpen is om een gestandaardiseerd aanbod te produceren en te vermarkten via één specifiek distributie kanaal tegen een optimale marge, moet veranderen in een waardeketen die op klantorders op maat uit meerdere distributiekanalen tegelijk kan reageren.

Veel organisaties vragen zich dan ook af hoe men de traditionele waardeketen kan herontwerpen tot meer flexibele, klantgerichte en vraaggestuurde netwerken van organisaties en wat het ze onder de streep, d.w.z. aan marge bijdrage oplevert. Men zoekt naar methoden en technieken welke hun kunnen ondersteunen om de benodigde flexibiliteit naar de markt marge-efficïent te realiseren.

Een van de methoden is het gebruik van modulariteit in het herontwerp van diensten, bedrijfsprocessen en netwerkstructuren ondersteund door Informatie en Communicatie Technologie. Het gebruik van ICT, in het bijzonder het Internet, faciliteert een snellere en meer betrouwbare coördinatie en communicatie tussen relevante partijen in de waardeketen. Modulariteit in ontwerp in diensten, bedrijfsprocessen en netwerkstructuren faciliteert het gericht (her)bundelen van gestandaardiseerde basis componenten in de meest diverse settings.

Eerder onderzoek (Hoogeweegen, 1997) heeft aangetoond dat met de inzet van ICT ondersteunde modulariteit geïndividualiseerde en kosten-efficiënte bedrijfsnetwerken in de transport sector ontworpen kunnen worden. De vragen die wij ons stelden zijn:
Hoe kan door het gebruik van ICT ondersteunde modulariteit een flexibel en marge-efficiënt netwerk van organisatie herontworpen worden? En wat betekent dit voor de individuele organisaties in het netwerk? ,
Beinvloedt een ex-ante inzicht in de flexibiliteit en marge van een ICT ondersteund herontwerp ook de besluitvorming tot invoering ervan?

De beantwoording van deze vragen vereist een *herontwerpmethode* die enerzijds inzicht verschaft in de verdeling van de flexibiliteit en de winstgevendheid over de individuele organisaties in het bestaande bedrijfsnetwerk. Anderzijds dient de methode ook een ex ante

inschatting van beide aspecten op te leveren voor de ICT ondersteunde herontwerpen van het bestaande bedrijfsnetwerk.

De onderzoeksvragen zijn in hoofdstuk één als volgt geformuleerd:

Kunnen we een methode ontwikkelen voor het ex ante inschattten van marge welke gebruikt kan worden bij het door ICT ondersteunde herontwerpen van een bedrijfsnetwerk? In het bijzonder een methode die de relatieve verandering in marge voor alle betrokken organisaties, i.e. actoren, inschat.

Wat is de invloed van zo een methode op de beslissing van de actoren om een specifiek ICT ondersteund herontwerp van het bedrijfsnetwerk in te voeren?

In dit proefschrift wordt de desbetreffende herontwerpmethode met haar 'decision support tool' ontwikkeld vanuit drie perspectieven t.w. : (1) ICT ondersteund herontwerp van bedrijfsnetwerken (Venkatraman 1994), (2) zakelijke modulariteit (Hoogeweegen, 1997 en Wolters, 2002) en (3) Information Economics (Parker & Benson, 1988). De methode en geautomatiseerde tool zijn vervolgens gebruikt in twee gevallenstudies in de diensten sector en vervolgens geëvalueerd op hun toepasbaarheid en generaliseerbaarheid.

In de hoofdstukken twee t.e.m vier wordt de weg naar de ontwikkeling van de herontwerpmethode en het decision support tool beschreven. *Hoofdstuk twee* bevat de literatuur studie met uitdieping van o.m. definities, methoden & technieken voor kosten/baten analyse van ICT effecten en (her)ontwerp van bedrijfsnetwerken en relevante beïnvloedende factoren in de besluitvorming. Dit resulteert o.m. in de introductie van het het concept 'marge van een bedrijfsnetwerk' en de constatering dat de modulaire herontwerp methode van Hoogeweegen (1997) een goed startpunt vormt voor de onwikkeling van de benodigde methode voor het ex ante inschatten van de marge bijdrage van een ICT ondersteund herontwerp. De herontwerp aanpak van Hoogeweegen benoemt vier generieke herontwerpvariabelen, welke in diverse settings, het modulair ontwerp van produkten, bedrijfsprocessen en netwerkstructuren met gebruik van ICT kunnen ondersteunen. Deze ontwerpvariabelen zijn 'service elementen', 'produktie elementen', 'process modules' en 'process module netwerk'.
Echter, voor de beantwoording van onze onderzoeksvragen dient Hoogeweegen's aanpak uitgebreid te worden met de ontwikkeling van:

- een formeel onderzoeksmodel waarbij de relatie tussen het modulair inrichten van bedrijfsnetwerken met ICT en de bijdrage aan marge en flexibiliteit van het bedrijfsnetwerk onderzocht kan worden in de praktijk
- een geformaliseerd protocol met generieke herontwerp stappen en activiteiten
- een decision support tool dat flexibele toegang verleent tot het model en het protocol

Gebaseerd op de bevindingen van de literatuur studie wordt in *hoofdstuk drie* het formele onderzoeksmodel met de centrale en aanverwante proposities beschreven. De centrale propositie is dat het gebruik van ICT ondersteunde modulariteit tegelijkertijd bijdraagt tot de verbetering van marge en de verhoging van de flexibiliteit van het bedrijfsnetwerk. Daarom zijn eerst sleutel-prestatie-indicatoren van een bedrijfsnetwerk benoemd zoals 'marge-flexibiliteit', 'bedrijfsnetwerkkosten', 'bedrijfsnetwerkopbrengsten', 'bedrijfsnetwerkflexibiliteit', 'bedrijfsnetwerkveelzijdigheid', 'bedrijfsnetwerksnelheid' en 'bedrijfsnetwerkmarge'.

Hoofdstuk vier bevat de ontwikkeling van het geformaliseerde protocol en de verdere operationalisering van de variabelen welke ten grondslag liggen aan het inschatten van marge-flexibiliteit. Het *14 stappen-protocol* bevat de keuze van determinante factoren welke de besluitvorming m.b.t. het marge-flexibel (her)ontwerpen van een bedrijfsnetwerk beïnvloeden en hun onderlinge samenhang. Het protocol start met de analyse van de huidige strategie, objectieven en structuur van een bedrijfsnetwerk, om via de identificatie van de vier eerder genoemde ontwerpvariabelen en vooropgestelde prestatie-indicatoren de marge-flexibiliteit van een bedrijfsnetwerk te berekenen. En vandaaruit, ICT ondersteunde herontwerpscenarios te modelleren en de ex ante marge-effecten van deze ontwerpen te evalueren. Dit laatste is mogelijk door de koppeling van specifieke ontwerpvariabelen aan specifieke prestatie-indicatoren. Teneinde het gebruik van het onderzoeksmodel en het 14 stappen-protocol te ondersteunen is een decision support tool, genaamd *Business Network Navigator* genoemd, ontwikkeld.
Dit werkend software prototype bevat o.m.:

- de voorstelling van het huidige ontwerp en toekomstige ontwerpen van een willekeurig bedrijfsnetwerk op drie analyse nivo's: t.w. het proces nivo, het actor nivo en het bedrijfsnetwerk nivo
- de berekening van de benoemde prestatie-indicatoren
- de visualisatie van het orderfulfilment door het process module netwerk
- de simulatie van veranderingen in bedrijfsactiviteiten, in rollen van actoren en in schakels tussen actoren
- de onderlinge vergelijking op de vooropgestelde prestatie-indicatoren van de verschillende bedrijfsnetwerk ontwerpen
- management informatie rapporten

Om te onderzoeken in welke mate en onder welke condities de centrale en aanverwante proposities gelden zijn vervolgens twee gevallenstudies uitgevoerd.

In de *hoofdstuk vijf* en *zes* beschrijven we twee gevallenstudies. Door het gebruik van ICT, in het bijzonder het Internet, op het klantcontactpunt ontstaan nieuwe vraaggestuurde klantprocessen die om een (betere en snellere) aansluiting vragen op de bestaande fulfilment processen van het bestaande bedrijfsnetwerk. Naadloze aansluiting van front – office & back-office processen vergen hoge ICT investeringen in het bedrijfsnetwerk,

welke doorgaans niet gelijk verdeeld zijn over de individuele organisaties. Om de effecten van deze investeringen d.i. electronische integratie op de marge-flexibiliteit prestatie -- op zowel het bedrijfsnetwerk nivo, als het actor nivo -- transparant te maken zijn verschilldende bedrijfsnetwerk scenarios gemodelleerd volgens de richtlijnen van de ontwikkelde herontwerp methode en doorgerekend met behulp van de Business Network Navigator. In de eerste gevallenstudie beschrijven we hoe we tot ICT ondersteunde herontwerpen komen van het bedrijfsprocessen gerelateerd aan het openen van een giro rekening door het bestaande bedrijfsnetwerk bestaande uit Postbank, Postkantoren en PTT Post. Daarna vergelijken we de verschillende herontwerpscenarios op veranderingen in 'marge-flexibiliteit' en op veranderingen in de rollen en posities van de huidige actoren in het bedrijfsnetwerk. Alle herontwerp scenarios resulteren in een verbetering van de bedrijfsnetwerkmarge en flexibiliteit. Echter, deze verbetering is niet evenredig verdeeld over alle actoren in het bedrijfsnetwerk. Met name het marge effect voor de focale actor is marginaal en de herontwerpstudie heeft dan ook niet geresulteerd in daadwerkelijke implementatie van een ICT ondersteund herontwerp. Eenzelfde werkwijze is gehanteerd in de tweede gevallenstudie waar we de bedrijfsprocessen gerelateerd aan het aanvragen van een patentonderzoek modelleren en herontwerpen door inzet van Internet in het bedrijfsnetwerk bestaande uit het Europese Octrooi Buro, het Nederlandse Octrooi Buro, PTT Post en ABN/AMRO. Het ICT ondersteunde herontwerp resulteert in een nagenoeg evenredige verdeling van de marge verbetering voor alle actoren in het bedrijfsnetwerk. Dit herontwerp is, na een uitgebreide markttest daadwerkelijk geïmplementeerd.

In *hoofdstuk zeven* becommentariëren we op basis van de empirische uitkomsten de zes benoemde proposities en evalueren het gebruik van de *Business Network Navigator*. Op basis van de resultaten van de twee gevallenstudies zijn vijf van de zes oorspronkelijke proposities gehandhaafd en één propositie is verworpen. De gehandhaafde hypothesen zijn:

1. Het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tot verlaging van de kosten indien het a) de kosten gerelateerd aan de produktie elementen van een actor of tussen actoren verlaagt of b) de kosten gerelateerd aan het managen van afhankelijkheden tussen de produktie elementen verlaagt;
2. Het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tot verhoogde bedrijfsnetwerksnelheid wanneer het a) de produktie tijd binnen een actor verlaagt en /of b) het koppelen van de produktie-elementen en proces modulen tussen actoren versnelt;
3. Het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tot verhoogde bedrijfsnetwerkveelzijdigheid wanneer de ICT infrastructuur het bundelen van nieuwe (sets van) service elementen ondersteunt;
4. Het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tot hogere bedrijfsnetwerkopbrengsten wanneer klantspecifiek-gebundelde en -geprijsde

electronische service elementen tussen actoren in het bedrijfsnetwerk verhandeld worden;
5. Het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tegelijkertijd tot verlaagde bedrijfsnetwerkkosten en verhoogde bedrijfsnetwerkveelzijdigheid;
6. Een ICT ondersteund herontwerp wordt geïmplementeerd wanneer al de huidige actoren in het bedrijfsnetwerk voordeel hebben van de marge-flexibiliteit verbetering tengevolge van het gebruik van ICT ondersteunde modulariteit.

De vooropgestelde propositie t.w; 'het gebruik van door ICT ondersteunde modulariteit in het bedrijfsnetwerk leidt tegelijkertijd tot verhoogde bedrijfsnetwerkopbrengsten en verhoogde bedrijfsnetwerkflexibiliteit', is verworpen. Wellicht is dit een van de oorzaken van veel mislukte investeringen in inter-organisatorische systemen.

Het gebruik van de *Business Network Navigator* is in de praktijk geconditioneerd door de mate waarin actoren confidentiële bedrijfsinformatie, met name op activiteiten-gebaseerde kosteninformatie, willen én kunnen uitwisselen voor het gemeenschappelijk doel d.i. optimalisatie van de marge van het bedrijfsnetwerk als geheel.

In *hoofdstuk acht*, tenslotte, worden de onderzoeksvragen beantwoord, de bijdragen van het proefschrift aan wetenschap en praktijk becommentarïeerd en suggesties voor vervolgonderzoek geformuleerd. Eerst beantwoorden we de twee centrale onderzoeksvragen. De eerste onderzoeksvraag is met de ontwikkeling en het testen van de ontwikkelde herontwerpmethode en haar ondersteunende tool nu makkelijk met 'ja' te beantwoorden. Het toepassen van de methode bij het herontwerpen van bedrijfsnetwerken leidt immers tot:
1. inzicht in hoe specifieke klantorders vertaald kunnen worden naar exact die processtappen die uitgevoerd moeten worden om de orders te verwezenlijken
2. het formuleren van alternatieven in activiteiten, routes en schakels tussen actoren in het processs module netwerk om specifieke klantorder orders te realiseren en
3. het meten van de marge-flexibiliteit effecten van deze ICT ondersteunde veranderingen op zowel het individuele actor nivo, als op het bedrijfsnetwerk nivo, alsook de verdeling ervan over de actoren.

Beantwoording van de tweede onderzoeksvraag ligt minder voor de hand gezien de tegengestelde uitkomsten van de twee gevallenstudies. De conclusie is dan ook dat de methode weliswaar ex ante nuttige informatie genereert over potentiële marge-flexibiliteits verbeteringen voor het bestaande bedrijfsnetwerk maar dat deze informatie op zich niet 1-op-1 leidt tot invoering van een ICT ondersteund herontwerp van het bedrijfsnetwerk. Wel zet het managers aan tot denken over verdere mogelijkheden van zakelijke modulariteit in de eigen produktportfolio en bedrijfsprocessen. In het algemeen kan gesteld worden dat het

gebruik van een gestructrureerde herontwerp methode sneller zal leiden tot de beslissing tot invoering van ICT in een bedrijfnetwerk waar het ICT beslisproces een gestructureerd proces is, dan in bedrijfsnetwerken waar het een politiek beslisproces is.
Aangezien de empirische toetsing van de ontwikkelde methode en werkinstrumenten zich beperkte tot twee gevallen studies kent dit onderzoek zijn beperkingen. Zo kan het toepassen van de methode in andere bedrijfsnetwerken, c.q. in andere sectoren, wellicht resulteren in andere empirische uitkomsten. Echter, aangezien het toepassen van de in de methode gebruikte herontwerp -en inschattingsprocedures niet afhangt van specifieke karakteristieken van een bedrijfsnetwerk, doet dit geen afbreuk aan de waarde van de methode op zich. Ook is de methode op zich, door haar modulaire karakter, uit te breiden naar niet financiële prestatie-indicatoren. Zo is ook het werken met 'bedrijfnetwerk scenarios' als afspiegeling van de werkelijkheid een beperking. Echter, de methode is ook toepasbaar op netwerkontwerpen waarin nog meer actoren tegelijkertijd in nog meer netwerken interacteren. De eerste gevallenstudie waarin verschillende bedrijfsprocessen tegelijktertijd in een multi-channel setting interfereren is hier een illustratie van. Tevens werden in de gevallenstudies de belangen van overige stakeholders zoals de overheid, wetgeving en vakbonden niet expliciet behandeld. Deze stakeholders zullen met name in de besluitvorming omtrent de invoering van herontwerpen hun invloed laten gelden. Echter, de modulaire methode laat toe om de effecten van wetgeving, zoals bijvoorbeeld openingstijden, te verwerken als een capaciteitsbeperking waaronder het bedrijfsnetwerk dient te opereren. De impact van overige stakeholders in de herontwerpen wordt dan alsnog, weliswaar indirect, meegenomen worden.

Dit onderzoek heeft op diverse wijze een bedrage geleverd aan de wetenschap en de bedrijfspraktijk. De voornaamste bijdragen van dit proefschrift aan de wetenschap zijn:

1. Het illustreren van de uitgangspunten van de bedrijfsnetwerk theorie versus de transactie kosten theorie (Williamson, 1981) als basis voor het maken van de trade-off in governance structuren. Dit onderzoek toont aan dat door het gebruik van ICT de transactie kosten van een bedrijfsnetwerk lager worden, terwijl tegelijkertijd de organisatorische flexibiliteit verhoogt. In zoverre onderschrijft het Clemons et al. (1993) 'move to the middle' hypothese;
2. Het definiëren en meten van marge op het inter-organisatorische vlak. In tegenstelling tot Porter's (1985) definitie van marge welke beperkt blijft tot het meten van marge van een individuele organisatie definieert en meet dit onderzoek de marge voor het totale waardennetwerk van een organisatie;
3. De ontwikkeling van een operationele methode om het effect van ICT ondersteunde modulariteit op de prestatie van een bedrijfnetwerk te meten. Dit is een aanvulling op het werk van o.m. Lee & Tang (1997) en O'Grady (1999) ten aanzien van de impact van modulariteit op de prestatie van organisaties en op het werk van o.a. Bakos (1998) en Davenport & Short (1990) ten aanzien van het gebruik van ICT als middel om de prestatie van organisaties te verhogen;

4. De uitbreiding van het raamwerk van Venkatraman (1994) met het nivo van bedrijfsnetwerk integratie. Dit onderzoek vult het werk van Venkatraman (1994) aan ten aanzien van de voordelen van ICT ondersteunde bedrijfstransformatie. Dit onderzoek onderschrijft Venkatraman's hypothese dat inter-organisatorische bedrijfstransformatie leidt tot grotere marge verbeteringen dan intra-organisatorische bedrijfstransformatie. Echter, dit onderzoekt onderscheidt een aanvullend nivo bij de vijf door Venkatraman onderscheiden nivo's van bedrijfstransformatie nl. het nivo van bedrijfsnetwerkintegratie.

Concrete toepassingsmogelijkheden in de bedrijfspraktijk van dit onderzoek zijn:
1. het gebruik van de methode en voorbeelden van de gevallenstudies voor modulair produkt ontwerp;
2. het gebruik van de methode om transparante, unieke en geïntegreerde klantgerichte prestatie doeltstelllingen te benoemen voor een bestaand bedrijfsnetwerk;
3. het gebruik van de methode om te komen tot een raamwerk voor een nieuw klantrentabilteits systeem gebaseerd op klant specifieke kosten en prijzen;
4. het gebruik van de methode om ICT ondersteunde herontwerp projecten te analyseren en/ of te implementeren;
5. het gebruik van de 10 geformuleerde ICT herontwerp richtlijnen als alternatieve denkpistes bij het herontwerpen van bedrijfsprocessen;
6. het gebruik van de 'business network navigator' voor het continu evalueren van bedrijfs (proces) verandering. Hoe gedetailleerder de databases van de *Business Network Navigator* gevuld zijn, hoe beter en makkelijker de effecten van nieuwe ontwerpen doorgerekend kunnen worden.

Suggesties voor vervolgonderzoek zijn o.m.:
1. Het ontwikkelen van een generieke toolbox van methoden, technieken en werkende applicaties voor het analyseren, monitoren en verbeteren van de dynamische vraaggestuurde netwerken;
2. Het komen tot een typologie van bedrijfsnetwerken in de dienstensector welke in meer of minder mate gebaat zijn bij de invoering van ICT ondersteunde modulariteit;
3. Meer toepassingen in de praktijk om de werkelijke bijdrage van de methode in o.m. de implementatie-besluitvorming te onderzoeken en dit vanuit een ander dan het focal actor- perspectief
4. Uitbreiding van de *Business Network Navigator* met meer gedetailleerde kosten typen, prijs scenariosimulaties, ingebouwde sensitiviteitsanalyses, meer prestatie-indicatoren etc.

CURRICULUM VITAE

Dominique Delporte -Vermeiren was born on February 2nd, 1964 in Deurne (Belgium).
After graduating at the UFSIA University in Antwerp, she started her career in the financial service industry where she gained experience in marketing and general management in Belgium, France and the Netherlands. In 1990, she chose to continue her career in the telecommunication industry, at KPN, where she gained marketing and sales experience in the field of data and mobile communications. In 1992, she switched over to the logistic branch of KPN. After completing an MBA at INSEAD in Fontainebleau, France, in 1994 she started to work at PTT Post as consultant strategy and business development. She was in charge of several strategic projects in the field of marketing, customer service and key-accountmanagement. In 1998, she started a part-time career in the academic world at the University of Rotterdam as PHD student. In that context, she is (co–)author of several publications on the effects of the use of ICT in organizations. In 2001, she started her own consulting firm, DMC BV, which enabled her to group her activities in the field of ICT-enabled redesign projects, part of which involved work with several nonprofit organizations. Since June 2002, she continues her career in the publishing sector, at Wolters Kluwer Belgium, where she holds the position of Director Publishing Center Fiscal and Financial Professionals.

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Improving the flexibility and profitability of ICT-enabled business networks:

an assessment method and tool.

This thesis deals with the development and the first empirical examination of an assessment method and decision support tool for the ex ante assessment of margin to be applied in ICT-enabled redesign of business networks. Many industries face the demand for customisation. This customisation challenges them to tailor products and services to the specific requirements of every individual customer, while at the same time maintaining their current levels of economies of scale. It forces organisations to become more flexible (defined in terms of their ability to produce different and customised products) towards the market without losing profitability, i.e. margin. Managers start to question the suitability of their current organisational design, which originates from the traditional supply chain and become increasingly aware of the benefits of a different approach to organisational design: ICT-enabled business networks, to respond quickly to a changing environment. However, managers struggle with how they should accomplish this, and to what extent it will influence their current level of flexibility and profitability. Therefore, they need a method and managerial tool that can help them assessing the reengineering of a business network – in particular, prior to performing the actual change in the business network. For this purpose, the described assessment method and decision support tool, called Business Network Navigator, was developed.

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