Targeting Target Costing

Targeting Target Costing

COST MANAGEMENT AND INTER-ORGANIZATIONAL PRODUCT DEVELOPMENT OF MULTI-TECHNOLOGY PRODUCTS

Martin Carlsson-Wall

STOCKHOLM SCHOOL OF ECONOMICS

Dissertation for the Degree of Doctor of Philosophy, Ph.D.
Business Administration
Stockholm School of Economics 2011

Keywords:
Target costing
Cost management
Accounting
Inter-organizational accounting
Management control
Inter-organizational relationships
Product development
Inter-organizational product development
Multi-technology products

Targeting Target Costing
© SSE and Martin Carlsson-Wall, 2011
ISBN 978-91-7258-848-6

Graphic design by: Oscar Carlsson

Pictures used by permission from ABB Robotics

Printed in Sweden by:
Intellecta Infolog, Göteborg 2011

Distributed by:
The SSE Research Secretariat
Stockholm School of Economics
Box 6501, SE-113 83 Stockholm, Sweden
www.hhs.se

To Louise

Preface

This report is a result of a research project carried out at the Department of Accounting at the Stockholm School of Economics (SSE).

This volume is submitted as a doctor's thesis at SSE. The author has been entirely free to conduct and present his research in his own ways as an expression of his own ideas.

SSE is grateful for the financial support provided by VINNOVA.

Filip Wijkström
Associate Professor
SSE Director of Research

Acknowledgements

Most people probably think that writing a PhD thesis is a lonely job. This is far from true. In fact, similar to the development of new products, the development of a thesis is carried out interactively with a number of individuals who help you along the way.

Starting with my supervisor committee, Professor Johnny Lind, Professor Lars Östman and Professor Lars-Erik Gadde have all guided and supported me in different ways. As my main supervisor, Professor Lind has taught me how to write academic texts and spent a great deal of time giving feedback on the different versions of this thesis. I have sincerely appreciated his continuous support. From Professor Östman, I have learned how to critically examine my research ideas. Using a slightly different research approach, he has made me understand the importance of taking a more holistic perspective. In the future, I hope I can gain more insights into this. Being an expert on the Industrial Network Approach, Professor Gadde has helped me to develop my theoretical ideas. Every time we have met, I have gotten detailed comments and he has always given me constructive feedback which I hope this thesis gives justice to. Together, all three have therefore played important roles in the completion of this thesis.

Another group of people who have helped me are all the wonderful colleagues at the Department of Accounting. During seminars, in corridors and in reading different drafts, I profoundly appreciate your time and effort. I especially want to thank Ebba Sjögren, Henning Christner, Torkel Strömsten and Anna Brattström (Department of Management) for giving thoughtful comments that improved my thesis in different ways this last year.

During the PhD process I have also received help from a number of people outside the Stockholm School of Economics. As a Visiting Professor, Trevor Hopper has read several drafts over the years. Professor David Cooper provided much inspiration, support and feedback when I spent one research semester at the University of Alberta. I also want to thank Dr. Mikael Cäker for insightful comments as an opponent during my final seminar and, Dr. Martin Messner for his support and friendship over the past years.

Regarding my empirical study, I owe a major debt to the individuals at ABB Robotics, DriveSys and Design-Net who took the time to answer my questions. I want to especially thank Ola Svanström and Mats Myhr at ABB Robotics for helping me with introductions and gaining access to various documents. I am also grateful for the generous financial support provided by VINNOVA.

A big part of my work at the Stockholm School of Economics has also included teaching. Even though the environment at the Department of Accounting is very friendly and helpful, two colleagues deserve extra thanks. Tomas Hjelström has always been there to answer tricky questions and Gunnar Lindholm, with his help and unselfish behavior has been one of the most valuable colleagues I have had.

However, even though I have gotten valuable support from so many people, there is one colleague who stands out: Kalle Kraus. This thesis has been greatly improved by his thoughtful comments and never ending support. At times when I have been frustrated, Kalle has always managed to cheer me up and find new angles. Thank you! I am really looking forward to the research projects that we have planned for the coming years.

Finally, to my friends and family: thank you for your endless support and patience! To my parents Göran and Catharina, my sister Emma and my brother Oscar, your enthusiasm has been amazing. All along, you have been proud of my work, but you have also helped me with important practical issues such as babysitting, cooking dinners and designing the cover page. To other close friends, Martin Neovius, Christoffer Holmberg and Pernilla Hultén, thank you for great talks along the way. From other departments at the Stockholm School of Economics, Niklas Modig and Karl Wennberg, thank you for being such good friends and always sending energetic e-mails!

Still, the one who has carried me through this PhD-process is Louise, the love of my life. Even though I have been "in my bubble" for a long time, you have always understood what it takes to complete a thesis.

Stockholm, April 27, 2011

Martin Carlsson-Wall

Table of Contents

1 Framing the research problem

1.1 Target costing as a strategic way to manage costs

This thesis is about managing costs and profitability in product development, more specifically, about target costing of multi-technology products. This is an important topic, because as many researchers have argued, up to 70-80% of a product's cost is set during product development and cannot be changed when the product reaches production (Ansari and Bell 1997, Davila 2000).

However, reducing costs is not an easy task because beyond the uncertainty of not seeing the end result there is often a need to co-operate closely with customers and suppliers (Nixon 1998, Mouritsen et al 2001). Trying to reduce costs while simultaneously solving technical problems is therefore a challenging task (Davila and Wouters 2004). As an illustration, a project manager at ABB Robotics says:

> During the entire project, there are parallel projects and line activities. Often, things are re-prioritized, projects are delayed or there is an important customer problem. Then everything falls apart. There is a constant need to combine and re-combine different issues[1].

To avoid product development failures, target costing has been put forward as an important accounting practice (Kato 1993, Mouritsen et al 2001, Everaert et al 2006). In fact, some claim that target costing is one of the most important cost management innovations over the past decades. For example, Ansari et al (2007) argue that target costing goes way beyond the tradi-

---

[1] 98 out of 99 interviews in this thesis were conducted in Swedish and then translated into English. Potential mistranslations are the responsibility of the author.

tional scope of cost management and should be seen as a systematic profit planning process:

> Despite a proven record of success, many managers often underestimate the power of target costing as a serious competitive tool. When general managers read the word "costing," they naturally assume that it is a topic for their finance or accounting staff. They miss the fact that target costing is really a systematic profit planning process. (p.513)

The major elements and overall logic of target costing is illustrated in the target costing equation (Kato 1993):

> Expected Sales Price – Required Profit = Target cost for the product

As the equation highlights, target costing starts with the expected sales price. To discipline product development engineers, target costing has an external perspective and starts by asking customers what they want (Ansari and Bell 1997). By then deducting the owners' profit requirements, a target cost is established for each product (Kato 1993). This is the cost goal each product must meet before it is launched. By creating this financial awareness, target costing is seen as a central process for linking product development to customers, owners and suppliers (Ansari and Bell 1997, Östman 2009).

To understand the concrete ways that target costing links customers, owners and suppliers, Cooper and Slagmulder (1997) offer a process model in three steps. Starting with customers, a first step is called *market-driven costing*. Through interviews and surveys with potential customers and benchmarking of competitors, an estimated selling price is established. By comparing the target price with long-term business plans, a desired profit margin is then calculated which results in the establishment of a target cost. An example of market-driven target costing is provided by Carr and Ng (1995). Studying Nissan in the UK, they show how the setting of target costs for the car models Micra and Primera were closely linked with the development of the overall business plan.

Having established the target cost, a second step is called *product-level target costing* (Cooper and Slagmulder 1997). Here, the goal is to establish the target cost gap, which is the difference between current costs and the target cost. An important part of this is functional analysis (Yoshikawa et al 1994, Mouritsen et al 2001). By breaking down the product into functions, a product hierarchy is established where financial benefits of each function are analyzed in more detail. For example, studying the development of alarm systems, Mouritsen et al (2001) describe how the cost of new technology is analyzed in relation to the additional benefits it gives customers.

Finally, a third step is called, *component-level target costing*. As the name implies, cost reduction is carried out on a component level. This often involves suppliers. For example, Carr and Ng (1995) show how 80% of costs in a Nissan automobile come from suppliers. Similar numbers have also been found for airplanes (Swenson et al 2003), security systems (Mouritsen et al 2001) and gearshift systems (Agndal and Nilsson 2009). According to Cooper and Slagmulder (1997), a central part of the process model illustrated in figure 1.1 is therefore that companies should start with a detailed analysis of customer requirements and then discipline suppliers to ensure that new products are not too costly when they are launched.

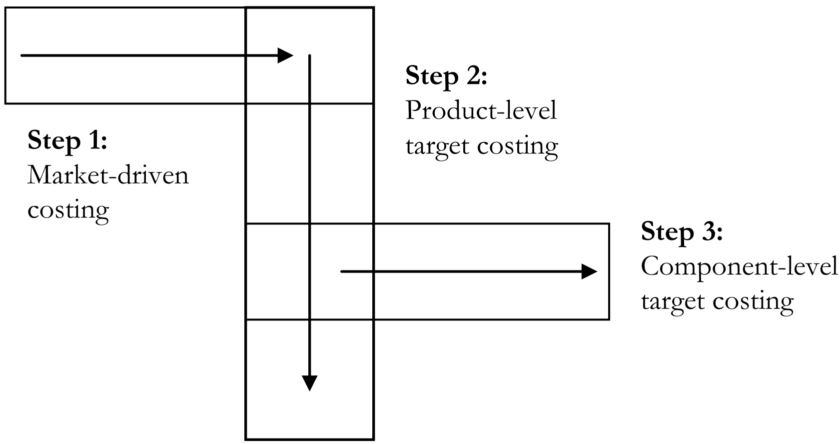

Figure 1.1: A process model of target costing (Cooper and Slagmulder 1997)

Still, recent reviews have argued that more theoretical and empirical work is needed (Hansen and Jönsson 2005, Ansari et al 2007). For example, Hansen and Jönsson argue that most studies on target costing lack a systematic research design and focus too much on normative guidelines while Ansari et al highlight how target costing has only begun to address the complexities of supplier co-operation.

The need for more empirical and theoretical work on target costing can also be motivated by drawing on product development research. For example, a number of studies have demonstrated the challenge of embeddedness and how "no project is an island" (Engwall 2003, Dubois & Araujo 2006). More specifically, due to complex interdependencies, product development is a highly distributed activity that involves customers, suppliers and parallel projects (Håkansson and Snehota 1995, Engwall 2003).

In addition to embeddedness, product development research has also shown how the product development process is incomplete and difficult to plan (Håkansson and Waluszewski 2002, Sosa et al 2004). In a single point of time, firms working with product development are constantly facing new discoveries (Brusoni and Prencipe 2001, Håkansson and Waluszewski 2002). For example, at the start of a product development project, companies never know exactly what the end product will look like, what the cost of developing that product will be or what the customer actually will want to purchase in the future (Brown and Eisenhardt 1995, 1997).

Surprisingly, the target costing literature has largely neglecting embeddedness and incompleteness. Seeing product development as a rational plan, target costing has focus on planning and disciplining within firms (for recent reviews see Ansari et al 2007, Carlsson-Wall and Kraus 2010). As a consequence, target costing models of today do not incorporate the full complexity of product development practice. Taken together, this means that there is considerable scope for developing new models of target costing. Before this is done, it is time to introduce ABB Robotics (Robotics), the empirical context of this thesis.

1.2 Target costing challenges at ABB Robotics

To illustrate how embeddedness and incompleteness affect target costing processes, let me introduce Rebecca, a project manager at Robotics. By following her during one week we get a hint of target costing practice[2]. In three episodes, it will be shown how target costing is a messy process of combining and re-combining elements within and across organizational boundaries.

1.2.1 What do customers really want?

Monday, 09:00
– discussing an incomplete customer pre-study with the steering committee.

Ten people were waiting when Rebecca entered the conference room. When everyone had taken their coffee, they all started to go through the first draft of the customer pre-study.

Product manager: Rebecca, I honestly cannot make sense of this material. What do customers really want?

Rebecca: I know it is a bit confusing. We have talked with different customers, but it is difficult to pinpoint their needs. They are often stressed and when they say something, there might be contradictions.

Sales manager: Yes, I know what is like to deal with large customers. Have you talked with Leif Andersson, the technical manager at Volvo? After 20 years he can help you prioritize between "nice to have" and "must have" requirements.

---

[2] This narrative is made up from the 99 interviews and the 22 days of direct observation made in this thesis. The target costing challenges faced by Rebecca should therefore be seen as representatives of the entire material.

Technical manager: I would also recommend Ernst Rümmel, the production manager at the Gent factory. In Volvo's last order, he was very influential in setting their technical specification.

Rebecca: I have talked with Leif on the phone, but he promised we could come down to Gothenburg and have a sit-down.

Sales manager: When you meet the Volvo people, get hold of Inger Jönsson, their purchasing director. It would be great to learn about future robot projects within the Ford Group.

Product manager: Yes, and especially to hear about Volvo's long-term views. We need know what the "customer hang-ups" are; otherwise we might risk losing future orders.

1.2.2 How do we reduce costs without opening a can of worms?

Wednesday 13:00
– Discussing cost estimations with the project group

Only half of the project team was present at the conference table. Peter, the assistant project manager was home with his sick daughter and Anna, the logistical expert was visiting a supplier in Asia.

Rebecca: Welcome to today's meeting. The main point is a follow-up on cost estimations. As you know, the target cost is more than 20% lower than the current robot systems. Karin, where do we stand?

Karin: Right now, cost reductions are disappointing. They are not as low as we planned (hands out a summary). Let's start with the largest components.

Rebecca: As you know, drives and computers are the largest components. They make up 30% of total purchasing costs. Our initial estimates show that costs can be reduced by 9% and 17 %.

Jacob: Why do we only save 9% on drives?

Rebecca: A big reason seems to be increased functionality. Since we want more powerful drives, it is difficult to simultaneously reduce cost.

Karin: How about changing the technical interfaces. Can the drive be integrated with other components? We all know how costs can be reduced by giving suppliers a larger responsibility.

Jacob: Yes, but integration can also increase costs if we do not know how components function together. "Smart solutions" can easily open a can of worms we never wished opened.

Rebecca: I know. Walking around in this fog drives me crazy!

1.2.3 How do we create a win-win situation with suppliers?

Friday 14:30
– Debating and negotiating cost trade-offs with DriveSys

Rebecca looked at the cost-estimations. Didn't she tell Stefan they needed 15-20% cost reductions? She flipped through DriveSys's offer. The technical issues look fine. Nothing really new, but on the other hand who would expect that after two months and a tight deadline? She picked up the phone to call Stefan, the key account manager at DriveSys.

Rebecca: Hi, I am sitting here with your initial cost-estimations. They are not really what I expected, only a reduction by 9%.

Stefan: That's the best we can give you. We were forced to include stronger and more expensive components to meet your functionality needs.

Rebecca: Ok, but have you considered our volumes? Over the next couple of years we will purchase 60,000-70,000 units instead of today's 30,000-40,000.

Stefan: I know it's a big order. My problem is that I cannot convince our Business Controller that your estimates are correct.

Rebecca: Come on! This is the third generation since 1990. Initially, we sold 1000 robots, now we are selling almost 8000.

Stefan: Yes, it has been a great partnership. But how can we be sure? How about functionality, your technical specification wasn't fully developed. Can you be more precise there?

Rebecca: I am not sure. Our sales guys are still arguing about functionality. I have told them they need to prioritize if General Motors and IKEA want different things. How about you, can't you talk with your suppliers. They must be concerned if you lose ABB as a customer?

Stefan: They are, but for some large suppliers we are just a small player. An order to ABB doesn't make that much difference. However, I'll see what I can do. I'll keep you posted.

Summarizing target costing challenges at ABB Robotics

Even though it is only a short introduction, these empirical episodes highlight two central challenges for conducting target costing: embeddedness (Granovetter 1985, Anderson et al 1994) and incompleteness (Håkansson and Waluszewski 2002, Sosa et al 2004).

In the first episode, the difficulties of identifying customer needs were illustrated. Instead of a clear demand, there were many different clues. To help prioritize, Rebecca was recommended to talk with experts at Volvo, a long-term customer of Robotics. Even though this only gave a partial picture, debating the trade-offs between "need to have" and "nice to have" were central features in the target costing process.

Embeddedness and incompleteness were also evident in the second episode. Discussing cost estimations, it was difficult to reduce costs when interdependencies with parallel projects were not fully known. Target costing therefore proceeded by discussing alternatives before it was decided that a temporary compromise was needed. As Rebecca said when the future was so difficult to plan, "walking around in this fog drives me crazy!"

Embeddedness and incompleteness also guided negotiations with close suppliers. Even though Rebecca was not satisfied, she could not force DriveSys to comply with her target cost demands. Instead, solutions emerged interactively. For example, Rebecca tried by offering larger volumes and Stefan asked if the technical specification could not be more detailed. When negotiations did not lead to a win-win situation, connections to other customers and suppliers were discussed.

Embeddedness and incompleteness therefore show how joint-problem solving and negotiations are highly intertwined in target costing processes. On the one hand, both Rebecca and Stefan were interested in joint problem-solving. The relationship between Robotics and DriveSys had lasted for over ten years and involved several product development projects. On the other hand, both parties wanted to avoid costly network effects (Anderson et al 1994, Håkansson and Snehota 1995). For example, while Stefan promised to talk with key sub-suppliers, he also pointed out that DriveSys was only a small customer. In a similar way, when Rebecca was asked to clarify the technical specification, she pointed out the problems of prioritizing between General Motors and IKEA. As a result, the phone call resulted in a compromise; both parties promised to go back and "do what they could" in the hope of finding a mutually acceptable solution.

1.3 Research question and central choices

As was initially described, the target costing model by Cooper and Slagmulder (1997) has been widely accepted as a starting point for conceptualizing the target costing process. Building on studies of large Japanese companies, it has outlined central activities and shown the potential benefits of using target costing. However, as the empirical episodes illustrated, research on target costing can be extended in at least two directions.

First, regarding *space*, embeddedness between customers, suppliers and parallel projects has largely been neglected. For example, while inter-organizational target costing has focused on supplier dyads (Cooper and Slagmulder 2004, Agndal and Nilsson 2009) the literature on intra-organizational target costing (Nixon 1998, Hansen and Jönsson 2005, Everaert et al 2006) has not addressed how individual projects are affected by parallel projects.

Second, regarding *time*, incompleteness and non-linear dynamics have been less emphasized within the target costing literature. For example, even though iterations between stages are discussed (Cooper and Slagmulder 1997, Ansari and Bell 1997), many target costing researchers still focus on planning and follow-up. As a result, there are few studies that pay attention to issues such as trial-and-error, improvisation and compromise. For example, Hansen and Jönsson (2005) argue that a central issue for future research should be to focus on the complexities of performing target costing in actual practice:

> The existing literature on Target Costing has primarily been prescriptive in the way that it has presented the target costing principles and focused on the benefits of pursuing them in companies (Cooper 1995, Cooper and Slagmulder 1997)... Not much research has been explorative and addressing organizational complexities that arise when Target Costing principles are performed in practice (for exception, see Mouritsen et al 2001). (p.223)

In line with Hansen and Jönsson (2005), an ambition of this thesis is therefore to problematize target costing by drawing on product development research. More specifically, the overall research question of this thesis is:

How does embeddedness and incompleteness affect target costing processes?

Following this research question, the research purpose is to develop a process model of target costing that acknowledges that embedded and incomplete nature of product development. Such a model can be seen as an alternative to Cooper and Slagmulder's (1997) model. Below, I outline how I intend to answer the research question and fulfill the research purpose.

1.3.1 The empirical focus: multi-technology products

Before describing the key features of my process model, it is suitable to offer a few words of caution. First, the result of this thesis will not be a complete model, but a start for further development. As will be shown, theoretically and empirically informed practice studies of target costing have only recently emerged in the target costing literature (Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009) and much research remains to be done. In terms of theoretical scope, the ambition is therefore theoretical development (Keating 1995, Edmondson and McManus 2007).

Secondly, this model focuses on multi-technology products, an empirical setting which is characterized by high levels of embeddedness and incompleteness (Brusoni et al 2001). For example, multi-technology products are developed in supplier networks and due to incompleteness the end result emerges first when some development has been conducted. As Sosa et al (2004) describe incompleteness or as they call it, product ambiguity:

> Due to product ambiguity, defined as the absence of knowledge about design variables and/or their interfaces, some design interfaces are not foreseen at the outset of the project and only discovered after design teams work on the systems themselves. (p.1677)

Delimiting this study to multi-technology products is also done because many previous target costing studies have focused on this empirical context. For example, recent examples include airplanes (Ansari et al 2006), alarm systems (Mouritsen et al 2001), automobiles (Hansen and Jönsson 2005), buildings (Nicolini et al 2000), copper rod machines (Nixon 1998), excavators (Cooper and Slagmulder 2004), gear systems (Agndal and Nilsson 2009), medical products (Davila and Wouters 2004) and telecom systems (Ellram 2002).

Against this background it is surprising that none of the target costing studies emphasizes embeddedness. For example, while one group of studies focus on single projects within a company (Nixon 1998, Hansen and Jönsson 2005, Everaert et al 2006), inter-organizational target costing studies either treat suppliers as a collective (Nicolini et al 2000, Mouritsen et al 2001, Ellram 2002, Ansari et al 2006) or focuses on single supplier dyads (Cooper and Slagmulder 2004, Agndal and Nilsson 2009). By explicitly focusing on embeddedness in multi-technology products, this thesis addresses an important gap in the target costing literature.

Regarding incompleteness, emerging research on target costing practice has started to address this challenge (Hansen and Jönsson 2005, Agndal and Nilsson 2009). For example, Hansen and Jönsson describe how formal use of target costing can hinder quick decision-making and Agndal and Nilsson illustrate how target costing is important in the early phases of a product development project. *Still, none of these studies offers a detailed account of how embeddedness and incompleteness are combined in target costing processes.* For example, we do not know how target costing processes connect customers and suppliers when new and unexpected discoveries are made. By focusing on embeddedness and incompleteness in multi-technology products, this thesis therefore extends target costing research in time and space.

1.3.2 The theoretical focus: embeddedness and incompleteness

A possible reason that the target costing literature has not addressed embeddedness and incompleteness might be the lack of incorporating product development theories. As several authors have pointed out, target costing has largely been normative and descriptive (Hansen and Jönsson 2005, Ansari et al 2007). It is only recently that more elaborate theoretical developments have begun to surface in the form of Transaction Cost Economics (Cooper and Slagmulder 2004), Actor Network Theory (Mouritsen et al 2001, Hansen and Jönsson 2005) and the Industrial Network Approach (Agndal and Nilsson 2009).

To understand how target costing processes are affected by embeddedness and incompleteness, this thesis combines product development theories from the Industrial Network Approach (Anderson et al 1994, Håkansson and Snehota 1995, Håkansson and Waluszewski 2002, Dubois and Araujo 2006) and strategic management (Brown and Eisenhardt 1997, Uzzi 1997, Brusoni et al 2001, Engwall 2003). More specifically, product development is seen as *an embedded and incomplete process of resource combining*.

Starting with the assumption of resource heterogeneity (Penrose 1959), this view of product development highlights how actors combine and re-combine technical and organizational resources into valuable services (Håkansson and Waluszewski 2002, Baker and Nelson 2005, Strömsten and Waluszewski, forthcoming). In the context of multi-technology products, resource combining occurs when customers, suppliers and third parties integrate different sub-systems into complex systems. As Dubois and Araujo (2006) describe this collective process of systems integration:

> Systems integration activities involve a number of interacting parties and a process of incremental, mutual adjustments guided by dyadic interactions, which often have to take into account interdependencies that are not containable within those dyads. (p.29)

To clarify and define embeddedness, this thesis proposes two types of embeddedness; *network embeddedness* and *project embeddedness*[3]. Network embeddedness is primarily inter-organizational and relates to connections between customers, suppliers and third parties (Anderson et al 1994, Håkansson and Snehota 1995, Araujo et al 2003). Project embeddedness is primarily intra-organizational and relates to connections to projects and activities within a company (Engwall 2003, Sydow et al 2004). Together, network embeddedness and project embeddedness help to capture *target costing space* within and across organizational boundaries.

Incompleteness relates to the difficulty in foreseeing the end result of the product development process (Håkansson and Waluszewski 2002). To specify incompleteness, this thesis proposes three concepts; *re-designs* (Dubois

---

[3] A number of authors have highlighted how time is an important aspect of network and project embeddedness (e.g. Håkansson and Snehota 1995, Håkansson and Waluszewski 2002, Engwall 2003, Lind and Dubois 2008). In this thesis, temporal aspects are analyzed through the concepts of re-designs, development rhythm and path dependency.

and Araujo 2006), *development rhythm* (Brown and Eisenhardt 1997) and *path dependency* (Håkansson and Waluszewksi 2002). Re-designs and development rhythm capture non-linear dynamics within product development projects. More specifically, due to incompleteness, re-designs illustrate how goals need to be revised and a changing development rhythm emphasizes how timepressure and waiting are two central features in the development of multi-technology products. It is also important to extend the time horizon beyond single projects (Lundgren 1995, Håkansson and Waluszewski 2002). For example, a number of studies have shown how cost reductions are realized by re-using technologies from previous projects (Hargadon and Sutton 1997, Håkansson and Waluszewski 2002, Dubois and Araujo 2006). Together, re-designs, development rhythm and path dependency therefore help to capture temporal complexities in target costing processes.

1.3.3 The methodological focus: micro-processes

Given the empirical and theoretical focus of this thesis, this last section motives the focus on micro-processes and describes some methodological challenges.

Inspired by Hansen and Jönsson (2005), this thesis emphasizes the organizational complexities that occur when target costing is performed in actual practice. More specifically, it joins the emerging stream of target costing studies that study micro-processes (e.g. Mouritsen et al 2001, Cooper and Slagmulder 2004, Hansen and Jönsson 2005, Agndal and Nilsson 2009). A common denominator among these studies is the case study method (Eisenhardt 1989, Dyer and Wilkins 1991). For example, by focusing on depth, these studies have shown how inter-organizational target costing has intra-organizational effects (Mouritsen et al 2001), how the relational context of supplier relationships is important for realizing cost savings (Cooper and Slagmulder 2004), and how target costing dynamics evolve over time (Hansen and Jönsson 2005, Agndal and Nilsson 2009).

In terms of research design, this thesis conducts a case study of industrial robot systems. The empirical context is suitable for a number of reasons:

(1) industrial robot systems are multi-technology products; (2) Robotics has close relationships with both customers and suppliers; and (3) it was possible to study target costing in several product development projects over time.

To capture the micro-processes, it was decided to focus on the project level and study target costing in three product development projects over time, ALFA, BETA and DELTA. Furthermore, to understand how target costing related to overall network dynamics in close customer and supplier relationships, this study also conducted interviews on an organizational level. With this research design, it was possible to discover how target costing changed over time and how each project was related to Robotics' broader organizational challenges. Even though this research design is influenced by target costing practice studies, it differs in two important ways. First, drawing on network and project embeddedness, this study *combines* customer, supplier and intra-organizational spaces. This holistic approach is rare among practice studies, since demands on data collection have focused research on isolate parts such intra-organizational activities (Hansen and Jönsson 2005) or supplier dyads (Cooper and Slagmulder 2004, Agndal and Nilsson 2009).

Secondly, drawing on re-designs, development rhythm and path dependency, this study combines several temporal concepts within one study. Even though previous research have described the non-linear dynamics within target costing processes (Mouritsen et al 2001, Hansen and Jönsson 2005), this study shows how such dynamics can be conceptualized and how they are combined both within and across multiple projects. Taken together, this thesis develops a process model of target costing that is firmly rooted in product development theories and an in-depth case study involving multiple levels of analysis.

1.4 Structure of thesis

This thesis builds on three main parts; setting the scene (ch 1-3); target costing in practice (ch 4-7); and bringing it together (ch 8-10). After this introduction, chapter two starts by problematizing target costing and then linking target costing research to two closely related accounting research fields: inter-organizational accounting and accounting-and-new product development. The theoretical chapter then reviews product development theories on embeddedness and incompleteness before a skeleton framework of target costing is sketched out together with four refined research questions.

Drawing on Lukka and Granlund (2002), the methodological chapter starts with a discussion about the difference between "actual practice" and "best practice." Since the target costing literature has a large focus on "best practice", this part shows how the practice of target costing builds on a more systematic and reflective methodology. Having described what it takes to study "actual practice," chapter three then moves on and describes central research choices in this thesis and how the research process was carried out in four major phases.

As figure 1.2 shows, chapter four begins the empirical part of this thesis. Focusing on the organizational level, chapter four describes the evolution of target costing and how it links to overall network dynamics. Following this historical description, chapters 5-7 then demonstrate the details of target costing practice. ALFA shows early attempts of target costing; BETA how target costing operates under time pressure, and DELTA illustrates the content of target costing processes when it becomes more formalized.

Having detailed the empirical findings, chapter 8-9 analyzes target costing related to embeddedness and incompleteness. More specifically, using the skeleton framework developed in chapter two, each target costing concept will be analyzed and compared across the empirical cases. Finally, in chapter 10, a synthesis is made. Focusing on multi-technology products, it will be shown how my target costing model provides an alternative to the model by Cooper and Slagmulder (1997), and extends prior studies on target costing practice. Chapter 10 then ends by discussing implications for inter-organizational accounting and accounting-and-new product development and how these research fields can be further integrated in future studies.

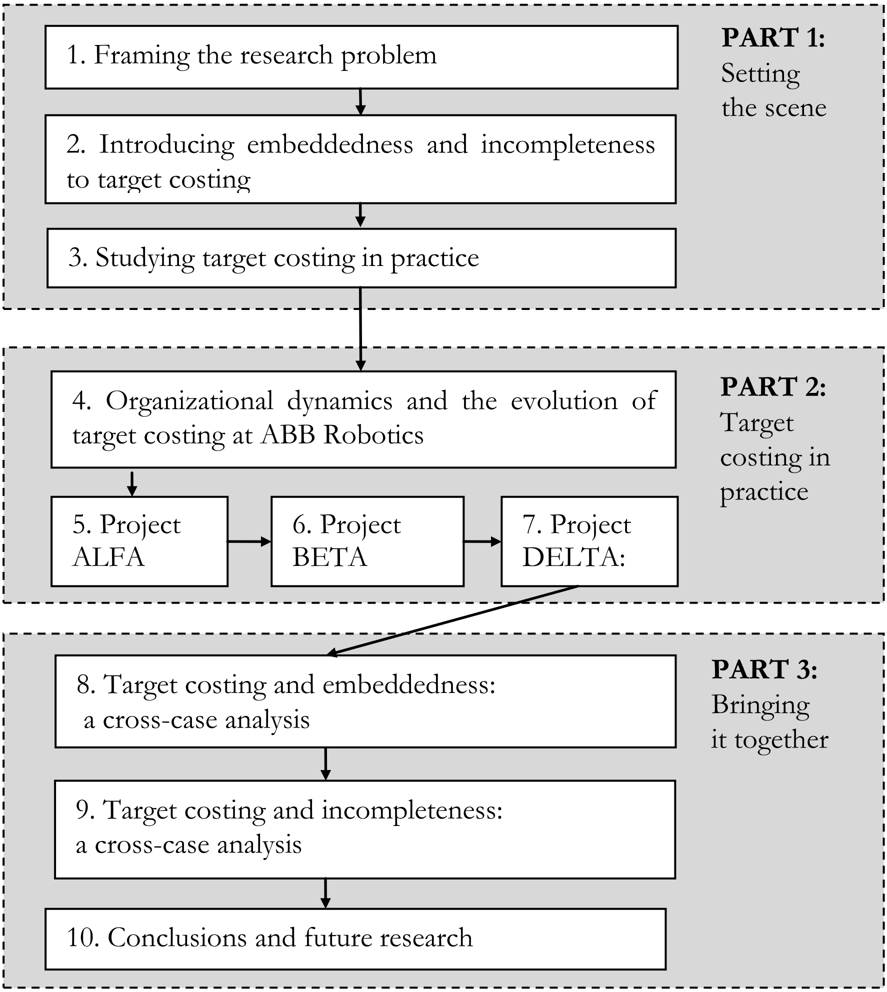

Figure 1.2: The structure of the thesis

2 Introducing embeddedness and incompleteness to target costing

2.1 Prior research on target costing

2.1.1 Problematizing target costing

In my introduction, the elements and logics of target costing were illustrated through the target costing equation:

> Expected Sales Price – Required Profit = Target cost for the product (Kato 1993)

Even though the equation only has three elements, it was argued that target costing questions central principles in cost management. An initial difference is the *starting point*. Instead of starting with internal costs, target costing takes an external perspective and starts with the customer price (Ansari et al 2007). By including both revenues and profit margins, target costing has a broader scope and is closely linked to a company's strategy. For example, studying high-tech companies, Mouritsen et al (2001) showed how target costing affected a company's core competence and long-term product portfolio.

Secondly, target costing questions the traditional understanding of *where* cost management occurs. Whereas traditional cost management starts in production, target costing begins in the early phases of product development (Cooper and Chew 1996, Ellram 2000). Instead of making controllers responsible for cost reduction activities, target costing is a collective responsibility within cross-functional teams (Ansari and Bell 1997, Cooper and Slagmulder 1997, Ellram 2002). Organizing target costing within cross-functional teams also has strategic implications, because new discoveries are often made when experts from engineering and production work together. For example, studying a small manufacturing company, Nixon (1998) described how cross-functional teams were critical in developing a radically new product.

A third difference is that target costing has a different *temporal scope*. Instead of focusing on immediate product costs, target costing adopts a life-cycle perspective (Kato 1993, Ansari and Bell 1997). For example, calculations and trade-offs go beyond product costs and also include service and maintenance costs. As a consequence, using target costing companies can choose a more expensive component in the short term to improve the long-term profitability. This extended temporal scope also has strategic implications because it problematizes what the company should offer to its customers (Mouritsen et al 2001). For example, when service and maintenance are included in the product calculation, it might be more profitable to offer a fully customized solution rather than selling single products.

Table 2.1 summarizes the main differences between target costing and traditional cost-plus costing. As can be seen, target costing has an external focus starting with the customer price. Taking a life-cycle perspective, costs are reduced by focusing on design. By integrating cost management with long-term views on customers and product development, target costing has a more strategic orientation compared to cost-plus costing.

Costing themes	**Cost-plus costing**	**Target costing**
Starting point	Internal costs	External customer price
Spatial scope	Production	Design
Temporal scope	Immediate product costs	Life-cycle perspective

Table 2.1: Comparing cost-plus costing with target costing

Even though many studies on target costing begin with the target costing equation, it is also important to acknowledge that they focus on different things. For example, one way of studying target costing is to focus on techniques (Tani 1995, Shank and Fisher 1999, Swenson et al 2005). A central theme in these studies is to identify the information systems that are used to conduct target costing. For example, based on a survey of Japanese companies, Tani (1995) discuss the technique of simultaneous engineering and in a more recent study Swenson et al (2005) introduce techniques for implementing target costing.

Another way to study target costing is to focus on the actual activities of carrying out target costing (Ansari and Bell 1997, Cooper and Slagmulder 1997, Mouritsen et al 2001, Hansen and Jönsson 2005, Everaert et al 2006, Agndal and Nilsson 2009). For example, Everaert et al (2006) see target costing as a process which involves both the identification of a target cost as well as the activities required to reach this cost goal:

> Target costing is the process of determining the target cost for products early in the new product development process (NPD) and of supporting the attainment of this target cost during this NPD process. (p.238)

In a similar way, Ansari and Bell (1997) highlight the process perspective but also emphasize the importance of cross-functional teams and the value chain in their description of target costing:

> The target costing process is a system of profit planning and cost management that is price led, customer focused, design centered and cross-functional. Target costing initiates cost management at the earliest stages of product development and apply it through the product life cycle by actively involving the entire value chain. (p.11)

This thesis takes a process perspective. More specifically, starting from the target costing equation (Kato 1993), this thesis sees target costing as a cost management process which occurs in product development projects and that links customers, owners and suppliers. Furthermore, this thesis proposes that researchers should discuss connections between target costing and related management accounting practices such as value engineering, functional analysis, open-book accounting and inter-organizational cost management. This is an important issue because as Dekker and Smidt

(2003) point out, companies often conduct target costing but call it something else:

> Only one respondent answered that the system is actually called target costing. This diversity of names and descriptions used implies that many firms have developed a system of techniques, based on similar principles as target costing, without being familiar with the concept. Empirical research into this type of systems thus may better focus on its characteristics, instead of its name. (p.299)

To illustrate why it is important to discuss the relationship between target costing and other management accounting practices, consider the empirical complexity in a product development project. First, *target costing* is present if the development team starts by asking customers the price they are willing to pay for a specific functionality. Secondly, examples of *value engineering* and *functional analysis* are also demonstrated if the development team analyzes the cost consequences of different technical alternatives. Furthermore, if trade-offs are discussed in a transparent and open way with suppliers, we have evidence of *open-book accounting* and *inter-organizational cost management*. So, given the close connections between target costing and related practices, this thesis takes a broad view and sees target costing as a process involving an umbrella of related management accounting practices (e.g. Swenson et al 2003, Ansari et al 2007). This means that value engineering, functional analysis, open-book accounting and inter-organizational cost management are seen as practices that can be part of a target costing process.

There are two reasons for adopting this approach. First, the empirical focus in this thesis is on product development, the central theme in target costing. In product development projects, previous studies have shown how value engineering and functional analysis are two important practices related to target costing (Yoshikawa et al 1994, Everaert et al 2006, Angdal and Nilsson 2009). Furthermore, since the development of multi-technology products specifically involves close supplier relationships (Brusoni et al 2001), it became natural to see open-book accounting and inter-organizational cost management as part of a target costing process, as long as they occurred *within* the product development projects.[4]

Secondly, an integrated view simplifies empirical investigation. Instead of emphasizing contrasts between target costing and related management accounting practices, the analysis can focus on how they are integrated and complement each other. For example, in the empirical chapters, the overall narrative will describe the target costing process, but within this process, it will be shown how value engineering, functional analysis, open-book accounting and inter-organizational cost management are used. By studying target costing in this way, more focus will also be placed on the practices and processes, rather than on debating the boundaries of various techniques.

2.1.2 Reviewing embeddedness within target costing

Having discussed how target costing is viewed in this thesis, it is time to focus on embeddedness (Anderson et al 1994, Håkansson and Snehota 1995, Engwall 2003). More specifically, this section will show how embeddedness has largely been neglected within the target costing literature but also how embeddedness has been used within the broader accounting literatures of inter-organizational accounting and accounting-and-new product development.

A start for discussing target costing and embeddedness is a study by Cooper and Slagmulder (2004). Studying seven Japanese manufacturing companies and drawing on Transaction Cost Economics (TCE), the authors in-

---

[4] With this integrated view of target costing, it is important to acknowledge that open-book accounting and inter-organizational cost management can have broader views. For example if a study focuses on a supplier relationship instead of a product development project, it can be that open-book accounting and inter-organizational cost management plays a more significant role since they, in contrast to target costing, can be carried out *both* within development projects and in daily operations.

troduce three target costing patterns.[5] An initial pattern is called *Functionality-price-quality tradeoffs*. This type of target costing involves low risks and low returns because only minor design changes are allowed. If cost reductions are too low with the first pattern, companies can introduce a second pattern called *Inter-organizational Cost Investigations*. During Inter-organizational Cost Investigations, the supplier is allowed to make larger design changes, and linkages to production processes are analyzed in a higher degree to reduce costs. However, focusing on multi-technology products, the most interesting contribution lies in the concept of *Concurrent Cost Management (CCM)*. During this pattern, close interaction with the supplier is crucial because target costing starts early and involve joint problem-solving.

To illustrate CCM, Cooper and Slagmulder (2004) describe the close relationship between Komatsu[6] and the supplier Toyo Radiator. Both companies face a difficult challenge because in Komatsu's next generation Toyo Radiator needs to develop an engine cooling system with 40% more capacity at only 18% higher cost. To master this task, two types of CCM were used; parallel and simultaneous. During parallel CCM, both companies worked independently which helped the supplier to focus and it was also more resource efficient. However, sometimes simultaneous CCM was required to support joint problem-solving. For example, Cooper and Slagmulder (2004) describe how simultaneous CCM was needed because Komatsu's fan had to fit exactly with the engine cooling system that Toyo Radiator was responsible for. Cooper and Slagmulder (2004) therefore demonstrate how target costing processes are highly intertwined with the complexity of the technical problem-solving. One part cannot be done separately from the other if the ambition is to achieve significant cost reductions.

---

[5] The primary focus in Cooper and Slagmulder (2004) is on supplier dyads. However, the example with Tokyo Motors, Yokahama and Kamakura illustrates some instances of target costing in value chains (p.7-8).

[6] Komatsu is a large manufacturer of construction and mining equipment, forklifts trucks and forest machines (see www.komatsu.com). These are all examples of multi-technology products.

Drawing on the Industrial Network Approach, another article is Agndal and Nilsson (2009). For the purpose of this thesis, the relationship between the automotive company and the supplier of gearshift systems is of particular relevance. Similar to the Komatsu and Toyo relationship, this is a close relationship where the supplier is highly involved in joint cost-reduction activities. For example, Agndal and Nilsson (2009) describe how the supplier's accounting information was important in reaching target costs and how a joint cost platform was used to delimit re-negotiations when technical changes were made. In this way, adding a more explicit supplier perspective and acknowledging that cost re-negotiations are needed add to the practice of Concurrent Cost Management introduced by Cooper and Slagmulder (2004).

However, even though Cooper and Slagmulder (2004) and Agndal and Nilsson (2009) provide detailed accounts, they have limitations if one focuses on multi-technology products. First, we know little about interdependencies between customers, suppliers or third parties. For example, even though product development research have demonstrated the importance of network embeddedness (e.g. Anderson et al 1994, Håkansson and Snehota 1995, Baraldi and Strömsten 2009), this is not discussed in either of the articles. Secondly, focusing on supplier dyads, we know little about project embeddedness within a company. For example, even though product development studies have shown how one project is connected to another (e.g. Ancona and Caldwell 1992, Engwall 2003), there is little in Cooper and Slagmulder (2004) or Agndal and Nilsson (2009) which describes these connections. As a consequence, important challenges in conducting target costing are left out.

Within the field of inter-organizational accounting, network embeddedness has received considerable attention. For example, research reviews have explicitly stated that future research should focus on the network level (Håkansson and Lind 2007, Kraus and Lind 2007, Caglio and Ditillo 2008). However, inter-organizational accounting has spent little effort on project embeddedness. One reason might be the lack of studies that focus on the project level. For example, even though studies describe product development activities (Dekker 2004, Håkansson and Lind 2004, Kajüter and Kulmala 2005, Miller and O'Leary 2007), this is not done on a project level that would enable a combined analysis of network and project embeddedness.

In contrast, within the field of accounting-and-new product development (for a review, see Davila et al 2009) the primary focus has been on intra-organizational activities on a project level. For example, Davila (2000) and Ditillo (2004) explore how uncertainty affects how accounting is used in product development projects, and recent more process-based studies have shown how single projects are embedded into processes of strategizing (Jörgensen and Messner 2009, 2010, Mouritsen et al 2009, Revellino and Mouritsen 2010). However, when focusing on intra-organizational activities, network embeddedness is largely ignored. Given that product development theories have shown how multi-technology products require an inter-organizational focus, it seems like network embeddedness could add a new perspective to accounting-and-new product development.

By drawing on network embeddedness and project embeddedness, this thesis therefore starts to integrate target costing research with broader accounting literatures. More specifically, by studying target costing, this thesis demonstrates how the role of accounting in inter-organizational relationships and new product development can be integrated for mutual benefits. Project embeddedness can be added to inter-organizational accounting while network embeddedness can provide new perspectives the field of accounting-and-new product development.

2.1.3 Reviewing incompleteness within target costing

In relation to incompleteness, this section will show the difficulties in using a plan-and-implement logic in target costing. When relationships between means and ends are not foreseeable, it will be shown how a combination of planning and improvisation is needed.

Early critique of the plan-and-implement logic can be seen in the studies by Nixon (1998) and Nicolini et al (2000). For example, studying the development of copper rod machines, Nixon (1998) shows how target costing in early phases of a product development project relied on sense making rather than detailed planning. For example, experts from different functions made qualitative assessments rather than developing concrete performance measures. In fact, Nixon (1998) describes how a plan-and-implement logic is possible first when uncertainty is reduced and outcomes can be seen.

Studying construction projects in the UK, Nicolini et al (2000) describe another problem of a plan-and-implement logic, "catch 22" situations. To be able to make a detailed plan, customers rely on information from suppliers. However, when suppliers realize that early assessments make them accountable for potential cost increases, they are reluctant to give advice and share information. As a consequence, the project can end up in a "catch 22" situation where no one dares to take the next step because they are afraid of costly re-designs (Nicolini et al 2000).

To bridge the incompleteness gap, Hansen and Jönsson (2005) suggest that target costing needs to incorporate more improvisation. Studying target costing within Volvo Cars, they highlight the importance of informal negotiations. Rather than relying on planned schedules decided by one party, costs were reduced by making preliminary check-ups and creating win-win situations between the design and production departments (Hansen and Jönsson 2005).

The importance of improvisation for dealing with incompleteness is also evident in broader accounting research fields. For example, within inter-organizational accounting, van der Meer-Kooistra and Scapens (2008) recently argued that a critical issue for future research is to move beyond "simple notions of control" because setting a clear goal and doing detailed follow-ups is difficult in dynamic environments such as inter-organizational relationships:

> Thus, we need to move beyond simple notions of control – as a linear process, in which objectives are formulated, target set and performance monitored. A package of governance practices is needed to enable the parties in lateral relationships to handle the complex mix of hierarchal, market and relationship practices. (p.382)

In a similar way, within the field of accounting-and-new product development, Abernathy and Brownell (1997) highlighted the dangers of detailed planning systems. Through a survey study of 150 R&D managers, they found that only personal forms of control improved product development performance. Instead of using a plan-and-implement logic, the key for these R&D managers were informal discussions and continuous training.

An interesting way to go beyond the critique of a plan-and-implement logic is to divide incompleteness into computational and cognitional complexity (Grandori 1997, Ditillo 2004). More specifically, studying software projects Ditillo (2004) showed that a plan-and-implement logic is possible, if it deals with computational complexity that involves the challenge of *keeping track* of activities. If complexity comes from coordinating a large number of subprojects which are known individually, this can be done through formal rules and detailed documents (Ditillo 2004). In contrast, cognitional complexity is characterized by ambiguity and a collective need for sense making (Grandori 1997, Ditillo 2004). In this type of activity, coordination occurs through socializing and *creating a shared vision* (Ditillo 2004). For example, the collective sensemaking described by Nixon (1998) could be seen as a way of dealing with the cognitional complexity in developing the new copper rod machine.

This thesis therefore suggests that target costing might rely on combinations of planning and improvisation. These types of combinations have also been emphasized within product development research. For example, within the Industrial Network Approach, Håkansson and Waluszewski (2002) specifically draw attention to the importance of combining planning and improvisation for coordinating network embeddedness. Within strategic management, a large number of empirical studies on product development have also demonstrated how planning and improvisation are combined (Brown and Eisenhardt 1997, Tatikonda and Rosenthal 2000, Kamoche and Cunha 2001, Lewis et al 2002, Engwall and Westling 2004).

2.2 Theories on product development

So far, my theoretical chapter has demonstrated three things in relation to previous target costing research: (1) the neglect of incorporating network and project embeddedness; (2) how incompleteness has begun to be addressed but can be further developed; and (3) the potential of integrating target costing with the broader fields of inter-organizational accounting and accounting-and-new product development.

Even if the review has suggested *what* could be done, we still do not know *how* it can be executed. In this section, we start this process. More specifically, by combining product development theories from the Industrial Network Approach and strategic management, this thesis shows how product development of multi-technology products can be seen as an *embedded and incomplete process of resource combining* (Granovetter 1985, Uzzi 1997, Håkansson and Waluszewski 2002, Engwall 2003).

2.2.1 Product development as a process of resource combining

One central assumption underlying this view of product development is resource heterogeneity. Drawing on Penrose (1959, 1960), resource heterogeneity emphasizes that resources have no pre-determined value. Instead, the value of a specific resource depends on the service it delivers when it is used (Håkansson and Waluszewski 2002, Baker and Nelson 2005). If we return to the relationship between Komatsu and Toyo Radiator, assuming heterogeneous resources there would be no pre-determined value in the engine cooling system. Instead, according to Penrose (1959), the value would depend on how it was to be used. For example, the more Komatsu can integrate the engine cooling system with other components, the more costs can be saved and functionality improved. The assumption of resource heterogeneity therefore emphasizes the importance of knowledge and learning (Håkansson and Waluszewski 2002, Baker and Nelson 2005). In the context of target costing, this means that the key to both determining and achieving target costs is knowledge about the surrounding technical and organizational resources; how they can be combined and how they can be turned into useful services.

2.2.2 Resource combining and embeddedness

If we assume that resources are heterogeneous and that value is created when they are combined and integrated, embeddedness is brought to the foreground.

Starting with *network embeddedness,* the focus here is primarily on inter-organizational activities on an organizational level. More specifically, network embeddedness can be used to analyze interdependencies between customers, suppliers and third parties (Anderson et al 1994, Håkansson and Snehota 1995, Araujo et al 2003). For example, in studying the development of IT-systems, Hjelmgren (2005) describes how a central activity in product development is the handling of contradictory customer needs. By analyzing connections on a network level, Hjelmgren (2005) shows how tensions between customers drive the development process forward. Another example of network embeddedness is provided by Wedin (2001). In studying electricity, what is seen by many as a "commodity product," Wedin shows how electricity is embedded in multiple resource layers. Not only are connections to customers important, Wedin also demonstrates that the use of electricity is highly dependent on connections to third parties such as printing companies, newspaper magazines and advertising agencies.

Another type of embeddedness involved in resource combining is *project embeddedness* (Sydow et al 2004, Lind and Dubois 2008). In this thesis, project embeddedness is used to highlight interdependencies to projects and line activities within a company. This is an important issue, because as Engwall (2003) conclude, no project exist in an organizational vacuum:

> No project neither takes off from, nor is executed in, an organizational vacuum. The impact from history and context might be of different kinds and of different magnitudes in different projects and in different situations, but that there would be no influence seems implausible. (p.804)

Studying a research project within biotechnology, Lind (2006) shows how project embeddedness can be related to both resources and activities. For example, a high degree of project embeddedness occurs when the project is dependent on both external resources and activities within parallel projects. To cope with project embeddedness, empirical studies have highlighted a number of coordination mechanisms. For example, Brown and Eisenhardt (1997) describe how top management rely on cross-project coordination, while Ancona and Caldwell (1992) emphasize how team projects use a wide range of different tactics. More specifically, rather than emphasizing "external communication" as a mean for coping with project embeddedness, Ancona and Caldwell (1992) show how project teams need differentiate their external communication and address top management with one tactic and parallel teams with another.

2.2.3 Resource combining and incompleteness

With embeddedness on both project and organizational levels, the process of resource combining is inherently incomplete (Håkansson and Waluszewski 2002). No actor has full knowledge of all resource combinations, or as a project manager says in a study by Tatikonda and Rosenthal (2000):

> Of course, we know what the big pieces are, but the problem is that we don't know what the small tasks are until we get there in the project, and sometimes, these small things turn out to be the big tasks! (p.402)

To cope with incompleteness (Håkansson and Waluszewski 2002), a large number of empirical studies have shown how multi-technology products are developed interactively between customers and suppliers. For example, recent studies include airplane engines (Brusoni et al 2001), automobiles (von Corswant 2003), customized electronics (Gressetvold 2004), IT-systems (Baraldi 2003, Hjelmgren 2005), milking machines (Zander and Zander 2005) telecom systems (Brady and Davies 2004) and trucks (Dubois and Araujo 2006). In fact, the importance of interaction can be traced back to Penrose (1959, 1960) and the notion of *"an inside track"*. More specifically, Penrose argues that a company's growth is related to the development of close customer relationships where the supplier has intimate knowledge and "an inside track". For example, in the description of the Hercules Powder Company, Penrose (1960) specifically highlights the importance of close customer interaction:

> Because of the nature of its market [business-to-business], Hercules stresses "technical service" to customers; salesmen are for the most part technically trained men. In selling their products the salesmen are expected to take an active interest in the production and market problems of their customers. This permits them to acquire an intimate knowledge of the customers' businesses and not only to demonstrate the uses of their own product and to suggest to customers new ways of doing things, but also to adapt their products to customers' requirements and learn what kinds of new products can be used. (p.13)

Since interaction occurs on multiple hierarchal levels and across multiple functions, it is difficult to use a plan-and-implement logic in these product development processes (Håkansson et al 1982, Håkansson and Ford 2002, Baraldi and Strömsten 2009). This thesis therefore proposes three concepts for understanding incompleteness; (1) re-designs (2) development rhythm and (3) path dependency. Even though they are empirically intertwined, conceptually the first two highlight dynamics within projects while path dependency primarily helps to understand dynamics between projects.

Starting with *re-designs*, this is important because handling new discoveries is a constant challenge in developing multi-technology products (Håkansson & Waluszewski 2002). For example, Ethiraj and Levinthal (2004) describe Intel's problems of coping with unexpected domino-effects:

> Time and again, a project team of as many as 500 circuit engineers, chip architects, and software wizards found it had underestimated the difficulty of its task, more than once sinking into a quagmire of complexity with no obvious way out. (p.160)

With frequent re-designs, another challenge is an uneven *development rhythm* (Ancona et al 2001, Ford and Håkansson 2006). Since multi-technology products consist of many sub-projects (von Corswant 2003, Hoegl and Weinkauf 2005), re-designs for one component might cause delays in other sub-projects. Due to incompleteness, development rhythms are therefore often "lumpy" (Ford and Håkansson 2006), characterized by either time pressure or waiting.

However, resource combining also occurs between projects because re-using previous technologies is critical for lowering costs and improving quality (Hargadon and Sutton 1997, Dubois and Araujo 2006). The importance of history can be described through the concept of *path dependency* (David 1985, Håkansson and Waluszewski 2002, Garud et al 2010). A common example to illustrate path dependency is the QWERTY keyboard (David 1985). Even though QWERT was not functionally better, it became the standard computer keyboard because investments in knowledge and equipment created a path where the QWERTY standard became locked-in with other technical and organizational resources.

In this thesis, path dependency is used to show how stability can both hinder and support product development (Håkansson and Waluszewski 2002, Garud and Kärnö 2001, 2003). For example, studying the development of green paper technology, Håkansson and Waluszewski (2002) show how path dependency made it difficult to introduce a new technical solution. In their case study, even though IKEA was one of the largest buyers of catalogue paper in the world, they could not force their German suppliers to change to a more environmentally friendly standard. When investments to other customers had already been made, these suppliers refused to change because the risk of losing other customers was too high. On the other hand, Håkansson and Waluszewski (2002b) also show how path dependency can facilitate product development. For example, a new and slightly adjusted solution could be developed together with Finnish and Swedish suppliers. Rather than starting from scratch within a single company, Håkansson and Walusezewski (2002) therefore demonstrate how new products were developed by linking technological crossroads on a network level.

Summarizing embeddedness and incompleteness in product development theories:

If the first section demonstrated *why* there was a need to integrate target costing with related accounting literatures, this section has taken a first step towards showing *how* such an integration can be achieved. More specifically, starting from the assumption of resource heterogeneity (Penrose 1959, 1960), this thesis argues that product development can be seen as an embedded an incomplete process of resource combining.

Starting with embeddedness, an overall theme was the *importance of context*. Due to complex interdependencies, network embeddedness and project embeddedness help to understand why product development projects need to relate to various contexts. For example, while network embeddedness can be used to capture embeddedness between customers and suppliers on an organizational level (Anderson et al 1994, Håkansson and Snehota 1995), project embeddedness is useful in exploring embeddedness to parallel development projects within a company (Ancona and Caldwell 1992, Engwall 2003).

However, the importance of context does not necessarily mean that integration is the answer, because too much integration can result in over-embeddedness (Håkansson and Snehota 1995). An overall theme among the time concepts was therefore the combination of *planning and improvisation* in dealing with embeddedness. For example, while a re-design might require improvisation in one supplier dyad, it is simultaneously important to plan the synchronization with other suppliers to avoid too much time pressure.

Integrating product development theories from the Industrial Network Approach and strategic management, this section has shown how both planning and improvisation is necessary to develop multi-technology products. When there are multiple customers, suppliers and parallel projects, it is not enough to rely on either planning or improvisation. Instead, seeing product development as an embedded and incomplete process of resource combining, planning and improvisation is constantly carried out one multiple levels.

2.3 Integrating embeddedness and incompleteness with target costing

It is now time to start the development of the skeleton framework. More specifically, this section proposes a number of target costing concepts that can be used to understand how target costing is affected by embeddedness and incompleteness, the overall research question of this thesis.

2.3.1 Integrating embeddedness with target costing

A central conclusion in section 2.1 was that practice studies of target costing had not offered an alternative to Cooper and Slagmulder's (1997) model of target costing. To address this gap, this thesis proposes three alternative sub-processes: customer-driven target costing, architectural-level target costing and supplier-level target costing. The following section introduces each concept and shows how they differ to Cooper and Slagmulder's (1997) concepts of market-driven target costing, product-level target costing and component-level target costing[7].

Customer-driven target costing

Customer-driven target costing focuses on multi-technology products in close customer relationships. This is an important development, because as Nicolini et al (2000) conclude, market-driven target costing is primarily effective for commodity goods and services:

> Market-based target-setting processes are quite effective in dealing with commodity goods and services. This does not apply in quite the same way in non-commodity sectors such as construction… The determination of the price acceptable by the "market" for a unique item and a unique customer is a difficult and complex issue that will need further exploration. (p.320)

[7] For more information on Cooper and Slagmulder (1997), see figure 1.1.

Drawing on network embeddedness, figure 2.1 shows how a central task in customer-driven target costing is to simultaneously cope with both dyadic and network levels. More specifically, even though it is important to listen to individual customers, it is equally important to analyze how adaptations create cost synergies among other customer relationships.

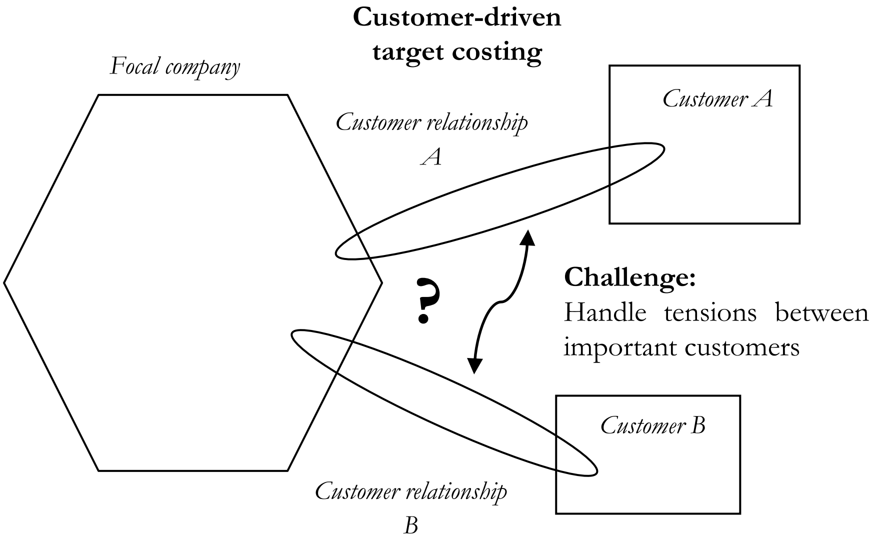

Figure 2.1: Customer-driven target costing and network embeddedness

Starting with a single customer relationship, customer-driven target costing is characterized by interaction on multiple levels. For example, to understand what the customer wants, it is often necessary to interact with individuals from different functions and different hierarchal levels (Brady and Davies 2004). Because of this, identifying what the customer *really* wants is challenging task.

Customer-driven target costing process becomes even more complex if one considers the network level. For example, as figure 2.1 illustrates, what happens if two customers want different functionality? Are both functionalities included in the product or is only one customer prioritized? Even though product development theories offer tentative suggestions of customer-driven target costing, empirical studies are still needed to further explore target costing in close customer relationships.

Architectural-level target costing

A second theoretical development involves project embeddedness. More specifically, even though the concept of product-level target costing (Cooper and Slagmulder 1997) highlights connections to the product portfolio, limited attention has been paid to parallel projects. Being inspired by the notion of architectural innovation (Henderson and Clark 1990, Ulrich 1995), a second sub-process is therefore called *architectural-level target costing*. Focusing on parallel projects, architectural-level target costing is an intra-organizational activity. It is about managing costs by re-configuring components within the product architecture (Ulrich 1995) and linking the product architecture to parallel projects (Engwall 2003).

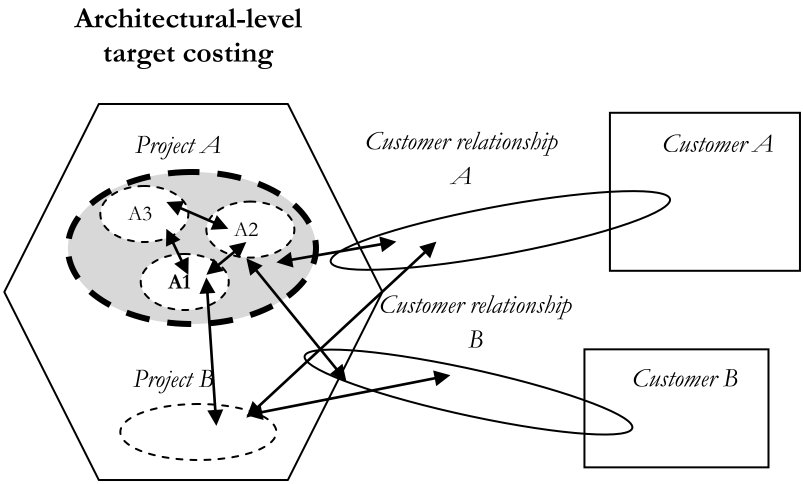

Figure 2.2: Architectural-level target costing and project embeddedness

Even though the target costing literature has spent limited attention on project embeddedness, an exception is the study by Davila and Wouters (2004). Studying high-tech companies, they show how cost management occurs *outside* the product development project. More specifically, to make sure engineers spend their time on revenue-drivers such as new functionality or time-to-market, costs are managed by a parallel cost team. Because of this, Davila and Wouters (2004) argue that cost synergies related to parallel projects are not part of target costing.

Architectural-level target costing challenges Davila and Wouters' idea of parallel cost teams because as figure 2.2 shows, handling interdependencies to parallel projects could also be a central part of target costing processes. For example, since project A (grey area) is combined with project B, it does not seem unlikely to think that target costing in project A has to incorporate interdependencies in the parallel project B when trade-offs between cost and technology are made. Developing the concept of architectural-level target costing can therefore help us understand whether target costing is a complement or a supplement to other cost management practices.

Supplier-level target costing

Drawing on network embeddedness, supplier-level target costing is third and final sub-process. As the literature review demonstrated, target costing in supplier relationships has received considerable interest. For example, Cooper and Slagmulder (2004) developed the concept of Concurrent Cost Management and Agndal and Nilsson (2009) illustrated the importance of also acknowledging cost information from the supplier side. However, as figure 2.3 shows two issues can be still be further developed.

First, more emphasis can be placed on connections between product development projects and *ongoing component deliveries*. For example, replacing a key supplier might not be profitable if one also considers the effects on ongoing component deliveries. Even though Cooper and Slagmulder (2004) describe the importance of a long-term supplier relationship, there is only limited discussion of the controversies that might arise when target costing is related to ongoing component deliveries. Are additional "relationship costs" included in target costing? If so, how do they influence supplier selection? By explicitly addressing ongoing component deliveries, supplier-level target costing helps to understand the complexity of conducting target costing in practice.

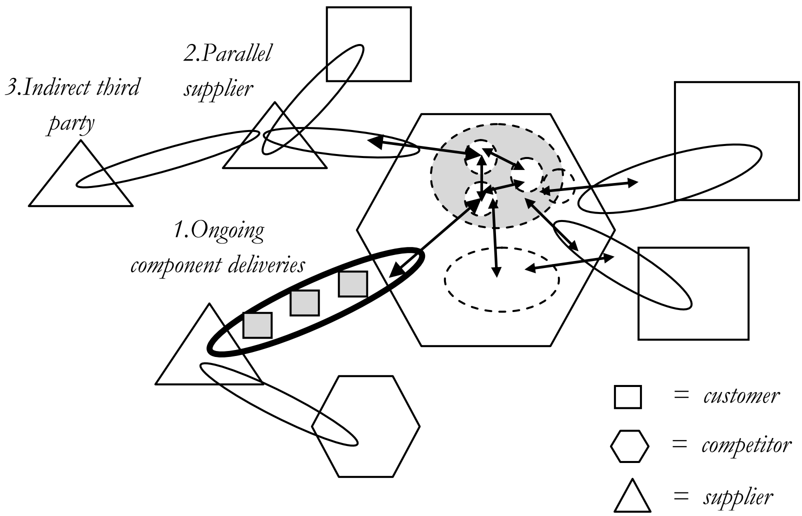

Figure 2.3: Supplier-level target costing and network embeddedness

Secondly, supplier-level target costing also involves interdependencies on a network level. As figure 2.3 shows, one type of network embeddedness relates to parallel suppliers. These are suppliers which the focal company has a direct relationship to. From a target costing perspective, a central task is to ensure that cost savings in one relationship is not off-set by cost increases in another. However, as product development research has shown (e.g Håkansson and Waluszewski 2002, Dubois and Araujo 2006), supplier-level target costing most likely involves connection to indirect third parties. For example, as figure 2.3 illustres, a cost reduction might depend on adaptations made at a supplier's supplier or if the supplier can sell the same solution to other important customers creating "big sellers".

2.3.2 Integrating incompleteness with target costing

A central conclusion in the literature review was the difficulty of using a plan-and-implement logic. Drawing on product development research, this section highlights three target costing challenges: the challenge of re-design, the challenge of development rhythm and the challenge of path dependency. Together they improve our understanding of how planning and improvisation are combined in target costing processes.

The challenge of re-design

From a target costing perspective, re-designs can be challenging because they might cause conflict and re-negotiations. For example, if a customer wants to add functionality late in the development process, this might not be included in the agreed target cost.

Within target costing, a few studies have addressed the challenge of re-designs. For example, a detailed example is provided by Hansen and Jönsson (2005). Emphasizing the need for fast decision-making, they highlight how re-designs work poorly if target costing is too detailed and hierarchal. Another illustration is provided by Nixon (1998). Studying the Scottish copper rod company CCM Ltd, he describes how re-designs arise in close cooperation with customers. For example, during the development phase, an Iranian customer discovered that they needed an additional recycling function on the copper-rod machine. As a result, re-negotiations around cost estimates occur. As Nixon describes this process:

> The target operating cost of the "AG" machine was viewed as a technical and political challenge. It was political in the sense that design configurations which gave the required direct cost per ton of copper rod output had different implications for the cost of the machine and its development, and gave rise to extensive discussions and negotiations. (p.341)

However, despite these contributions, the area of target costing and re-designs has a lot more to offer. For example, we do not how re-designs are related to network and project embeddedness. Linking re-designs to embeddedness could also provide valuable insight beyond target costing research. For example, few studies within inter-organizational accounting have addressed the micro-processes of re-designs and within the field of accounting-and-new product development, re-design efforts could add to a much needed inter-organizational perspective on accounting-and-new product development.

The challenge of development rhythm

A second challenge can be found in the development rhythm. As Ford and Håkansson (2006) argue, development processes between customers and suppliers are often "lumpy," characterized either by time pressure or delays. Previous target costing research has also illustrated how an uneven development rhythm has consequences for target costing. For example, Mouritsen et al (2001) describe how tight cost control is difficult with fast product development, and Davila and Wouters (2004) argue that time pressure is one of the main reasons why cost reductions occur *outside* product development projects.

Still, we know little about delays. For example, how is functional analysis conducted if a parallel project is late and does not provide adequate input or what happens if a delay increases project cost on a network level? Can the customer get compensation from the supplier for all the network effects or only for effects within the dyad? Similar to re-designs, an uneven development rhythm can result in conflicts about *cost increases*. Given that previous research has largely portrayed the target costing process as cooperative focusing on cost reductions, interesting challenges lies in exploring how unexpected cost increases are dealt with.

An understanding of development rhythm and re-negotiations could also add to recent discussions within inter-organizational accounting. For example, Håkansson et al (2010) argue that negotiating compromises is a central area for future research and a number of studies have called for more research focusing on accounting and networking (e.g. Thrane and Hald 2006, van der Meer-Kooistra and Vosselman 2006, Caglio and Ditillo 2008).

Recent studies within accounting-and-new product development also highlight the importance of developing more dynamic perspectives. For example, Jörgensen and Messner (2010) described how project teams renegotiated roles and responsibilities in relation to product development phases while Mouritsen et al (2009) illustrated how accounting was part in problematizing re-designs.

The challenge of path dependency

The third and final challenge focuses on dynamics *between* development projects. As product development research has demonstrated, it is important to re-use technology over several product generations (Hargadon and Sutton 1997, Håkansson and Waluszewski 2002). Developing multi-technology products is therefore not only a matter of including the network level, but also an issue of connecting the present with history and future.

The challenge of path dependency has been noted in previous target costing research. For example, Cooper and Slagmulder (2004) describe how Concurrent Cost Management engages several product generations and Agndal and Nilsson (2009) specifically emphasize path dependency:

> In order to reduce costs, S3 uses components or modules from previous products, for which costs have already been established. Also, since the cost platform plays such an important role in cost calculations, typically only the cost of the particular change needs to be calculated. (p.95)

Still, path dependency has not been addressed at the level of specific sub-processes. For example, regarding customer-driven target costing, how are functions from previous generations handled? Can a key customer alone motivate the keeping of specific functionality? If not, how is the overall relationship with this customer affected if they are not listened to?

Path dependency also raises question regarding functional analysis. The current literature describes functional analysis in relation to single products (Ansari and Bell 1997, Cooper and Slagmulder 1997, Mouritsen et al 2001). However, when individual products are integrated into larger customized solutions, predicting how products will be used can be difficult (Håkansson and Waluszewski 2002). For example, it is not easy to estimate the life-span of a customized solution. If functional analysis misses important interdependencies, how is this handled when they are discovered later on?

The challenge of path dependency also adds to recent discussions in inter-organizational accounting (Miller and O'Leary 2005, 2007, Boland et al 2008). An interesting feature is that path dependency can be related both to the underlying technology (Miller and O'Leary 2005, 2007) as well as to accounting itself (Boland et al 2008). For example, while Miller and O'Leary show how Intel and other chip manufacturers are dependent on re-using old technology, Boland et al discuss how the evolution of accounting practices among construction companies are highly influenced by the historical heritage of competitive bidding.

Path dependency can therefore be used to describe both the complexity of target costing (path dependency in technology), but also the evolution of target costing over time (path dependency in accounting). This dual quality of path dependency will be studied in this thesis. For example, even though the primary focus is on path dependency in technology, the evolution of target costing will also be demonstrated.

2.3.3 Theoretical framework and refined research questions

This section summarizes the theoretical framework and introduces four refined research questions. To start with, this chapter has argued for a process approach of target costing where related management accounting practices such as functional analysis, value engineering, inter-organizational cost management and open-book accounting are seen as part of target costing as long as they occurred during product development projects. Taking a process view has a long tradition in target costing (e.g. Ansari and Bell 1997, Cooper and Slagmulder 1997) and especially among theoretically and empirically informed practice studies of target costing (e.g. Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009).

Secondly, integrating product development theories from the Industrial Network Approach and strategic management, this thesis emphasizes the importance of embeddedness and incompleteness for understanding target costing processes. More specifically, relying on the concepts of network embeddedness and project embeddedness, three sub-processes were proposed: customer-driven target costing, architectural-level target costing and supplier-level target costing. Even though there are similarities with Cooper and Slagmulder's (1997) model, there are also distinct differences. For example, while market-driven target costing has a business-to-consumer focus, *customer-driven target costing* focuses on business-to-business customers. While product-level target costing spends little time on parallel projects, this is a central feature in *architectural-level target costing*, and while component-level target costing focuses primarily on intra-organizational activities, *supplier-level target costing* emphasizes close interaction in supplier networks.

Furthermore, to understand how incompleteness influences target costing processes, three target costing challenges were proposed: re-designs, development rhythm and path dependency. Rather than portraying target costing as a linear process that can be managed by top managers, these three challenges highlight potential complexities in target costing processes. For example, it was shown how re-designs and development rhythms potentially cam cause conflicts regarding cost increases and how path dependency might make it difficult to exclude functionality if it is required by an important customer.

Having described the theoretical framework, it is now time to introduce four refined research questions. Compared to the overall research question in chapter one, the refined research questions are explicitly linked to multi-technology products and the refinements of embeddedness and incompleteness. More specifically, the first refined research question asks:

> *How does network embeddedness affect target costing processes in a context of multi-technology products?*

The aim of this question is to develop the concepts of customer-driven target costing and supplier-level target costing. This adds valuable knowledge to target costing, but also adds to the field of accounting-and-new product development that has an intra-organizational focus.

The second research question relates to project embeddedness. More specifically, the second refined research question is formulated as:

> *How does project embeddedness affect target costing processes in a context of multi-technology products?*

The aim of this question is to develop the concept of architectural-level target costing. This moves target costing research beyond "the single project perspective" (Engwall 2003) but also adds new perspectives to inter-organizational accounting which has yet to explore the project level.

The third research question focuses on incompleteness. As the theoretical framework demonstrated, there were three time challenges; re-designs, development rhythm and path dependency. A third refined research question is therefore:

> *How do re-designs, development rhythm and path dependency affect target costing processes in a context of multi-technology products?*

The aim of this question is to explore the micro-dynamics of target costing. For example, we know little about when and how these time challenges occur during a product development project. Furthermore, this research question can also help us understand how the three sub-processes are connected. For example, how are customers and suppliers connected during re-designs or what happens to parallel projects if there is a strong time pressure to deliver to a key customer?

The final research question concerns target costing evolution, a neglected issue within target costing. For example, while case studies have focused on the complexities of target costing (e.g. Mouritsen et al 2001, Hansen and Jönsson 2005) survey studies have focused on why companies adopt target costing (e.g. Tani et al 1994, Dekker and Smidt 2003, Ax et al 2008). As a consequence, we have limited knowledge if and how target costing processes change over time. The fourth refined research question is therefore:

Do target costing processes in a context of multi-technology products change over time, and if so, what explains these changes?

Studying target costing evolution also has the potential to contribute to inter-organizational accounting. For example, a number of studies have observed how an organization's history affects how they adopt accounting practices (e.g. Van der Meer-Kooistra and Vosselman 2000, Dekker 2004, Coad and Cullen 2006, Thrane and Hald 2006, Boland et al 2008). By taking a longitudinal perspective and studying ABB Robotics before they used target costing, how they adopted target costing and how target costing processes changed over time, this study can potentially contribute to other studies within inter-organizational accounting that deals with accounting change more broadly.

3 Studying target costing in practice

This chapter describes the methodology of this thesis. More specifically, it describes central research choices as they emerged during the research process. This is done in two steps. Section 3.1 motivates research design, use of theory, data collection and data analysis. For each part, different options are described on how choices were made to empirically capture and analyze the micro-processes of target costing. To further describe the links between theory, empirics and method section 3.2 focuses on the research process and how I dealt with unexpected problems and opportunities. Finally, in section 3.3, reflections are made on the consequences of different research choices and how they affect the trustworthiness of this thesis.

3.1 Principles and practices of this thesis

3.1.1 Methodological differences in studying actual and best practice

As was described in chapter two, many studies on target costing have had the normative ambition of focusing on best practice (Hansen and Jönsson 2005, Ansari et al 2007). Interviewing senior managers in well known companies such as Toyota, Nissan and Boeing, target costing has been portrayed as sequential process which can largely be directed by a single company. Drawing on product development research there is reason to believe that current models of target costing needs to be revised. More specifically, not only do we need new theoretical concepts, we also need a research design that is suitable for studying actual rather than best practice. The intention of this section is therefore to outline how this thesis which focuses on actual practice is different from previous target costing research that has focused on best practice.

A good starting point for such a discussion is a study by Lukka and Granlund (2002). Analyzing Activity-Based Costing (ABC), Lukka and Granlund develop a framework that distinguishes three methodological differences between studies on best practice and actual practice: knowledge interest, research methods and styles of argumentation.

Areas of comparison	**Research focusing on best practice**	**Research focusing on actual practice**
Knowledge Interest	An interest in creating easy-to-understand techniques that can be sold to customers	An interest in describing, and understanding with scientific rigor how and why an accounting innovation is used
Research Methods	Research methods are hybrids and pragmatic. A wide range of methods can be applied in one paper. Limited methodological reflection	Both qualitative and quantitative research methods are used. Each method is done according to its own standards
Styles of argumentation	Straightforward, one clear message per paper which often result broad generalizations	"Duller", few generalizations are made and if they are, they are based on systematic empirical evidence

Table 3.1: Lukka and Granlund's framework for distinguishing methodlogical differences between studies on best practice and actual practice

Starting with *knowledge interests*, Lukka and Granlund (2002) argue that studies on best practice focus on technical knowledge and creating a marketable product. Rather than being open to unexpected results, the key interest lies in developing a technique which can be sold to companies[8]. In contrast, studies on actual practice focus on describing, explaining and understanding

[8] Lukka and Granlund actually refer to this stream as "Consulting research" while research on actual practice is called "Basic research".

how and why a research phenomenon occurs (Lukka and Granlund 2002). For example, drawing on product development theories, this thesis explores how and why target costing processes are affected by embeddedness and incompleteness. The interest in describing and problematizing target costing can also be seen in target costing practice studies. For example, the studies on NewTech (Mouritsen et al 2001), Volvo Cars (Hansen and Jönsson 2005) and the gearshift supplier (Agndal and Nilsson 2009) all draw on different theoretical frames to analyze their empirical data. This thesis also has a clear interest

A second difference involves *research methods*. More specifically, as table 3.1 shows, while studies on actual practice rely heavily on methodological references, these references are largely absent within studies on best practice. For example, Lukka and Granlund found that best practice papers about activity-based costing could include a wide range of methods, even within the same paper. The difference in methodological sophistication is evident in target costing. For example, reviewing more than 180 books and articles, Ansari et al (2007) show that a majority of articles focus on best practice and that these (especially before the year 2000) focus on secondary data or use a limited number of interviews. In contrast, recent studies on target costing practice are more methodologically reflective and innovative. For example, Hansen and Jönsson (2005) video taped project meetings to understand how target costing problems were solved in daily practice. In this thesis, an in-depth case study was conducted using an abductive research approach (e.g. Dubois and Gadde 2002). More specifically, to capture the micro-processes of target costing, the theoretical framework was developed iteratively with the field study.

A third and final difference concerns *styles of argumentation*. In studies of actual practice, the language is much "duller," neutral and often provides opportunities for other interpretations. Since this type of research is methodologically reflexive, it is essential in studies on actual practice to motivate claims with links to empirical data and theoretical arguments. In contrast, the argumentation style for studies on best practice is more direct and focused on potential values for the buyer. As Lukka and Granlund note when analyzing the titles of best practice articles:

> The style of argumentation is typically very straightforward and vigorous in the genre of consulting research [best practice research]. Directly from the start of the text the reader is clarified as to what the message of the text is. (p.173)

Even though the message of this thesis might seem clear (include product development complexity in models of target costing), I have tried to use a style of argumentation that is more reflective. For example, the methodology chapter ends with a discussion about potential limitations and in the analytical chapters I critically examine my framework using a wide range of different theories. By doing so, the ambition is to give an honest account and show how the complexity of target costing practice can be analyzed in a number of ways.

3.1.2 Theoretical ambition and use of theory

Given that theory plays an important part in studies of actual practice (Lukka and Granlund 2002), this section describes the theoretical ambition of this thesis and how theory was used during the research process.

Starting with theoretical ambition, several authors have argued that research can focus on theory development, theory refinement or theory testing (Keating 1995, Dubois and Gadde 2002, Edmondson and McManus 2007). For a young field, theory development is a suitable research scope. By conducting case studies and asking open-ended research questions, the goal is to develop new emergent theories. At this stage, researchers often use inductive methods and strive for identifying patterns which can be further developed in later studies (Edmondson and McManus 2007).

When a research field matures, focus shifts from theory development to theory refinement (Keating 1995, Dubois and Gadde 2002). Instead of creating new theory, focus is on integrating previous bodies of work into more structured frameworks (Edmondson and McManus 2007). As a consequence, research questions are more focused, data can include both qualitative and quantitative elements, and data analysis focuses on identifying relationships between concepts (Edmondson and McManus 2007). An approach for conducting theory refinement is abduction, where theory, method and empirics are intertwined and continuously developed as new discoveries are made. Describing the key elements of abduction, Dubois and Gadde (2002) write:

> One major difference [in abduction], as compared with both deductive and inductive studies, is the role of the framework. In studies relying on abduction, the original framework is successively modified, partly as a result of unanticipated empirical findings, but also of theoretical insights gained during the process. (p.559)

When a research field becomes established, theory testing is an appropriate theoretical ambition (Keating 1995). In these instances, research questions are often focused on testing hypotheses or focusing on extreme cases to develop boundary conditions for a specific theory (Edmondson and McManus 2007).

Given the ambition to integrate product development theories and link target costing to broader accounting fields, this thesis focuses on theory refinement. More specifically, by drawing on the Industrial Network Approach and strategic management, the theoretical ambition is to introduce embeddedness and incompleteness to the target costing literature. This provides an alternative to existing models within target costing (Cooper and Slagmulder 1997) and extends the literature focusing on target costing practice (e.g. Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009).

The ambition of theory refinement further links to how theory is used in this thesis. Being inspired by an abductive approach, this thesis began with a skeleton framework based on the Industrial Network Approach where embeddedness and incompleteness were included. As data collection and data analysis proceeded, the theoretical framework was then revised a number of times. For example, project embeddedness (Engwall 2003) was added during the research process. Criticizing a linear plan-and-implement way of conducting research, Dubois and Gadde (2002) specifically point to the benefits of constantly updating the theoretical framework as new interesting discoveries are made:

> We have found that the researcher, by constantly "going back and forth" from one type of research activity to another and between empirical observations and theory, is able to expand his understanding of both theory and empirical phenomena. (p.555)

3.1.3 Research design choices

Returning to the four research questions, they all focused on processes. Network embeddedness and project embeddedness focused on where target costing processes occurred and re-designs, development rhythm and path dependency were introduced to understand how planning and improvisation could be combined in target costing processes.

Reviewing process research, Langley (1999) concludes that a common denominator is the focus on sequences of events that involve multiple levels of analysis. Because of this, studying processes primarily involves qualitative data or as Langley (1999) writes "Process data are messy. Making sense of them is a constant challenge" (p.691). However, despite focusing on qualitative data, there is still a choice regarding where the data should be collected. For example, some authors argue for single case studies (Dyer and Wilkins 1991, Dubois and Gadde 2002, Halinen and Törnroos 2005) while others prefer multiple case studies (Eisenhardt 1989, 1991, Eisenhardt and Graebner 2007).

In this thesis, a single case study was chosen because previous studies have shown that depth is important for capturing micro-processes (Gersick 1994, Håkansson and Waluszewski 2002, Engwall and Westling 2004). For example, in an extreme example, Gersick (1994) only interviewed two individuals. Over a period of 14 months, 12 interviews were conducted with the CEO and 8 interviews with the Venture Capital Partner to uncover the difference between time-based pacing and event-based pacing in an American start-up.

A second reason for a single case study relates to the complexity of studying network embeddedness. To study how close customer and supplier relationships are interconnected, extensive case studies are needed. For example, within the Industrial Network Approach, researchers often conduct more than 100 interviews to unpack the complexity of network embeddedness (e.g. Wedin 2001, Håkansson and Waluszewski 2002). Summarizing this case study tradition, Halinen and Törnroos (2005) conclude:

> A single-case study is an appropriate design for network research in many situations. The objective of providing holistic descriptions of contemporary business networks to learn about their nature, management and evolution is such a demanding task that a single-case study is often the only option. (p.1291)

Having decided to conduct a single case study, another choice was about the level of analysis (Langley 1999). More specifically, should target costing be studied on a project or an organizational level? As the literature review showed, previous studies of target costing practice have focused on both levels. While studies on intra-organizational target costing have focused on the project level (Nixon 1998, Hansen and Jönsson 2005), inter-organizational target costing has emphasized the organizational level (Mouritsen et al 2001, Cooper and Slagmulder 2004, Agndal and Nilsson 2009). To be able to capture micro-dynamics, but also to capture project embeddedness, it was decided to have the project level as the primary level of analysis. Nonetheless, since network embeddedness and the evolution of target costing can be studied on multiple levels, it was decided to collect data on both project and organizational levels. As a result, the empirical part of this thesis begins with a description of target costing evolution on an organizational level, and continues with detailed examples of target costing on a project level.

A third research design issue involved the choice of studying ABB Robotics. Using theoretical sampling (e.g. Eisenhardt 1989), Robotics was selected based on four criteria: (1) they develop multi-technology products, (2) they had extensive experience of working with close customer and supplier relationships, (3) target costing had been important since the early

1990s and (4) Robotics provided good access to data. A fifth advantage which was discovered during the research process was Robotics' involvement in other research projects. For example, a parallel PhD thesis (Ekman 2006) focused on IT-implementation involving close customer relationships, and a detailed master thesis focused on the use of stage-gate models in product development projects. These parallel research reports provided another way of critically examine my findings

.

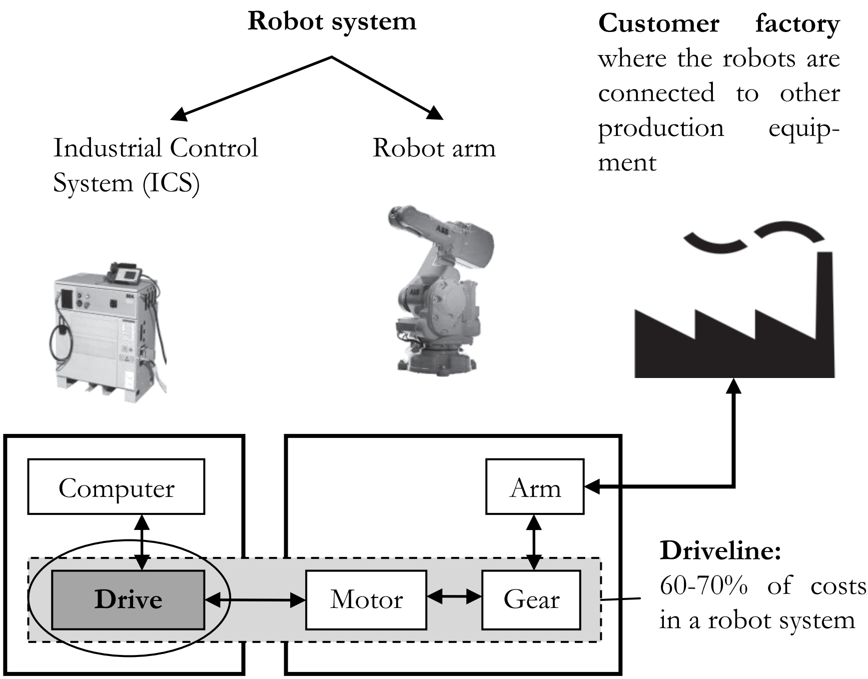

Figure 3.1: Interdependencies between the drive and other complex components in a robot system

A fourth choice involved the selection of inter-organizational relationships. Based on previous theory and discussions with employees at Robotics, it was decided to start with the relationship between Robotics and DriveSys[9]. This inter-organizational relationship was chosen because the drive is one of the most costly and technically complex components. For example, as figure 3.1 illustrates, the drive is not only a significant part in the Industrial Control System, it is also the link between the Industrial Control System and the robot. Because of this, the drive has complex interdependencies both to other projects within ABB Robotics as well as to other customers and suppliers.

Besides providing opportunities to study target costing in relation to network embeddedness and project embeddedness, DriveSys also allowed me to investigate the three time challenges of re-designs, development rhythm and path dependency. For example, DriveSys had been involved in several product development projects which enabled an analysis of path dependency; within each project there were several critical episodes that gave the opportunity to study target costing in relation to re-designs and an uneven development rhythm. Furthermore, during data collection, additional customer and supplier relationships were added to complement areas not covered in the relationship with DriveSys. For example, to explore how Robotics worked with customers, relationships with General Motors and Daimler-Chrysler were examined. In order to see how Robotics worked with new suppliers, interviews were also made with Design-Net, one of the first suppliers to ever been given project management responsibility.

To effectively capture the actual practice of target costing, it was also important to make choices regarding the number and type of product development projects to include. From the beginning it was decided to focus on large platform projects because they provide the largest cost reduction op-

---

[9] The function of a drive system is to direct motors when to move, how to move and at which speed to move. In this sense, the drive system is similar to the nerve system in the human body. It gets direction from the brain (the computer in the Industrial Control System) and then sends signals to the heart (the motor) on how much blood (current) it should use to get the arms (robot arms) to move.

portunities. Since DriveSys had been involved in both ALFA and DELTA and the two projects featured contrasting styles of conducting target costing, it was decided to include these two product development projects.

However, as figure 3.2 shows, Robotics also makes smaller customer projects which are carried out between platform projects. The reason for this mix between larger and smaller projects is that large platform projects are only carried out every five years and during this time, key customers, such as General Motors or DaimlerChrysler, often want upgrades and other forms of customization. Since BETA was connected to both ALFA and DELTA and since Design-Net was responsible for project management, it was decided to include this third project in the study.

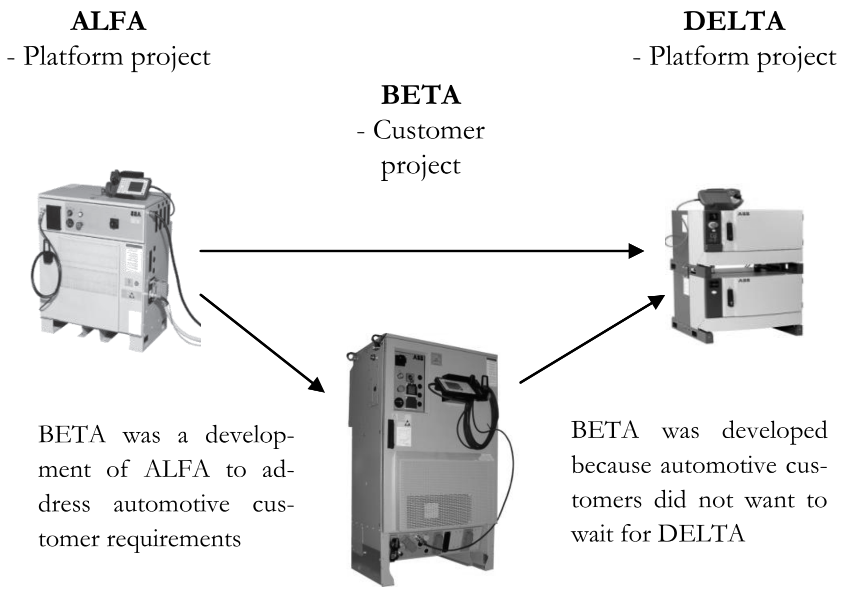

Figure 3.2: ALFA, BETA and DELTA, the three product development projects in this thesis

To summarize, this section has described five central choices in the research design of this thesis. First, a single case study was chosen to capture the many interdependencies between customers, suppliers and parallel projects. Secondly, it was decided to focus on the project level, but also to complement with dynamics on an organizational level. Thirdly, Robotics was selected because it fit both theoretical criteria within the context of multi-technology products and also provided good access to data. Fourthly, the key focus was on the relationship with DriveSys, but other customers and suppliers were also studied. Finally, both large platform projects and smaller customer projects were examined to show how target costing evolved over time and how target costing practices varied depending on project type.

Compared to previous studies, this research design has a number of advantages. First, it involves both inter-organizational and intra-organizational spaces. Previous studies have tended to focus on either inter-organizational target costing (Mouritsen et al 2001, Cooper and Slagmulder 2004, Agndal and Nilsson 2009) or intra-organizational target costing (Nixon 1998, Hansen and Jönsson 2005). Secondly, it focuses on the project level, but through the concept of project embeddedness, also explores how each project is embedded with other projects on an organizational level. The advantage of this is that the context of each project can be better understood. For example, in previous studies focusing on the project level (Nixon 1998, Hansen and Jönsson 2005), there is limited discussion how they related to overall organizational dynamics. Thirdly, the research design includes both platform and customer projects and how they are connected over time. Previous studies have focused on large platform projects and there has been no study that has captured path dependency over several projects as this study does.

As a consequence, by integrating embeddedness and incompleteness with target costing, and providing a suitable research design for capturing these theoretical concepts, this thesis takes a first step towards providing a more holistic model of target costing practice than has been done before.

3.1.4 Data collection involving multiple sources

Having motivated the research design, this section describes how data was collected. Following recommendations in accounting (Scapens 1990, Keating 1995, Lukka 2005), the Industrial Network Approach (Dubois and Gadde 2002, Halinen and Törnroos 2005), and strategic management (Eisenhardt 1989, Dyer and Wilkins 1991, Edmondson and McManus 2007), this thesis combines interviews with direct observation and archive studies.

In terms of interviews, a total of 99 interviews were conducted with 55 individuals. As table 3.2 shows, these interviews were distributed among five themes and four research phases. Before explaining the distribution, it should be noted that most interviews dealt with more than one topic. What might seem an exact count is therefore less clear if one looks at interview notes and transcripts. The numbers should therefore be seen as a classification of the *primary* focus of each interview. In appendix I, the classification is further organized according to hierarchal level, function and case company.

Topic/phase	Phase 1	Phase 2	Phase 3	Phase 4	Total
Context of robots	24	2	2	2	30
Organizational dynamics	14	1	1	3	19
DELTA Project	4	9	11	2	26
ALFA Project	-	4	9	1	14
BETA Project	-	-	7	3	10
Total	**42**	**16**	**30**	**11**	**99**

Table 3.2: Number of interviews and their *primary* topic

An initial pattern in table 3.2 is found in the focus on context and organizational dynamics in the first phase. An important experience was that it took time to get to know the robot context, and since initial interviews were conducted without a tape recorder (in order to gain trust), several follow-up interviews had to be done to clarify contextual issues. In phase three and four a tape recorder was used and this improved both the detail of interview transcripts and the ability to understand the setting[10].

A second pattern found in table 3.2 is that the three product development projects do not include an equal number of interviews. A primary cause for this was that data collection began with DELTA which was the most recent project, and was then continued back towards ALFA. The discovery of BETA was first done in phase three by which time most of the data collection had been conducted. Learning from DELTA and ALFA, interviews could be more focused addressing specific issues at this point.

To complement the interviews, direct observation was conducted. During phase one, 1-2 days a week was spent at ABB Robotics and I also participated in Robotics' "Supplier University", a two day workshop where eight to ten suppliers were invited. As the research progressed, direct observation was more focused on specific issues. For example, the project manager of DELTA was shadowed on the day Robotics decided that DELTA could be launched, and at other times participation was conducted in meetings that dealt with technical problems or meetings with the steering committee.

A third important part of the data collection was in archive studies. More specifically, with access to Robotics' intranet, it was possible to get hold of project documentation in the form of power point slides, organization charts, minutes from meetings and process descriptions. Cost calculations were shown to me during interviews, but these excel calculations were not as easily accessed. Over time when trust increased, I got to see more, but it can be noted that detailed cost calculations were not shown by the suppliers

---

[10] This is an issue where table 3.1 can be somewhat misleading. In a similar way as development projects were discussed in the first phase, context and dynamics were also dealt with in the later phases. However, since the primary topic of later interviews was the development projects, these issues (despite their importance in dealing with clarifications) did not occupy the majority of the interview time.

in this study. They only talked about costs in interviews but were not willing to share their internal calculations.

Two forms of external documentation became important during data collection. First, to understand Robotics' history, an archive study of ABB's annual reports from 1970 to 2008 was conducted. To complement interviews, the annual reports were used to pinpoint specific events. For example, an interviewee could have talked about "the big order from customer X" and then the annual report could confirm more specific time periods. Other external documents that were used were Robotics' customer cases. To show what robots can do, pdf-files can be downloaded from Robotics' website. Even though this type of presentation material needs to be analyzed with caution, they fill a function because they help to identify important customers and describe complex technical functionality in a pedagogical way. Both annual reports and customer cases were therefore used as a complement, but in this way they contributed with specific knowledge or provided pedagogical explanations.

3.1.5 Techniques for analyzing process data

Analyzing qualitative data can be a difficult and tiresome process (Eisenhardt 1989, Dubois and Gadde 2002). Process data is particularly complex because it often involves multiple levels and involve several units of analysis. Describing the challenge, Langley (1999) writes:

> And this is where the central challenge lies: moving from a shapeless data spaghetti toward some kind of theoretical understanding that does not betray the richness, dynamism, and complexity of the data but this is understandable and potentially useful to others. (p.694)

Drawing on Eisenhardt (1989), one way of structuring the material was to write up different types of case descriptions. For example, after phase one, a research report was written to VINNOVA, the financer of the research project and in phase three a teaching case was developed. These writing exercises were useful because they provided input for further data collection and theoretical development. For example, after phase one it became clear that target costing in product development projects could be an interesting research direction because many of the critical episodes between Robotics and DriveSys centered on this theme.

Two other techniques for analyzing the data were *within-case analysis* and *cross-case analysis*. For example, after phase two, a within-case analysis was conducted of DELTA. Analyzing target costing processes, especially focusing on the relationship with DriveSys, the empirical data showed interesting avenues for further development. For example, the connection to earlier projects became much clearer. However, within-case analysis also highlighted what had *not* been collected and thereby triggered new cycles of data collection and theory development (Dubois and Gadde 2002). For example, parallel projects was focused during phase three and in terms of theoretical development, the analysis of DELTA helped to develop customer, architectural and supplier-level target costing.

Still, to get a more detailed analysis, a combination of two process strategies for theorizing data was used: *narrative* and *temporal bracketing* (Langley 1999). Narrative is a suitable strategy when the data material is rich and includes many details. In this thesis, the interview data, complemented with notes of direct observation compiled a large pool of rich empirical material that needed to be analyzed. The advantage of the narrative strategy is that it is good for developing an accurate account of what has happened.

To complement the narrative strategy, temporal bracketing has its advantages in simplicity and generality (Langley 1999). By structuring data into phases, it became possible to distinguish the difference between cost reduction and cost containment. More specifically, as the empirical material will show, while target costing in the early concept phase focused on cost reduction, target costing in later phases focused more on containing (or minimizing) cost increases. For multi-technology products, this distinction is important because incompleteness creates a constant pressure on the development team to re-design technical solutions (Sosa et al 2004). These redesigns normally start during the development phase when prototypes are ready for testing, and then continues during pre-production when key customers often want modifications. Since re-designs often increase costs, an important element of target costing in later phases is therefore to *contain* these costs as much as possible. The strategy of temporal bracketing (Langley 1999) therefore helped to highlight the importance of project phases, something that was not initially part of the theoretical framework.

3.2 A research process in four phases

Having described the principles and practices, this section focuses on the research process. More specifically, the intention is to illustrate when particular events occurred and actually show *how* theory, empirics and method were intertwined in the development of this thesis. By doing this, the ambition is to create a trustworthy account which helps the reader to understand both the benefits and potential limitations of the thesis.

3.2.1 Understanding the context

This research project began in August 2002. I had just finished my master's degree at the Stockholm School of Economics and was offered a job as a research assistant. The ambition during the fall was to conduct a pilot study about management control and outsourcing, and if the project turned out well, the goal was to hire me as a PhD student.

While trying to negotiate access to a suitable case organization, the first months were spent reading articles about inter-organizational accounting, the primary literature at that time. Central articles were Carr and Ng (1995) about Nissan in the UK, Vosselman and Van der Meer-Kooistra (2000) about outsourcing relationships in the Netherlands, and Mouritsen et al (2001) who studied target costing and open-book accounting in two Danish high-tech companies. An observation that influenced my later work was that all studies focused on single supplier relationships. Since the inter-organizational accounting literature had begun to focus on network embeddedness (see Tomkins 2001 for an early example), it was therefore decided to draw on the Industrial Network Approach (Anderson et al 1994, Håkansson and Snehota 1995, Håkansson and Waluszewski 2002) which specifically discussed network embeddedness and the connections between customers, suppliers and third parties.

In September, Robotics emerged as a potential case organization. The company had both close customers and supplier relationships and through personal contacts I was invited to present my research ideas. Even though negotiating access to a case organization can be a challenge, I was fortunate, because after meeting with Ola Svanström, a technical manager, full access was offered to Robotics and a desk set up in the in the office landscape of the product development department.

To give a brief description, Robotics has its headquarters in Västerås, a city of about 130,000 inhabitants 120 km west of Stockholm. The headquarters is located in an industrial area, "Finnslätten", about 5 km north of Västerås' city center where about 800 employees work. At Finnslätten, Robotics houses all the major functions of the company. The sales, purchasing, product development and quality departments are located in the main office building, while the production and logistics departments are located in the robot factory 100 meters away. The office landscape of the product development department consists of about 20 desks. Here sit junior engineers, project members and external consultants. Managers have smaller offices surrounding the office landscape. At my desk was a computer with access to Robotics' entire intranet. This included internal documents about development projects, supplier guidelines, quality audits and lessons learnt from previous projects.

During the fall of 2002, I spent one or two days per week at Robotics. Usually, I would arrive at 9 am, do a couple of interviews and then sit at my desk and read. Since Robotics has a large coffee area in the middle of the office building, I also met people I interviewed there. However, even though informal contacts are highlighted as important for collecting data (e.g. Eisenhardt 1989, Hargadon and Sutton 1997) mixed results were experienced. Because of the many suppliers and external consultants working at Robotics, I primarily talked with the people I had interviewed. Even though people said hello, most employees had their coffee with colleagues from their own department.

Another observation was of the large number of meetings that occurred. Interviewees from Robotics spent most of their daily work in conference rooms which meant that the people who sat at their desks were often consultants. In line with Mouritsen et al (2001), outsourcing had changed the core activities within Robotics' product development department from technical engineering to project management. One interviewee also reflected upon this and said that young engineers were quite different from their older colleagues. Instead of being technical specialists, project managers were now needed to coordinate product development activities with customers and suppliers.

Interviews were done cross-functionally. Drawing inspiration from the Industrial Network Approach, the ambition was to identify management control practices and how they related to network embeddedness. In phase one 42 interviews were made with 28 different people representing management, purchasing, development, quality, logistics, production, sales and the controlling departments.[11] The interviews began with questions about the interviewee's background and then moved on to issues related to management control and outsourcing. For example, purchasers were asked about contractual issues, while quality engineers were asked about quality assurance. At this point, target costing was not the prime focus, but instead part of a larger package of management control issues.

Contacts with interviewees were done either by mail or through personal introduction. During the first phase, about twenty of the interviews were planned and the remaining interviews were the result of recommendations. In terms of location, interviews were conducted mostly in a conference room or in the interviewee's office. The average length was 65 minutes,

[11] The 42 interviews were divided into 30 initial interviews, 10 follow-up interviews and two interviews with DriveSys senior manager. Initially, the focus was on Robotics and using a focal actor strategy (Halinen and Törnroos 2005).

while the longest interview lasted for more than two hours. The plan was to keep interviews within one hour, but sometimes joint discussions took the conversation into new directions.

3.2.2 Focusing on target costing and product development

In the second phase data collection became more focused on target costing. As figure 3.3 illustrates, this required a methodological shift from the organizational level to the project level.

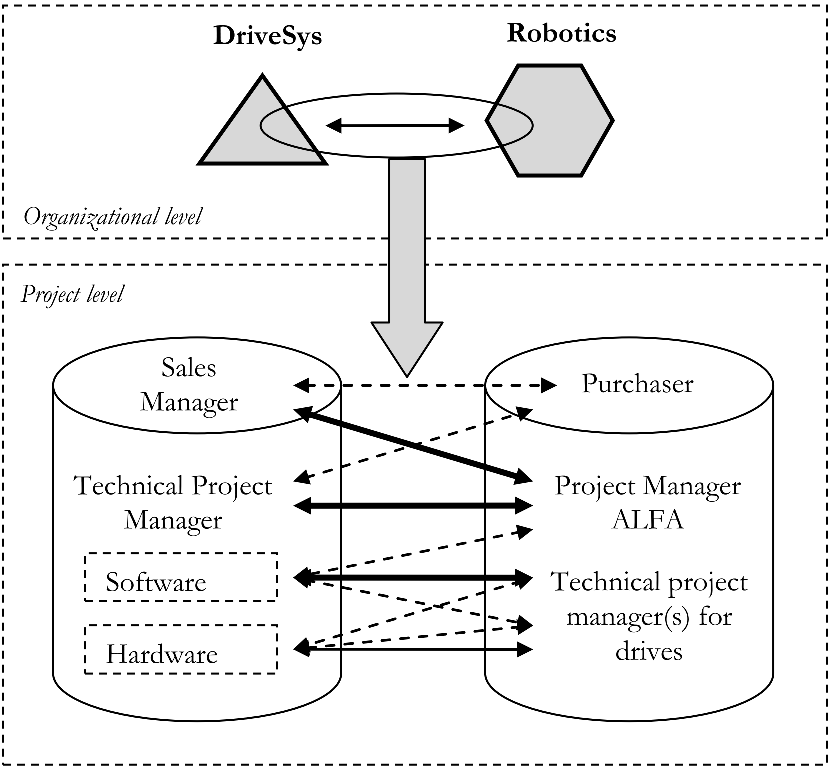

Figure 3.3: Shifting focus from organizational level to project level

A central issue during phase two was to identify which actors that were involved in target costing. For example, as the bold lines in figure 3.3 show, project managers from both Robotics and DriveSys played important roles in negotiating cost targets. In total, 16 interviews were made with employees at Robotics. These were semi-structured and detailed notes were taken. Except for identifying interaction patterns, phase two also included data collection on critical episodes where re-designs were needed or when the development rhythm had to change. For example, when DriveSys's drive system became over-heated, who should pay for this problem? Was it included in the initial target cost or was this Robotics' responsibility?

To get a more detailed theoretical framework, Håkansson and Waluszewski (2002) became an inspiration during this phase. Studying the development of green paper technology, they had combined network embeddedness and path dependency into a theoretical framework. During the fall of 2003, I therefore tried link target costing and the empirics at Robotics with Håkansson and Waluszewski's framework on product development and network embeddedness.

3.2.3 Extending the study with customers and discovering Design-Net

By the spring of 2004, my thesis project had progressed without any major setbacks. I had conducted 58 interviews and developed a theoretical framework that related network embeddedness to target costing in close supplier relationships. Still, struggling with both within-case analysis and cross-case analysis new challenges emerged.

An initial challenge involved my empirical focus. Even though my interviews had covered multiple hierarchal levels and various functions, they had concentrated on Robotics and only two interviews had been conducted with DriveSys. I therefore contacted DriveSys to see if additional interviews could be done to get their perspective. When this was approved and welcomed, I also began to use a tape recorder. My experience from the first two phases was that detailed notes covered accounting issues but that it was difficult to understand the technical details. Before every interview, the need for a tape recorder was explained and the interviewee was also told that he/she could stop the tape recorder at any time. During the remaining interviews, only one respondent stopped the tape recorder and this did not relate to any research issues.

A second challenge involved links to customers and parallel projects. Interviews both within Robotics and at DriveSys had shown that the supplier relationship was embedded into a structure of other projects and customer relationships. For example, in ALFA, General Motors had become a key customer which affected the relationship between Robotics and DriveSys. Another reason to extend my study with customers and parallel projects was to make a contribution within target costing. In 2004, practice studies on inter-organizational target costing had focused on supplier dyads. For example, Mouritsen et al (2001) had shown the importance of connecting inter- and intra-organizational processes, but there was no study that had included suppliers, customers and parallel projects within the same framework. Since the Industrial Network Approach particularly addressed these connections, I was reluctant to let go of this issue.

Unexpectedly, an opportunity emerged when Björn Axelsson, a marketing professor at the Stockholm School of Economics asked if I wanted to update a teaching case on Robotics. His earlier case had covered Robotics' early years during the 1970s and 1980s and I was to extend it with new empirical data on the 1990s and early 2000s. With aim of trying to "kill two birds with one stone," I therefore talked with several sales and product managers who had been involved in large automotive deals since the early 1990s. This gave me knowledge about close customer relationships, but I was also able to discuss missing pieces in relation to target costing in ALFA and DELTA.

Another opportunity that emerged during this time period was the discovery of Design-Net. During a workshop on outsourcing in close supplier relationships, I met with the CEO of Design-Net. When he heard of my thesis, he told me that Robotics was one of his customers and that they had conducted a joint product development project together. Fortunately, this was BETA, a customer project that Robotics had conducted in close co-operation with BMW, Peugeot and Renault. During my interviews, BETA had come up several times because it connected ALFA and DELTA. During the spring of 2005, interviews were therefore made both at Robotics and at Design-Net.

3.2.4 Combining and re-combining theory, method and empirics

After an exchange semester at the University of Alberta in Edmonton, Canada, the main data analysis began in the spring of 2006. Already during the process of transcribing the interviews, the risk of drowning in material became evident. To have some guidance, research literature on case study method was used (Eisenhardt 1989, Langley 1999, Dubois and Gadde 2002, Scapens 2004). As a first screening device, the target costing equation was used to pick out quotations from the raw material. From each interview, I picked out about 20-30 quotations that could be linked to target costing and the central challenge of over-engineering. Still, after having done that, more than 750 quotations and 200 pages of text were gathered.

To preserve the richness, but at the same time create some structure, the two strategies of narrative and temporal bracketing (Langley 1999) added further structure to the analysis. Starting with DELTA and drawing on product development research (e.g. Hoegl and Weinkauf 2005) I divided the project into three major phases which were called concept, development and pre-production phases. Even with three phases, the narrative from the customer, architectural and supplier sub-processes soon became overly detailed. For example, since boundaries between sub-processes were not always clear-cut, it was difficult to create a simple storyline. To cope with this, I created a table where DELTA was divided into mini-stories. The creation of mini-stories was then something that required further analysis, additional data collection and specifications within the theoretical framework. In line with Dubois and Gadde (2002), this was a tiresome and frustrating process because domino-effects often occurred when one chapter was changed.

An example of such domino effects was the decision to include the organizational level more explicitly in the thesis. Initially, the plan was to make chapter four a short background chapter and then add the three product development projects. However, when I realized that ALFA, BETA and DELTA were influenced by network dynamics in their respective time eras, it was decided to expand the scope. To complement the interviews and the other documents, I therefore analyzed all annual reports of the ABB Group between 1970 and 2008. By doing this, I was able to describe two large reorientation processes that could be related to the evolution of target costing. This was not something that was planned, but more an example how new discoveries and improvisation provided opportunities to improve the thesis further.

3.3 Methodological reflections

Having described the principles and practices and how these were combined in the research process, this final section provides some methodological reflections. More specifically, the intention of this part is to discuss how theory, method and empirical choices influenced the making of this thesis and how these choices contribute to research quality.

3.3.1 Consequences of choices

Starting with theory, the Industrial Network Approach (Håkansson and Snehota 1995, Håkansson and Waluszewski 2002) has been one of the central elements of this thesis. For example, this starting point allowed me see the lack of network studies within inter-organizational accounting and target costing and it was also influential in deciding to conduct a single case study. The benefit of such a strong link to a specific theory has been a clearer focus which has enabled me to develop an interactive and network view of target costing. On the other hand, a more open mind to the rich empirics at Robotics might have directed attention to other questions about target costing. For example, since the Industrial Network Approach focuses on horizontal processes between customers, suppliers and third parties, an alternative approach could have been to spend more effort in trying to understand how customers and suppliers were related to ownership demands and the calculation of the target profit margin (see Östman 2009 for suggestions how this can be done).

A second reflection concerns the focus of a single company, Robotics. Within network studies, this is called a *focal actor perspective* (Halinen and Törnroos 2005). Due to the complexity of delimiting time and space, this was seen as the most appropriate way to capture both micro-dynamics and network embeddedness in a target costing process. Furthermore, the focal actor perspective also enabled a rich data collection which was important for the discovery of project embeddedness. For example, few studies which interview several customers and suppliers have addressed both organizational and project levels. However, as the empirical chapters will demonstrate, I have purposefully tried to include "the other side" to avoid being too centered on Robotics. For example, comparisons with Ekman (2006) who interviewed customers (e.g. Volvo Cars) gave support to my interpretation of Robotics' customer side and since I interviewed two suppliers, getting their perspectives could be seen as an example of understanding a customer perspective.

3.3.2 Establishing trustworthiness in this thesis

One way to evaluate case studies is to reflect upon its *trustworthiness* (Lincoln and Guba 1985). More specifically, can a reader trust the methods, the empirics and its conclusions? Trustworthiness can be divided into four themes; credibility, transferability, dependability and confirmability. For each theme, there are a number of techniques which can be used to increase the level of trustworthiness.

Regarding *credibility*, a first technique is called *prolonged engagement* (Lincoln and Guba 1985). This means that the researcher can show that he/she stayed with the empirical setting for a long enough time to learn the context. In my case, data collection occurred in four phases between 2002 and 2008, and where the intense period 2002-2005 involved multiple visits to

Robotics, DriveSys and Design-Net. Another technique for achieving credibility is *member checks* which are done with individuals from the particular context (Lincoln and Guba 1985). In my case, key individuals were interviewed several times. This occurred with all three companies and at least one individual from each organization read and comment on the empirical material. Overall, these member checks made two adjustments. First, I began to use the tape recorder and I made an increased effort to include suppliers' voices in interpreting the data.

Another theme in achieving trustworthiness is *transferability* (Lincoln and Guba 1985). Transferability means how the researcher shows that the findings can be applied to other contexts. A central part of creating transferability is *thick description* (Lincoln and Guba 1985). More specifically, as proponents of single case studies have argued (e.g. Dyer and Wilkins 1991, Halinen and Törnroos 2005), thick description means that the reader feels that "they have been there" and that the level of detail is so high that the reader can transfer the knowledge to other settings. Using quotations, real pictures and calculations, I have tried to create as thick description as possible. Still, in terms of transferability, it is also important to acknowledge boundary conditions. For example, this thesis explicitly focuses on multi-technology products (Brusoni et al 2001) which is a context particularly characterized by embeddedness and incompleteness.

A third theme in achieving trustworthiness is *dependability* (Lincoln and Guba 1985) Dependability means that the researcher shows that the findings are consistent and could be repeated. A technique for achieving this is *inquiry auditing*, which means that an outsider is invited to challenge the process and outcomes of the study. An important way of challenging the findings of this thesis has been to write parallel papers and book chapters. For example, I have published one peer-reviewed article (Carlsson-Wall et al 2009), one book chapter in an international book about accounting in networks (Carlsson-Wall and Kraus 2010) and I have also written an article which have gotten "a revise and resubmit" in *Management Accounting Research* (Carlsson-Wall et al 2010). Altogether, external outsiders have thus critically examined my empirical material.

A fourth and final theme is *confirmability* (Lincoln and Guba 1985). The central issue here is to ensure that the findings are shaped by the respondents and not the bias of the researcher. Two common techniques for achieving this are *audit trail* and *triangulation*. Audit trail means that the researcher clearly shows how he/she has conducted the study. In this thesis, I have tried to do this by first describing the principles and practices and then describing the research process. Triangulation refers to the use of multiple data sources. As was described, this thesis builds on 99 interviews combined with several days of direct observation and archive studies. Still, since *reflexivity* is a third technique for achieving confirmability, it is important to highlight that triangulation does not always lead to clarity. As Dubois and Gadde (2002) write, triangulation can also lead to new discoveries. In my case, a number of adjustments were made during the research process. For example, focus shifted from the organizational level to the project level, the Industrial Network Approach was complemented with product development theories from strategic management and the empirical scope was extended with customers and parallel projects. Even though there are many differences, my research process therefore has similarities to the development of multi-technology products. They are both development processes which depend on the interaction with a few important counterparts and where the combination of planning and improvisation drive the development forward.

4 Organizational dynamics and the evolution of target costing at ABB Robotics

Chapter four begins the empirical part of this thesis. As figure 4.1 shows, the central theme is to describe organizational dynamics and the long-term evolution of target costing. More specifically, focusing on tensions between customers, owners and suppliers, chapter four describes how target costing evolution is related to two large re-orientation processes. Having focused on the organizational level, chapters 5-7 then describe the micro-processes of target costing on a project level. Together with the skeleton framework developed in chapter two, these empirical chapters lay the foundation for extending target costing in time and space.

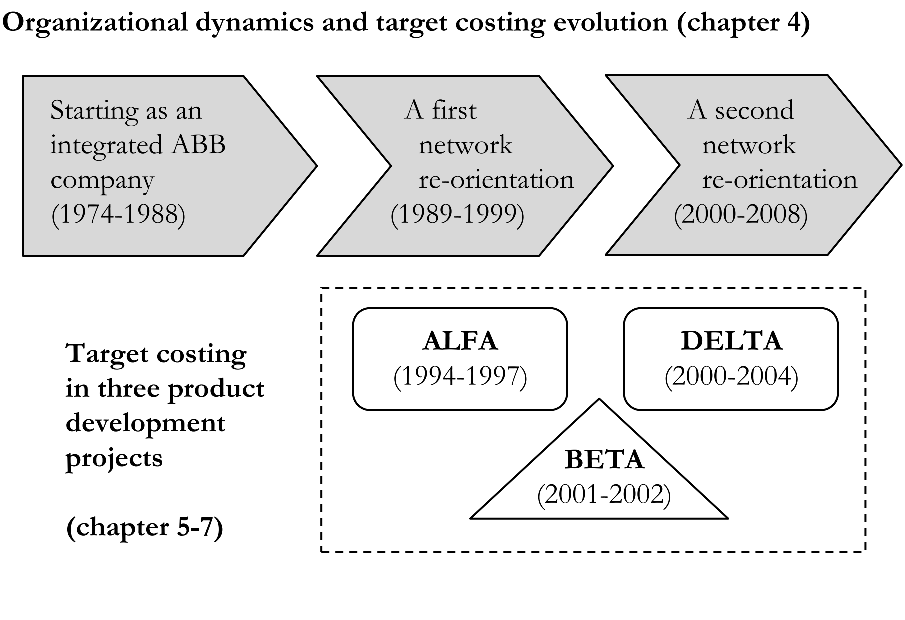

Figure 4.1: ABB Robotics' history in three phases between 1974-2008

4.1 An integrated ABB company (1974-1988)

> The construction of the robot was a white paper. It became an electrical robot with one of Sweden's first microprocessors. The challenge was to present a prototype to ABB's board 10 months after the start.
>
> Björn Weichbrodt, former CEO of ABB Robotics[12]

As Weichbrodt explains, transforming an immature robot technology into concrete products became Robotics' main challenge during the 1970s and 1980s. Driven by a strong entrepreneurial culture, this process was characterized by learning and discovery. For example, drawing on ABB's[13] corporate competence within electrical engineering, Robotics developed the first computer-driven robot in the world in 1974. Together with other technical innovations, Robotics became the largest robot company in Europe. Robotics' first period can be summarized as *"from an idea to an integrated ABB company."*

4.1.1 Drawing on ABB core competences

As with many ideas, Robotics was never meant to be. In 1969, ABB had invested in their first robots and Curt Nicolin, the Group CEO, saw a potential in reducing costs and improving working conditions. In fact, ABB had become one of the first Swedish companies to use robots. After initial experiments, the interest increased and ABB began to investigate if they could become the Scandinavian partner for the American robot supplier Unimation.

[12] This quote is taken from the book, "Människans förlängda arm – en bok om industrirobotens historia" (Westerlund, 2000, p.4) (in English, "The Extended Arm of Man. A history of the industrial robot").

[13] Up to 1987, ABB was two companies, the Swedish company ASEA and the Swiss company Brown Boveri. In this thesis, ABB is used, regardless if it is prior to 1987 or not.

However, even though Unimation[14] was interested in international expansion, they chose a partnership with Electrolux, another large Swedish manufacturing company. Having lost the Scandinavian license, ABB therefore decided to start their own robot business. Reporting directly to Curt Nicolin, the project manager Björn Weichbrodt was allowed to handpick 18 engineers, and given a large development budget.

Based on ABB's strength in electrical engineering the project group developed a prototype in less than a year. By letting the robot be driven electronically, the functionality was improved in several ways. For example, the robot became more accurate and easier to re-program. At this time a large risk was the micro computers. Computer technology was still immature and ABB was anxious if the small American supplier would survive. Today, we know the answer. The supplier was Intel, the largest micro processor company in the world in 2011. Robotics was one of Intel's first customers.

After developing the first robot in 1974, production became the next challenge. Robotics had neither the machinery nor the production knowledge. The project team visited several ABB factories, but few opportunities emerged since most factories were built around high volume products. Instead, production was placed at ABB's central electronics department. Keeping product development resources within the ABB Group was also the corporate strategy during the 1970s and 1980s. To finance large R&D investments, an ABB standard was developed and integrated into different products. For example, up to the late 1980s, drives, steering systems and cables were developed and manufactured by other ABB companies. This corporate policy created both opportunities and problems. On the one hand, Robotics got access to a large pool of knowledge and resources. For example, many components were often more sophisticated than could be purchased from external suppliers. On the other hand, being a small unit,

---

[14] In the early 1970s, the American robot company Unimation had become the largest robot company in the world. With General Motors as a large customer, Unimation began an international expansion in the late 1960s. During the 1970s, ABB, Volvo and other Swedish companies purchased Unimation robots.

Robotics' needs were not always prioritized. Over time, this created a situation where many ABB components became too expensive or did not include the functionality needed for robots. Towards the end of the 1980s, a gradual shift towards outsourcing to local Swedish suppliers therefore began.

4.1.2 The first customer – Magnusson in Genarp

In 1974, initial plans were to sell to large Swedish companies. Similar to the ABB Group, Robotics estimated a growing need for production improvements and creating a healthier working environment. Unexpectedly, a small, family-owned company in southern Sweden became the first customer.[15] As figure 4.2 shows, Magnusson in Genarp had experienced problems with the dirty working environment caused by the grinding and polishing of pipes.

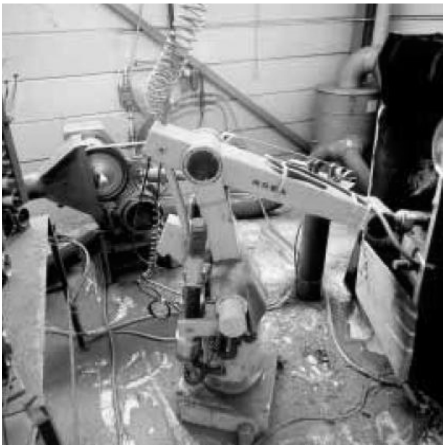

Figure 4.2: An ABB robot at Magnusson in Genarp, the first customer

[15] There had been some early attempts within ABB. However, Magnusson in Genarp was the first customer outside ABB.

Despite initial problems, Magnusson in Genarp became an important reference customer. For example, new customers often visited Magnusson and in 1975, Magnusson in Genarp became the first factory in the world to use robots 24 hours a day, 7 days a week. Describing the relationship with Robotics, Vivianne Jönsson says:

> The ABB personal were very service minded. They came as fast as we called them. On the other hand, we taught them about grinding and polishing. I mean, they did not know our needs. In the beginning, I also remember how our kids were a bit disappointed because they had thought the robot would be like a Walt Disney movie. At times, we therefore dressed the robot with both a hat and an apron.

In the early 1980s, sales efforts intensified. To increase volumes, Robotics began to target customers outside Sweden and specific robot centers were established in countries such as Germany, UK, France, US, Italy and Japan. By teaching customers about robot production, the goal was to become the leading robot company in Europe. The robot centers also took the first steps towards systems integration. By having a cross-functional team, more complex problems could be handled. As Björn Weichbrodt said in an interview in *The Industrial Robot* in June 1981:[16]

> To sell a robot is invariably a question of solving a customer's problem, so we are setting up a number of robot centers in the key industrial centers of the world in order to improve the quality of our service to our customers and enhance the use of ASEA industrial robots in industry. (p.92)

However, despite early attempts towards systems integration, the first period was characterized by selling single products to smaller customers. Except for Magnusson in Genarp, pilot tests were carried out with the Swedish Foundry Association. For example, robots were ordered by Kockums

---

[16] Articles from the *The Industrial Robot* are placed under "anonomous" in the reference list.

in southern Sweden and the Oxelösund Iron Mill, 130 km south of Stockholm. A main reason Robotics attracted non-automotive customers was the computer drive technology. By having a more sophisticated technology, ABB robots could be used for more precise activities such as arc welding, grinding and fettling. On the other hand, in contrast to robot manufacturers such as Unimation and Electrolux, the robots became more expensive and could carry less work load. As a consequence, the ABB robots were less popular among automotive customers who used robots for spot welding and material handling, two applications requiring robustness and a low cost per robot.

4.1.3 Cost cutting and new directions

In 1974, the ambition had been to create a large and fast-growing business unit. The ABB Group was actively searching for new opportunities and early robot experiments had turned out successfully. However, Robotics remained a small unit during the 1970s. It was placed in the Industry and Transportation division and it was not until 1977 that Robotics was publically featured in the ABB annual report. In many ways, the first decade was financially disappointing. Sales had not gone as planned and Robotics had not become a growth business.

In 1980, Percy Barnevik became the Group CEO of ABB. Having a corporate agenda of decentralization, he made Robotics a separate division and gave the company new resources. Estimating a high growth, Mr. Barnevik told *The Industrial Robot* in September 1981:

> ASEA is enthusiastic about robots for the good reason that it is one of the major growth areas within its sphere of competence; the robot market is expected to grow 30-35% overall per year for several years to come. (p.158)

During the early 1980s, sales growth also increased considerably. Robotics expanded internationally and acquired Electrolux's robot division and the Norwegian robot company Trallfa. In fact, growth was so high that a new organization was needed in 1985. Focusing on different application areas, profit centers were created for arc welding, spot welding, material handling, control systems and assembly systems. Driven by an entrepreneurial and decentralized culture, the goal was to increase growth even further.

In 1986-87 the economic climate changed. When customers drastically reduced their orders it became evident that the international expansion had gone too far. As an experienced Robotics manager summarized it "I guess it was time to sober up a little bit." Besides leaving Japan and reducing operations in North America, Robotics sold off the Electrolux robot division. The global ambitions had not succeeded and focus shifted back towards Europe. Other robot companies also faced financial problems. Similar to Robotics, they had also underestimated the growth in 1981-82 and then invested too much in 1984-85. For example, GMF Robotics, the largest robot company in the world, had to drastically reduce their North American operations. As *The Industrial Robot* wrote in September 1986:

> GMF Robotics, the jewel in the US robot industry crown, is beginning to lose its luster. The company is laying off 200 of its workers – nearly one third of its 690 strong payroll. (p.136)

4.2 A first network re-orientation (1989-1999)

> After the market expansion in the 1980s came the development towards systems integration… The ambition was there all the time, but the biggest development occurred during the 1990s.
>
> Björn Weichbrodt, former CEO of ABB Robotics (p.4)

Systems integration emerged as a main challenge during the late 1980s and early 1990s. Rather than selling single robots, automotive customers wanted help to solve complex problems. Often, the sales process could go on for years and then a big order had to be executed within months. To handle this unpredictable process, close relationships were needed with both customers and suppliers. Robotics' second period can be summarized as, "*from ABB integration towards networks.*"

4.2.1 Growing to be an ABB star

After the financial crisis, focus shifted towards automotive customers. Analyzing how Toyota and Nissan had used robots to modernize their factories, it was estimated that European and North American automotive companies would increase investments in robot production. However, because of the low prices offered by automotive companies, Robotics needed to cut costs. In the early 1990s, Robotics' biggest cost program was called P25 because the goal was to reduce product cost by 25%. As one Robotics manager says:

> Yes, that's when the big cost-hunt started, the P25 program. The background was that Stelio [CEO of Robotics in the early 1990s] saw the market development. I remember he had a favorite picture with the price development in the different parts of the world. He concluded that prices would be harmonized and that we had to cut costs by 25% to stay competitive.

Initially P25 was met with frustration since Robotics had not prioritized cost-consciousness. However, soon the product development department realized old ideas had to be re-evaluated. Describing the shift towards "best value" a Robotics manager remembers:

> You could notice we were an independent unit. Before, there was an ABB standard, but now it wasn't mandatory anymore. Now, the question became, is this good enough for us? It happened many times during P25.

A central part of P25 was the introduction of target costing. Since prices were so low, it was seen as important to involve customers more intensively. Similar to other empirical descriptions of target costing (e.g. Mouritsen et al 2001, Hansen and Jönsson 2005), target costing was less structured. Customer prices were linked to robot functionality and supplier costs, but the process of reaching the target cost was more informal and ad-hoc. Still, despite initial hesitation, the focus on costs paid off. During the early 1990s product costs were reduced by more than 20% and cost programs became the norm within Robotics. For example, P25 was followed by "Focus 30."

This way, target costing in individual projects was linked to an overall ambition to increase cost consciousness, both among employees and suppliers.

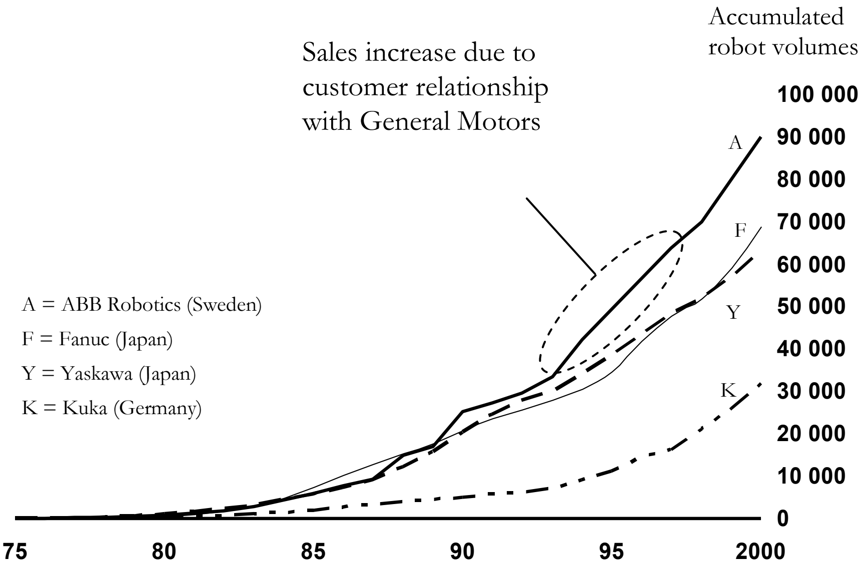

Figure 4.3: The largest robot manufacturers in the world and the accumulated number or robots sold between 1974 and 2000

As figure 4.3 shows, the success with cost reductiosn also had a positive impact on growth. In the late 1980s, Robotics had an installed base of 20,000 robots. Together with Fanuc and Yaskawa,[17] Robotics was one of the largest robot manufacturers in the world. Ten years later, Robotics had taken a clear lead and more than 90,000 robots had been sold. A main reason was the relationship with General Motors. By signing a large frame

[17] Fanuc and Yaskawa are Japanese while Kuka is German. During the 1990s, Fanuc and Yaskawa was strong in Japan and in North America, while Kuka became a strong systems integrator for Europan automotive customers.

contract in 1994 and then developing robot systems interactively, Robotics managed to increase sales considerably more than Fanuc and Yaskawa.

4.2.2 The largest customer – General Motors

In 1989, Robotics had a strong customer base in Europe but limited presence in North America. To reach annual volumes of 1000 robots, close relationships with General Motors, Ford and Chrysler became prioritized. This new focus required both organizational and technical changes. For example, organizationally, cross-functional teams were formed and placed geographically close to customers. This was necessary because the sales process changed and discussions about "the next big project" could go on for months or even years. Having insiders on multiple levels therefore became a critical strategy.

Technically, the product portfolio also acquired a different focus. For example, a new generation of large robots was developed. Focusing on spot welding the robot was developed in close cooperation with automotive customers. By having a modular concept, the new robots allowed large degrees of customization. Another technical change could be seen in the new generation of Industrial Control Systems (ALFA, chapter 5). With stronger computers, communication between robots and factory equipment was drastically improved. In fact, some Robotics engineers claimed the technical improvements in ALFA could be compared with the first revolutionary robot in 1974.

However, despite organizational and technical changes, developing customer relationships took time. A main reason was that General Motors, Ford and Chrysler already had close relationships with Japanese robot manufacturers. To gain access, Robotics therefore acquired Cincinnati Milacron, the largest American robot manufacturer in 1991. In October 1994 this paid off when Robotics won a multi-year frame contract with General Motors. It included a minimum of more than 1000 robots. In fact the order was so large that engineers back in Sweden thought it was too large. They feared other customers would suffer. As one sales manager remembers:

> I remember I had called a meeting here in the house. We had some problems to get the engineers motivated…It was so big. We appealed to their… how can I put it… co-operation in this. We need something special, but this is what we can win. It worked.

Even though General Motors contributed with growth, the relationship *did* consume large resources. For example, Robotics agreed to do many adaptations, and between 1995 and 1999 customer deals were lost to both Chrysler and Ford. Suppliers were also affected by the General Motors business since improvisation was required to handle the many unexpected events.

4.2.3 Outsourcing to Swedish suppliers

In 1989, Robotics developed most components within ABB. Ten years later the situation had drastically changed. The process started with P25, but grew over time. Continuous learning played an important part. As one Robotics engineer describes:

> I guess we changed our mentality a little bit after the initial success with P25. Cost savings were so large, sometimes cost were reduced by 40-50%.

To illustrate the change, the relationship with DriveSys serves as an example. During the early 1990s, Robotics had started to question the internal supplier, ABB Drives. Prices were too high and Robotics felt ABB Drives prioritized other customers. To reach the cost-reduction goals in P25, new alternatives were explored. Except for cost benefits and specialized competence, a Robotics manager recalls the different attitude from DriveSys:

> The treatment we got from DriveSys was quite different. Nothing was impossible. The customer-supplier relationship became much clearer compared to ABB Drives. I remember once in P25 when we needed additional cost reductions. The ABB Drives engineer just looked at us and said "guys, get real, we made your first cost goal, now you'll have to settle for this."

Cost reductions were primarily addressed in product development projects. For example, when DriveSys became a new supplier in 1991-92, a small development project was started. Except for minor adaptations within the Industrial Control System, development concentrated on new large robot generation. However, despite the joint focus, unexpected problems occurred in the summer of 1992. Just before launch, the drives would not work. Intense testing began, involving engineers from both companies. Still, the problem could not be solved. Finally, after much effort, the problem was identified to one of DriveSys's sub-suppliers. A small component had poor quality and this had caused a domino effect affecting several suppliers and sub-suppliers.

Even though DriveSys was responsible for the quality problem, the joint problem-solving created a stronger bond. Robotics appreciated DriveSys's dedication and also realized they had underestimated quality demands from large automotive customers. As a result, DriveSys was given an increased responsibility in ALFA, the following platform project.

4.3 A second network re-orientation (2000-2008)

> We now have a situation where industrial robots have become a large global industry, seen by many as mature, but where we still have the majority of development and expansion in front of us.
>
> Björn Weichbrodt, former CEO of ABB Robotics (p.4)

For Robotics, living in two worlds has been the main challenge during the 2000s. On the one hand, old automotive customers have continued to purchase large volumes. Being experienced users, they have been important to product development efforts. On the other hand, major growth has come from elsewhere. Global companies such as Foxconn, IKEA and US Postal Service have become new customers. Handling this increased customer heterogeneity characterizes Robotics' third phase.

4.3.1 The future customers – General Motors and/or Foxconn?

In 1999, a new group of customers had emerged, "the Potentials." Describing the Asian electronic producer Foxconn, a Robotics project manager says:

> Foxconn builds Ericsson, Nokia and Samsung. They build IPods, they build laptops. They have over a half million employees. They can have 200,000 employees in one factory. In one factory! I mean, that is twice the size of Västerås. They need robots. There we have a large future customer.

In contrast to automotive customers, "Potentials" had limited experience of using robots. However, compared to Magnusson in Genarp, "Potentials" were much bigger and required a lot more resources. Prioritizing "Potentials" therefore had to be done without sacrificing automotive customers.

Similar to the first re-orientation ten years earlier, product development became an engine for change. For example as figure 4.4 shows, the VEGA program that was launched in 1999 included product development projects for robots, Industrial Control Systems and software. Since Robotics had limited experience and knowledge of software development, a partnership was formed with Prosolvia, a Swedish IT start-up. Because of the growth predictions the venture quickly took off and in 2000 a new division was formed in Gothenburg. Describing the new direction towards software and "intelligent solutions", a product manager says:

> We realized we could not develop the cheapest robots. We had to differentiate. That was the time era, in all of ABB… we sold out because he goal was to have a lot of kronor per kilo. CDs were worth more than trains and generators. ABB sold out everything that was heavy. We kept the robots but should complement them with IT. That was the way for ABB, for all of Sweden, for all of the world at that time.

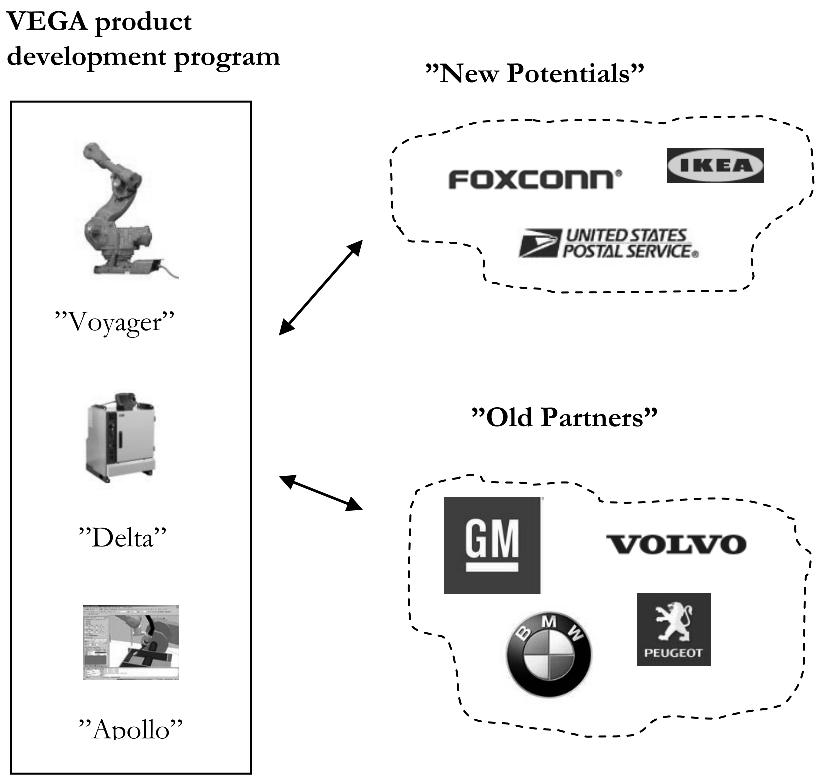

Figure 4.4: The VEGA Program and key customers

However, in early 2001 focus started to change. It began with a potential order from BMW who wanted to customize the old ALFA generation. This created some stir. The sales department wanted the BMW deal, while the product development department wanted to prioritize the ongoing DELTA project. During the summer, tensions increased when Renault and Peugeot also wanted customizations. At this point, the New Economy had begun to fade. To secure sales, it was therefore decided to start BETA (chapter 6). The goal was to make a customized product for automotive customers and then let DELTA (chapter 7) become the future product. During the autumn it also became obvious that the New Economy would not meet expectations. Robotics' expansion had gone too quickly. To avoid large losses, the software project Apollo was closed down and critical functionality was moved to parallel projects such as DELTA.

Between 2002 and 2005, automotive customers regained their priority and product development started to focus on cost. Instead of 15,000 robots per year, Robotics downsized to an organization formed for 10,000 robots per year. During this period, formalization also increased. For example, to facilitate customer prioritization "a gold list" was created where General Motors, BMW, Volvo, Peugeot and Renault became the first members. Robotics also re-organized product development activities. A product management unit was formed and an internal purchaser-deliverer system was created where product management owned the development budget and three smaller development departments sold their time. The increased level of formalization could also be seen in target costing. During ALFA, Robotics had experienced problems with ad-hoc solutions. With limited guidelines, key activities were forgotten and it was difficult to transfer knowledge to new project managers. Instead of "family" relationships, a time of "professionalism" began in DELTA.

Geographically, Asia emerged as the new growth region during the third phase. The situation was similar to North America in the early 1990s. Customers such as Foxconn were rapidly growing and the key challenge for Robotics was to combine sales with resources to ensure quality and support. As one salesman said in 2004:

> It's boiling over there. Our challenge in China is similar to the one we had when we jumped on board the automotive industry in the USA. To make sure we have the capacity to support our installations, so the market doesn't become dissatisfied. If that happens, success disappears quickly. Right now, that's our biggest problem over there.

Foxconn can serve as an example of an Asian "Potential." In 2000, the company had a turnover of 2.8 billion dollars. Five years later, the company had grown to an annual turnover of 28 billion dollars. Focusing on low-cost outsourcing, Nokia, Apple and Motorola had become key customers. This growth also created production challenges for Foxconn. If Apple changed forecasts, increased production capacity was needed overnight. Robot software therefore emerged as a key solution to increase flexibility. By using off-line simulation, new robot cells were up in hours. Even though Apollo had been closed down, ideas therefore lived on and created new growth opportunities for Robotics.

4.3.2 Outsourcing to global suppliers

> From a technical standpoint, the electronics industry has made a giant leap since 1996. This is mainly because of the volume boost in personal computers, Internet and the cellular phone area. Prices have dropped, performance has increased and new features are available. This is something we must utilize to stay competitive.
>
> Market requirement specification 2001.

The cost of electronics fell drastically from the mid 1990s. To reap the benefits, Robotics gradually changed its product development focus. Instead of close cooperation with smaller suppliers, it became more cost efficient to adapt to global supplier giants. Explaining the logic, a Robotics manager says:

> We want suppliers to have other customers as well. We cannot afford to pay the entire development cost ourselves. Instead, we try to identify suppliers where we can "ride the wave."

The logic of "riding the wave" is closely related to path dependency (Håkansson and Waluszewski 2002). Initially, a component is costly and not robust. However, relatively soon the cost of a component falls when global customers use it in large volumes. From a target costing perspective, a main challenge is then to estimate when a technology is robust enough to be integrated into the robot system. Describing the complexity of timing the waves a senior engineer says:

> Computer memories are a typical example. When we changed to a standard PC, we had a feeling that memories were here [points to curve] and we even wrote a report about it. So we had a feeling… but we did not pay enough attention to it. When we were done with the re-design, the computer memories were definitely down here so we lost some money… but it is not easy. At what pace does something like this move? It is difficult!

Another challenge with global suppliers was prioritization, that Robotics was only a minor customer. As the project manager for DELTA described a situation in the pre-production phase:

> The biggest problem right now is our suppliers. Many don't deliver prototype material on time. One reason could be that we are late with drawings, but I think we have improved. Rather, problems occur because they [suppliers] are high-volume manufacturers. It is difficult to get our prototypes into their production. Especially if there are components they need to order long in advance.

Despite tensions, global "ride the waves" suppliers increased during the 2000s. Formal standards became the norm and this spilled over to local Swedish suppliers. Instead of discussing the technical content, purchasers increased their influence. This created new problems. For example, during DELTA, Robotics and DriveSys experienced a major crisis. Finding combinations between formality and informality proved difficult. There were always new needs coming up.

4.3.3 Cost cutting and new directions

In 1999, the VEGA program was one of the largest investments ever made at Robotics. Being part of the New Economy software and IT had become a strategic goal and growth predictions were enormous. For example, Anders Narvinger, CEO of ABB Sweden wrote in the annual report of 1999:

> The new ABB is a knowledge intensive company. We deliver products, systems and turnkey solutions in close cooperation with the customer. The

> transformation to the new ABB is driven by expansions in growth areas such as Industrial IT, services and maintenance. (p.2)

Only a few years later a new business climate emerged. "Potentials" delayed investments and it became important for Robotics to secure sales from automotive customers. At the same time, the ABB Group also experienced problems. Besides a large asbestos law suit in the USA, bonus programs were also highly criticized. Instead of getting corporate support, Robotics had to go through a number of cost-cutting programs during 2002-2004.

However, in 2005-2006, the ABB Group re-organized its divisional structure. After the New Economy, focus was once again on growth. Still, with limited sales from automotive customers, Robotics found it difficult to remain an ABB star. Commenting on the annual report of 2007, the Swedish newspaper *NyTeknik* wrote:[18]

> For ABB Robotics, the past year has been shakier. The robot division has their largest customers within the automotive industry and the American manufacturers are showing negative results. At the same time, it is difficult to find new markets; smaller industries only purchase single robots, if they buy at all. Often, qualified employees are missing to run the robots.

Problems continued during 2008. Without large volume orders, it became difficult to sustain the organization. In December, Robotics therefore laid off 150 of its 800 employees. The company that had been the star within ABB in 1999 had now, almost ten years later become one of the worst performing business units within the entire ABB group.

[18] NyTeknik, 14 February 2008.

4.4 Concluding discussion

4.4.1 Organizational dynamics: two major re-orientations

Focusing on customers, owners and suppliers, the three elements in the target costing equation, this chapter has outlined Robotics' history in three major phases and two re-orientations. During the first phase between 1974 and 1988, Robotics went from an idea to a growing company. Having a new technology, product development focused on developing concrete products. Customer interaction focused on learning and showing the financial value of robots while resources came from internal ABB companies. For example, a main motive behind the first robot in 1974 was ABB's corporate core competence within electronics. Rather than focusing on hydraulic drives, the dominating technology at that time, Robotics developed a new, revolutionary concept based on micro-computers. From a ownership perspective, this period started with dreams but ended with crisis. Despite innovative products, sales did not go as planned. In the mid 1980s, patience had run out and *a first period of re-orientation* began.

During the second phase between 1989 and 1999, the gradual shift from an internal hierarchy towards external network structures became stronger. Large automotive customers wanted systems integration, and together with a demand for lower prices this initiated an outsourcing trend. Discussions concerning core competence gained prominence and internal ABB companies were replaced with local Swedish suppliers such as DriveSys. Financially, performance improved during this period. With large automotive orders, Robotics became the biggest robot manufacturer in the world. It was also during this phase target costing was introduced. By increasing cost awareness and linking target costing with company wide cost cutting programs such as P25 and Focus 30, profitability increased and Robotics became an ABB star. From an ownership perspective, dreams from the 1970s started to come true.

Despite the progress, *a second re-direction* began in the 2000s. With large price reductions, it became important to expand robot technology to new customer groups. Rather than focusing on automotive customers, Foxconn, IKEA and US Postal Service emerged as future growth customers. During this period, software also became more important. Instead of selling products or systems, "intelligent functionality" became the name of the game. For example, to reduce customers' total cost of ownership, Robotics invested heavily in simulation and diagnostic software. However, what seemed like an ocean of opportunities has not materialized. Despite the ambition to reduce dependence, automotive customers are still critical. Robotics therefore faces similar challenges as 1988. As of now in early 2011, sales have began to increase, but it seems too early to tell if Robotics has entered a new era of growth as was the case in the early 1990s.

4.4.2 Target costing evolution over time

Based on the organizational dynamics described in this chapter, we can now begin to say something about target costing evolution. First, regarding the introduction of target costing, there are similarities with both survey studies (Tani et al 1994, Dekker and Smidt 2003, Ax et al 2008) and case studies (Nixon 1998, Mouritsen et al 2001). A central theme in survey studies is that target costing is introduced when competition increases. For example, this has been shown in Japanese (Tani et al 1994), Dutch (Dekker and Smidt 2003) and Swedish (Ax et al 2008) contexts. Looking at Robotics, target costing was introduced when large automotive customers became more important. This can be seen as more competition, because all major robot manufacturers needed large volumes from automotive customers to finance their R&D investments. Furthermore, prices were drastically reduced and the technological requirements from automotive customers were also higher compared to smaller non-automotive customers.

Similarities can also be found with case studies. For example, both Nixon (1998) and Mouritsen et al (2001) describe how target costing is introduced when closer relationships are needed. In the first re-orientation, the introduction of target costing was linked to the development of *both* closer customer and supplier relationships. For example, large automotive customers seem to have triggered the adoption of target costing but it was also important to use target costing in relation to suppliers such as DriveSys. The concept of network embeddedness (Håkansson and Snehota 1995, Uzzi 1997) therefore shows that “increased competition” can be linked to the introduction of target costing, but that this occurs in specific and concrete customer and supplier relationships.

Having discussed the introduction of target costing, it is also interesting to note how target costing evolves over time. In ALFA, target costing was not as detailed and formalized. This informality is in line with target costing practice studies that have criticized “textbook” target costing (Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009). However, in DELTA, target costing became more formalized. Instead of applying a “family” logic, interviewees argued that Robotics needed to get “more professional.” This argument aligns with Cooper and Slagmulder (1997) who describe target costing as a detailed and disciplined cost management process.

Since few studies have focused on target costing evolution, it might be that disagreement regarding formalization is connected with learning. For example, it seems reasonable to think that companies which start with target costing do not adopt a detailed and formal approach at once. In this case, Robotics introduced a less detailed approach emphasizing the “family logic”. Similar results have also been found in the studies of CCM Ltd (Nixon 1998), NewTech (Mouritsen et al 2001) and Volvo Cars (Hansen and Jönsson 2005). On the other hand, it also seems reasonable that companies with target costing experience try to learn and fill in missing pieces. For example, studying large Japanese companies such as Toyota, Nissan and Olympics (Cooper and Slagmulder 1997), it is not surprising that the Japanese use a more detailed and disciplined approached. For example, similar to Robotics in their DELTA case, they have used target costing for some time and, being a large company it might also be easier to control suppliers in a formalized way. This last issue is interesting, because as DELTA will show, becoming “more professional” can easily create tensions resulting in larger crises. Having described organizational dynamics and the evolution of target costing, it is now time to turn to ALFA, the first project.

5 ALFA – the first attempts at target costing

In chapter five, the main goal is to describe the initial attempts at target costing. Coming from an entrepreneurial culture, target costing was adopted on a general level, but details were handled more informally or in a "family-style." Rather than emphasizing follow-up and discipline, target costing was used to reflect upon costs and discuss technical solutions. As figure 5.1 shows, ALFA was the first platform projects to use target costing. ALFA will therefore be used to give more detail within the first network re-orientation and how Robotics went from a vertically integrated company to focusing more on close customer and supplier relationships.

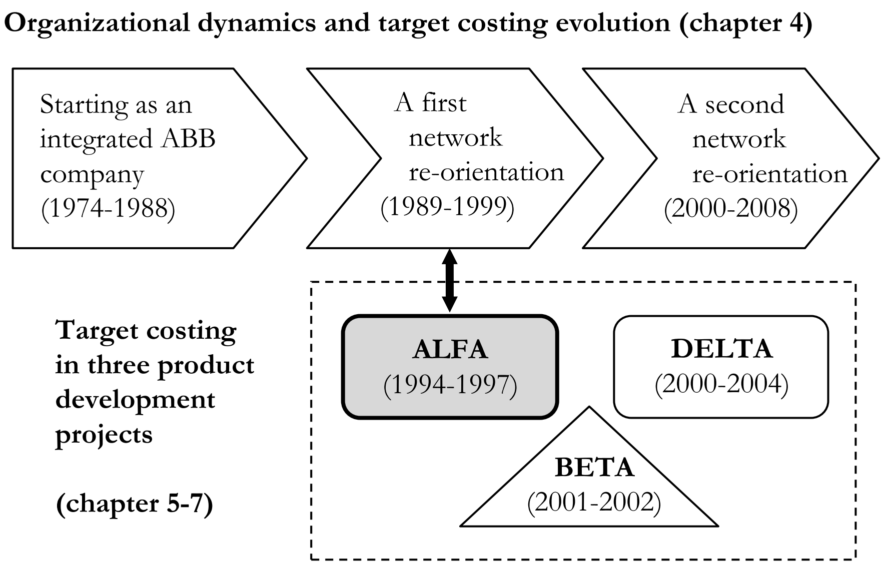

Figure 5.1: ALFA – the first attempts at target costing

5.1 Target costing during the concept phase

5.1.1 Challenges in handling large automotive customers

The first idea of forming ALFA began in the early 1990s. With large automotive orders, a new generation of Industrial Control System was needed. However, listening to customers proved to be more difficult than expected. As one senior engineer says:

> It is quite difficult to specify when you make a large technical improvement. A customer… when we asked them what they wanted they only told us what they needed right then. These could be very detailed demands. I am not sure how much it added to listen to customers. They could not imagine the large technical improvements we thought of. How could we then get them specified?

Even if it was difficult to interpret what customers wanted, a general trend that guided the target costing process was automotive customers' desire for systems integration. A robot system was not a single unit anymore. From a technical perspective, this meant that the product needed more functionality and that technical solutions needed to be more flexible. Systems integration also gave a depth to the customer relationships. With increased integration, people from different functions and geographical locations had to get involved and co-operate. With constantly evolving requirements, customer-driven target costing focused on understanding future robot uses. Instead of quantitative surveys, this was done in a qualitative manner. Project members in ALFA discussed robot use with customers' engineers and Robotics own sales staff around the world. During these talks, "customer hang-ups" were identified. For example, it became evident that some automotive customers wanted a smaller Industrial Control System. From a technical perspective, the project team could not understand this. Automotive customers often placed the Industrial Control Systems on shelves and they also had additional space on the factory floor.

However, after interacting with more customers it became obvious that decreasing the size or what was called "the footprint" was an important demand made by many different customers. Describing the complexity of both identifying and prioritizing "customer hang-ups," the project manager says:

> The key is to understand the problem and how they prioritize. It is really difficult to just go on what they write. They write a solution. You have to be out there and understand… how do they conduct their maintenance? How do they work in the factory? So you can try to find a solution to the basic problem and not the specified solution.

Another central issue identified in customer-driven target costing was improved quality. During 1991-92, Robotics had experienced problems with large automotive customers. Quality demands were much tougher when hundred robots were connected in systems integration solutions. As a sales manager describes the problems:

> There is a big difference between having one robot or 500 in a row. That is when you start noticing quality problems. A robot can break down every second or every third year and you still feel it is OK. But if you place them in a long row and one breaks down every day, then you start thinking "what the hell is this?"

A third challenge in customer-driven target costing was to cope with tensions between key customers. In ALFA, an example involved the ventilation functionality. From a quality perspective, ventilation is critical. With limited air flow, the Industrial Control System gets too warm and shuts down. However, a shut down can also happen if ventilation is too open because dirt comes into the Industrial Control System. It is therefore a trade-off between coolness and cleanness. To get a second opinion, the project team consulted two trusted automotive customers. Surprisingly, they wanted opposite solutions. One wanted to prioritize the restricted ventilation, while the other preferred a more open solution. Instead of clarity, the project team became increasingly confused.

Initially, customer-driven target costing therefore relied on a few general guidelines. According to the project manager of ALFA, focus was more on directing cost reduction than reaching a "scientifically specified goal." Having an entrepreneurial culture within Robotics, it was seen as important for ALFA to increase cost consciousness and get engineers to think in commercial terms.

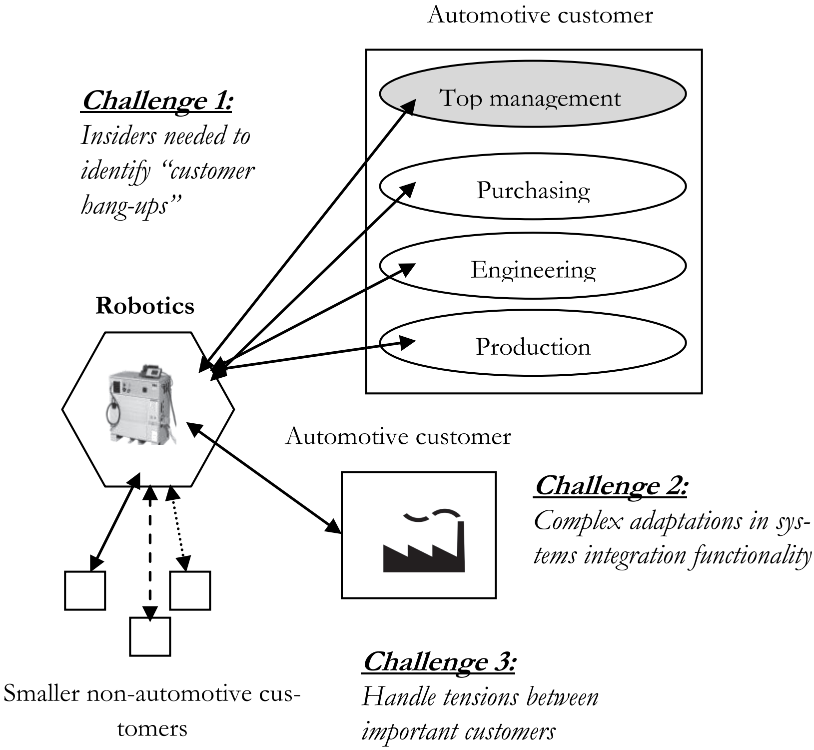

Figure 5.2: Three challenges in customer-driven target costing

Figure 5.2 illustrates three challenges in customer-driven target costing. At first, there is a need to have insiders on multiple levels to understand what the customer "really wants" and interpret if the customer is truly committed to a function or if it is only a certain individual within the customer organization that wants it. Secondly, systems integration poses a challenge because complex adaptations are needed. Not only is the customer buying a product, the product is also used in combination with other investments. From a target costing perspective, it is therefore important to understand how customers will use the functionality. Finally, a third challenge is to handle tensions between key customers. As the illustration with ventilation showed, it can be difficult to prioritize, especially during the concept phase when there is no technical prototype to provide guidance.

Having described challenges of customer-driven target costing, we now move on to architectural-level target costing and challenges related to a delay in a parallel project.

5.1.2 A parallel project makes functional analysis difficult

> Yes, finally you need to restart with a white paper. That is what we did with S4. Our software had become ten times bigger than it was designed for in the 1980s. It was written for the type of computers that existed ten years earlier. No one in their wildest dreams could imagine how much computer power you would get for that money ten years later. I mean, no one has done anything wrong, right?
>
> Robotics senior engineer

As the senior engineer describes, transitions between product generations can be more complex than expected. When Robotics realized that systems integration required much stronger computers, a large technical pre-study was initiated. Relatively early it became evident ALFA could not be handled in one project. As figure 5.3 shows, ALFA was therefore divided into two projects. Software was put in the project called S4 and the hardware was placed in ALFA. Describing the large step between S3 and S4, a senior engineer says:

> …this project [S4] wasn't at all successful, because the jump from S3 became so large. All the concepts were new and our entire organization was

totally taken by surprised, even though there were many small warning flags… we thought we had the experience.[19]

The problems in S4 affected architectural-level target costing in ALFA. Resources were moved and it became difficult to conduct functional analysis and value engineering when technical solutions had not been frozen in S4.

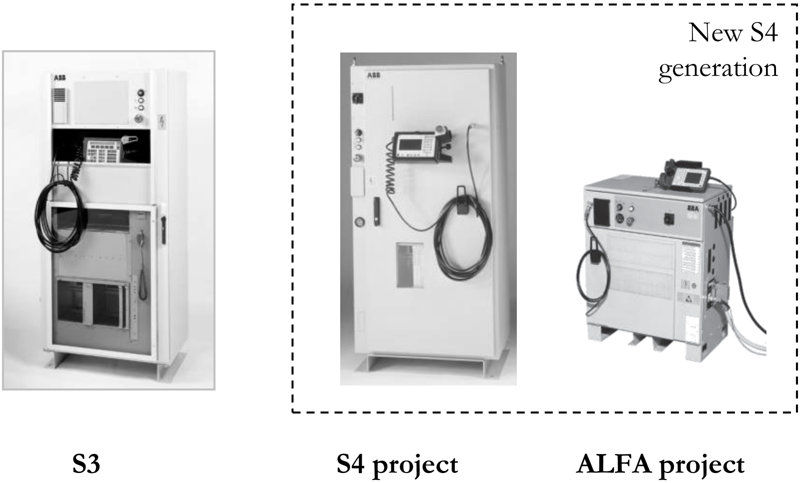

Figure 5.3: Migration from the old S3 generation to the new S4 generation

Figure 5.3 also illustrates another technical challenge in ALFA – at the same time as ALFA needed more functionality, the size of the cabinet needed to be reduced by 40% and go from 180 cm to 110 cm in height. What seemed like a promising start had therefore become a nightmare. S4 was late and ALFA did not have a clear solution for reducing the size.

[19]Even though S4 was delayed and cost more than budgeted, the technical advancements were extremely high. In that sense, the S4 generation had a long life-span, which made it one of the most important products in ABB Robotics' history.

5.1.3 Cost reductions by forming a family-style relationship

DriveSys was one of few suppliers who were responsible for *both* design and production. After the quality problems in the summer of 1992, both companies realized closeness was needed. Dedicated problem solving on the part of DriveSys had created an atmosphere of increased trust and both parties saw new benefits. As a technical manager at Robotics describes it:

> Just specifying demands… it doesn't work, because you don't know if they have understood. So instead we chose a closer co-operation to get a good end result.

After the first small product development project, there was continuous work to reduce costs. This was done through cross-functional meetings three or four times per year. Since DriveSys had outsourced production to a Swedish sub-supplier, they were also involved in the process. Describing the benefits of involving suppliers and sub-suppliers in value engineering, the technical manager continues:

> We often had supplier co-operation at the sub-supplier. We analyzed how the drives were produced, how they worked in the field, what the problems were in our production. If we found a threat, you had to do something. Those discussions gave us a feeling how the assembly machine worked. Often, we realized how a component could be exchanged to get a better flow in production.

Beyond incremental cost improvements, the cooperation also resulted in new ideas within ALFA. For example, it was discovered how the electronic components needed improved dirt protection. Still, after some time DriveSys started to feel trapped. To meet cost-reduction goals in P25 and Focus 30 they wanted ALFA to formally start. As the project manager says:

> After P25 and all the other cost-cutting activities, they [DriveSys] told me we needed to make a larger step. Too many interfaces were locked. We therefore started to discuss the next generation. How things could be improved, both from a cost as well as a functional perspective.

Since ALFA had lost project resources to the parallel project S4, a joint pre-study began with DriveSys. After brainstorming, DriveSys wrote a first draft and then project members in ALFA added technical details regarding communication, software and the mechanical interface. Reflecting on the joint pre-study, a senior DriveSys engineer says:

> In the first generation [1991-92], it was only us and ABB. The technical specification was already made. In ALFA, things were different. We had a pre-study and many wild ideas on how to build it. Analyzing pros and cons and how the entire ICS could be designed. Then it turned out quite traditional anyways.

However, despite the pre-study, DriveSys was not automatically selected. Instead, Robotics invited competing suppliers from Sweden, Germany and England. Since the drive supplier was responsible for both design and production, the contract included one target cost for the product and one target cost for the project. Robotics also used information from different drive suppliers to reduce costs. For example, a technically advanced solution from ABB Drives was used as a benchmark during final price negotiation. Describing the cost pressure, a product manager at DriveSys says:

> Cost was definitely a big issue. I mean, it always is…. We wanted to improve, compared to the first launch. But they [Robotics] constantly wanted to cut costs. We went from single axis to the modules with two or three axes. We started to modularize.

After comparing alternatives Robotics decided to continue with DriveSys. Knowing drives were difficult to specify, Robotics wanted a supplier with a known problem-solving capability. As one Robotics engineer described the criteria for selecting drive suppliers:

> The technical interface is very complex, the way we collect information and use it in our system. It is difficult to specify all the different possibilities… how we want the drive to function. So you really need a special relationship… that they understand the robot application.

5.2 Target costing during the development phase

5.2.1 Reducing costs and solving the cabinet size problem

Waiting for S4 to finish, project members in ALFA continued to search for solutions that could move the project forward. Describing the importance of cost considerations, a project member says:

> You had to monitor the cost all the time. First, you asked the supplier to give you an offer. Then you saw if it became cheaper than what you already had. If it was not cheaper, you moved on to your next idea. Monitoring costs were especially important when we made large technical changes.

Except for the problem of reducing the physical size of the Industrial Control System from 180 cm to 110 cm, another technical challenge was the effect of increased heat. When components were placed closed together, electrical current could unexpectedly be transferred from one component to another creating quality problems and increasing costs. Describing how Robotics and DriveSys tried to prevent these potential quality problems through functional analysis, a DriveSys engineer says:

> One problem with the old system [S3] was that drives were placed inside without protection. It became very hot. You had to start air conditioning. In ALFA, we really considered if the drives should be placed on the outside. We turned it, twisted it and discussed if it could be at the bottom or at the top. Robotics wanted reduced size and no warm components sticking out. It was a challenge.

While waiting for S4, a new communication technology was discovered. Instead of a centralized architecture with fixed places for each component, the new communication technology allowed larger flexibility. As a consequence, if the new technology worked, the architecture could be redesigned to save both costs and reduce the size. After writing down a rough idea the project manager in ALFA presented it to Robotics' Technical Director. Facing demands for lower costs, the Director asked for a quick investment proposal that could be presented to the CEO and the management team. Recalling the meeting, the project manager says:

> I went in to the meeting and said that I saw an opportunity here… that we could do several things at once. It might cost 7-10 million kronor [project cost], which meant I had to double my budget. Are you interested I asked them? They liked it instantly and I got the go ahead to investigate further. I had only done a rough estimate.

Since the re-design involved many components within the Industrial Control System, suppliers were also consulted. Asking open questions such as what drives cost proved valuable. For one component, a Finnish supplier made a detailed functional analysis and returned with a list of suggestions. The changes were summarized into two sections, one for component changes and one for architectural changes. Initially, the Finnish supplier thought architectural changes would not be allowed. However, it was soon discovered that the technical interface was very costly to manufacture. Due to specific requirements from Robotics, the supplier had to transport the component to various sub-suppliers around Finland. When the ALFA team realized the cost, they started an investigation. Could a standardized interface be allowed? After interacting with other suppliers, it was decided that the Finnish supplier would be allowed to change the architecture. Cost savings were therefore achieved by opening up the dialogue beyond the scope of what Robotics thought possible. Reflecting on the collective cost-reducing process, the project manager says:

> Cost-reductions were found in many places. One thing led to another… we made a large concept change. Some things became more expensive, while others became cheaper. Most of all, we saved money by reducing the size and making it easier to produce.

At this point, ALFA had started to accumulate more speed. S4 was almost finished and by discovering the new communications technology, the product architecture was re-designed to meet the "customer hang-up" for size reduction.

5.2.2 General Motors secures target sales

During the early 1990s, North America had become the new growth region. Since Fanuc had a joint venture with General Motors, Robotics' initial ambition was to approach Ford and Chrysler. Robotics also won large orders from Chrysler and Ford in 1992-93.

However, unexpectedly, General Motors became the largest customer in North America. A main reason for this was General Motors' ambition to reduce costs and Robotics ability to explore strong relationships with key individuals within General Motors' purchasing department. Historically, General Motors had a strong engineering culture. In Detroit they had a technical staff of more than 100 engineers dedicated to robot production. Still, to reduce costs, the purchasing department wanted to challenge Fanuc because without a second-source supplier, the purchasing department argued it would be difficult to reduce costs from Fanuc.

Robotics was therefore given a small test order of 50 robots. Unexpectedly, General Motors' factory management refused to accept the robots. They wanted to continue with Fanuc. A compromise was therefore reached where the robots were placed in different divisions so that factories could continue to rely on Fanuc robots. Even though this was not planned, it turned out to be a lucky co-incidence because Robotics gained personal contacts and positioned itself as a key player for General Motor's next robot investment program in 1994.

In 1994, S4 was still under testing and Robotics therefore offered the old Industrial Control System generation, S3. Just days before General Motors would decide, Robotics was informed that S3 was seen as outdated. Robotics therefore quickly improvised and decided to show S4. As one of the involved engineers describes:

> I was called to a meeting with one of their superintendents. He said, let's go down and have a look. We went down and I tried to talk and talk about the advantages of our [S4] system. Nothing touched him! It was not until I said that we have more computer power in the programmable interface than we

> had in the entire S3 generation that he became curious. "Does that mean you can run parallel execution, he said?" "Yes, I replied". "Good, book the entire day tomorrow and I will have my best technicians ready to go through the system."

Convincing the technical engineers provided the necessary support. Together with a low price, Robotics was awarded the frame contract in October 1994. However, since General Motors did not need the robots until the summer of 1996, Robotics soon began to persuade General Motors to switch to the ALFA generation. The target price was so low that an offer with S4s would not be as profitable as estimated. General Motors was also interested in joint development. With high training and service costs, they wanted to affect the standard functionality in ALFA. As one Robotics product manager explains:

> GM came back and said; "OK, we know we have a technical specification that twists your arm and we know this means you are making customized adaptations for us. We realize this lowers our quality compared to if we buy a standard system because you put more quality resources if the volume is 10,000 than 1000. What do you want to deliver to us?"

Except for reducing training and service costs, General Motors also had another reason for wanting joint product development. In 1994-95, they had begun to develop a new technical standard called Global Robot Specification (GRS). To improve capital efficiency, the goal of the GRS was to standardize robot purchases so that a robot from ABB could be run together with a robot from Fanuc or Kuka. To develop the specific details General Motors needed to test the GRS in real supplier contract. The joint product development was therefore not only beneficial to Robotics, it also gave General Motors opportunities to test some of their ideas.

5.2.3 Simultaneous engineering but no open-book accounting

On the supplier level, DriveSys had begun development. Being responsible for both design and production, target costs were related to both functional and quality goals. Describing the mix of financial and non-financial performance measurements, a senior DriveSys engineer says:

> Cost and quality were prioritized project goals. They did not emphasize functionality, but when we started the development we saw that we needed to digitalize the drives.

Describing the development process and the importance of formalizing responsibilities, the DriveSys technical manager says:

> Initially, ideas are floating around. Things are tried and often thrown away. But then, after a while people start to think "this might actually work." This can be a good solution. Then, things become more stabilized. Then you need to freeze and make sure you agree. In the end it is a contract between two parties that includes both a product and a project cost.

The drive project in ALFA was divided into two sub-projects, one for software and one for hardware. In each sub-project, DriveSys had two or three engineers and then a technical project manager. At Robotics, there was a project manager responsible for the development of drives and he worked closely with the purchaser who was responsible for the entire DriveSys relationship. From the beginning, hardware and software were seen as equally demanding projects. However, because of the new communication technology, software became a more complex and resource demanding sub-project. For example, to avoid costly delays, simultaneous engineering was required where engineers from Robotics and DriveSys worked side-by-side to finish on time. As a Robotics project member says:

> Concerning the digitalization… now it really became a joint project. They did not have competence in that. We helped them. Discussing their functional responsibility… we moved a regulation from our axis computer to their drive. Suddenly, they became very tightly integrated since our regulation people realized how central this was for our overall performance.

Despite the need for improvisation and closeness there was no open-book agreement. According to the DriveSys sales manager, open-book accounting was not feasible when the supplier took all the financial risk:

> With open books, who is responsible for cost reduction? What is the incentive for us? Instead, if we can reduce cost and then give back a little bit… a fair amount… I mean, we need to have margin on our products. With open books, the customer must guarantee a fix margin. Otherwise, it is no use.

Several interviewees also argued that open-book accounting only worked when the supplier had production responsibility. With a functional responsibility (both design and production), DriveSys made their profitability by transferring knowledge from one customer to another. If Robotics had full information, DriveSys argued this knowledge could easily be misused. The Robotics project manager also acknowledged problems with open-book accounting. According to him, financial issues were therefore handled "by a hand shake."

By *not* having open-book accounting, delicate issues and trade-offs could be negotiated informally between key individuals in Robotics and DriveSys. This way, the joint project could maintain flexibility within each organization and reciprocity could be upheld. Describing the mutual understanding, the project manager says:

> If I told him it was necessary, he did not care if it was politically acceptable. If we agreed, I took care of my side and he took care of his side. We always had a direct contact, made quick decisions and stood up for each other.

To summarize, the development phase illustrated how the target costing process was characterized by improvisation. On an architectural level, a redesign was approved when it was shown that the new communication technology both reduced costs and the size of the Industrial Control System. On a customer level, Robotics had to improvise to win the General Motors order and on a supplier level, simultaneous engineering was required to deal with the increasing digitalization.

5.3 Target costing during the pre-production phase

5.3.1 A "family" relationship, but who pays for unexpected costs?

On a supplier level, a central issue between Robotics and DriveSys was to handle unexpected problems. As the example with the new communication technology illustrated, both parties depended on each other. Robotics needed a cost efficient drive and DriveSys needed to sell large volumes. Describing the mutual interdependencies, the Robotics project manager says:

> Their happiness was dependent on ours. If we had quality problems, they would not have any volume. If that happens [quality problems], you can calculate money any way you like.

Emphasizing the importance of flexibility and improvisation, the technical manager at DriveSys also stresses the need for "an intimate relationship":

> …after some time in the project, you learn more and understand the task in a new way. Then you realize "aha, we need something else compared to what we calculated with." We hit some mines during ALFA. However, since we had an intimate relationship with ABB, we both figured out a way to adapt time schedules.

During the pre-production phase, time pressure was a continuous challenge. More specifically, to reach the deadlines set by General Motors, Robotics and DriveSys needed to help each other with the testing. From a contractual point of view, Robotics was responsible for the Industrial Control System and DriveSys was responsible for developing the drives. However, it was difficult to test the drives without having the rest of the Industrial Control System. As one DriveSys technical manager describes:

> It was constant synchronization, since they developed ALFA at the same time. We were very dependent on each other. That was one of the main

> problems, we needed the rest of ALFA to test the drives, but they needed our drives to test ALFA.

To reach the tough deadlines, DriveSys was therefore allowed to borrow a few robot systems without any additional costs. By relaxing contractual responsibilities and instead sharing resources, joint efforts were focused. To further speed up the development rhythm, Robotics also sent a senior software engineer who worked physically at DriveSys. On the other hand, DriveSys also added project resources to ALFA and accepted last minute changes without costly re-negotiations.

However, over time the unexpected costs gradually turned into a heated issue. Since Robotics had parallel activities, other sub-projects within ALFA began to question the amount of resources spent on DriveSys. The same debate occurred at DriveSys. How many technical modifications could be allowed? With a close relationship, critical reflections about the target cost were difficult to do. Describing the tensions between the technical content and the target cost, the Robotics project manager says:

> In ALFA we were less strict than with S3 [first project]. We were probably too "friendly." You have a contract to make sure you stay friends. In the end, we solved everything but technical problem-solving can quickly have financial consequences you do not see at first sight.

Unexpected cost increases were also related to the difficulty of clarifying responsibilities. For example, who was to blame when something went wrong? Was it Robotics' or DriveSys's fault? This was particularly important when General Motors discovered quality problems. Reflecting back on ALFA, a Robotics manager says:

> Iterative work is a combination of function and technical requirement specification. I guess one thinks in terms of technical requirements, but you write it in functions. That's not how we work today [2004]. Instead, we write technical requirements and the supplier answers with a proposed functional specification. Then we have a handshake and we can see if we have understood each other. I guess the old way is faster, but it is very diffi-

cult to say who demanded what? What was "need to have" and "good to have"? With the old way, you can't see the difference.

As a consequence, both Robotics and DriveSys began to revaluate the necessity of having a close relationship. In DELTA, Robotics became more impatient with deadlines while DriveSys tried to follow their structured development methodology to a higher degree.

5.3.2 Cost re-negotiations when new functionality is added

> In a car deal like General Motors, it works like this; this is our target price, that's how much we are willing to pay. Are you interested in the deal?
>
> Robotics engineer

The quote illustrates a common view in target costing; that target prices are decided by a strong customer (e.g. Cooper and Slagmulder 1997, Ansari and Bell 1997). Even though large customers certainly influence the target costing process, the intention of this section is to show how re-designs give suppliers like Robotics some room for maneuvering. For example, in ALFA, a central issue was to determine if a re-design was included in the target cost or not. To describe these cost negotiation processes let us continue where we ended. Robotics had won the largest order in company history. As one technical manager describes:

> We got the order in 1994, we began delivering in 1997. So we had a close cooperation with General Motors. We said, "OK, we are making a new system. We want you to be a part of this process. You'll get to specify the system with us." We sat down a couple times a week with the customer.

A first issue was project coordination. To execute the joint project, General Motors gave Robotics a single point of contact. He worked at the Central Staff and became Robotics "insider" within General Motors. Having a production background, he had extensive knowledge about robot usage. After coordinating local factory needs, a large number of technical modifications were added. As a Robotics product manager recalls:

> We sat for six months and ended up with a very thick [technical] specification, which I now show is about two cm thick. I told him, this costs a lot of more money because you bought a standard system.

With the target price as a background, modifications were evaluated and prioritized. Similar to the supplier relationship with DriveSys, open-book accounting was not used. Describing the price re-negotiations, a Robotics sales manager says:

> Yes, we had many tough discussions. We worked with trading lists. If you let go of this technical requirement, we can reduce X dollars per robot and so on. It was quite successful.

Function	Cost savings
Distributed I/O	$ 172,000
Replace flange disconnector w/ rotary type	$ 92,990
Replace servo power disconnector with rotary type	$ 187,000
S4PC cost savings activities	$ 82,620
Replace Allan Bradley pushbuttons, lamp sockets etc.	$ 4,300
Usage of less expensive connectors	$ 127,000
Cost reduction on other specific components	$ 15,000
Introduce ALFA	**$ 1,145,000**
Modifications of the mechanical units	$ 887,000
Increased Memory Requirement	**$ -1,329,375**

Table 5.1: Robotics' cost savings with General Motors.

Table 5.1 illustrates total cost savings with different types of modifications. For example, by replacing the push buttons with a cheaper brand, Robotics saved $4,300 and by using less expensive connectors an additional $127,000 could be won. However, as table 5.1 shows, the big difference was the switch from S4 to ALFA. By convincing General Motors to accept ALFA, Robotics' cost was reduced by $1,145,000. This was necessary, because the new communication technology required a stronger and more expensive computer memory which added total costs of $1,329,375.

During the process of re-negotiating modifications time pressure also increased. The first robots needed to be sent in August 1996, and during the development phase ALFA had also added BMW and Volvo as two other lead customers. Acknowledging the time pressure, the project manager says:

> You can imagine the consequences if something went wrong. At GM, it was going to GM Trucks, and at BMW it was their new 3-series. Not finishing on time was not an option. You just finish on time.

To strengthen coordination during the pre-production phase, ALFA began a sub-project called "find the problem." Early versions of ALFA were tested at General Motors, BMW and Volvo and a direct "hotline" was established between the customer factories and the ALFA project. Describing the challenge of meeting customer deadlines, the project manager says:

> We were late. In the first deliveries, we were not at all finished. We asked them, what do you need the robot for? Then we worked hard to fix that. Initially, they got very little software. However, they only needed the robots to integrate with cables and other production systems. Then we updated hardware and software along the way to match their growing requirements. It was really tight.

5.3.3 Time pressure makes it difficult to deal with new discoveries

When BMW started to build their production lines, it became clear that ALFA had left out critical functionality. To improve productivity, BMW wanted the Industrial Control System to control not only the robot, but also an external 7^{th} axis (a robot has 6 axes). More specifically, BMW wanted ALFA to control an external railroad but this customer functionality had not been included. ALFA could only run the six axes in the robot which meant a second Industrial Control System was needed to run the railway.

From both a technical and financial perspective, this was a poor solution. Technically, the customer had to find additional space for the second Industrial Control System and financially, Robotics would drastically decrease system profitability. Describing the situation, a technical manager says:

> The first system to BMW included an external axis, which meant a robot plus a railway. Then we gave them two Industrial Control Systems. So we gave them a lot of spare parts. Then we realized we needed a cost efficient alternative for large robots.

Realizing the dilemma between time pressure and system profitability, the ALFA team began searching for alternatives. On the one hand, BMW's demand for an external railroad was a valid problem and something that other customers also potentially needed. On the other hand, ALFA was tied up in three implementation projects where development speed was of crucial importance. Since the external railroad involved drives (each axis is driven by a drive), DriveSys was contacted. Could they see a solution to the problem? Was it possible to make a re-design? Describing the problem-solving process, the Robotics project manager says:

> I guess you identify a problem and start grappling with it. First, you need to make clear it is a problem… you know the step-cost. Then you start sniffing. Are there any possibilities to do anything at all? Initially I did not know much. Then they [DriveSys] came back with "we have an idea that might work" and then it roles on. It starts with, "we have seen a possibility; is it interesting?"

Early on, the ALFA team discussed potential domino-effects on other components. For example, to improve the drive, the transformer might also need a technical modification. Soon, the process started to become complex. Trying to isolate the changes to the drive, engineers at DriveSys began evaluating different alternatives. After tests and joint problem-solving with their sub-suppliers, it was concluded that the drives could be re-designed to fit the external railroad. However, the project was so extensive it could not be included in ALFA. Instead, a new smaller project was initiated where DriveSys was given additional money for conducting the re-design.

5.4 Concluding discussion

5.4.1 Target costing and embeddedness

Starting with *customer-driven target costing*, the ALFA case showed that target costing occurred primarily in close customer relationships. Rather than analyzing a "market", it was interacton on multiple levels that enabled Robotics to understand what customers prioritized and was willing to pay for. For example, by forming personal alliances with purchasers and engineers, it was possible to identify reduced size as a "customer hang-up." Furthermore, customer-driven target costing involved both product and systems functionality. The challenges with systems functionality were especially important for understanding network embeddedness. For example, BMW's wish to have an external railroad was not met until it was shown that Robotics could sell a similar solution to other customers. A central part of customer-driven target costing therefore involved how product and systems features could be combined among multiple customers.

Moving to *architectural-level target costing*, it was shown how functional analysis involved multiple levels of analysis. Before an individual component was changed, both the product architecture and the larger systems level were discussed. For example, the parallel development of ALFA and S4 demonstrated this complexity. When development began it was considered to be one project, but the technical complexity soon revealed how two subprojects were required. As figure 5.4 shows, ALFA was clearly interdependent with S4 because it was not possible to freeze technical solutions in ALFA before the new software functionalities had been tested and evaluated in S4. Rather than dividing the product into fixed modules, architectural-level target costing therefore involved problematizing technical interfaces both within and across project boundaries in order to gain multiple perspectives.

Finally, regarding *supplier-level target costing*, the relationship with DriveSys illustrated the importance of constant interaction both on a dyadic and network level. For example, when DriveSys's initial computer solution did not work, it was necessary to move beyond the dyadic relationship and consult a number of other suppliers and sub-suppliers. Figure 5.4 illustrates network and project embeddedness in ALFA. As can be seen, target costing progressed by combining and re-combining customers, suppliers and parallel projects. For example, during supplier selection costs were reduced by interacting intensively with both DriveSys and ABB Drives before it was decided that DriveSys should be chosen. In a similar way, even though BMW wanted an additional 7th axis, this customer functionality was not developed until General Motors and Volvo had gotten their robots and it was discovered that DriveSys could handle the re-design within the drive.

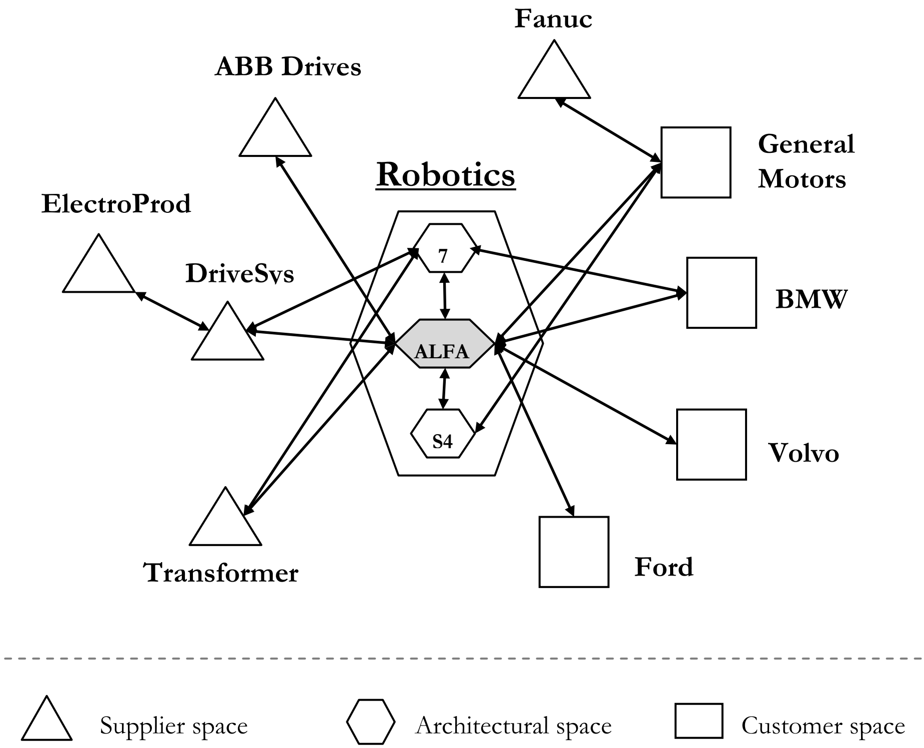

Figure 5.4: Network and project embeddedness in ALFA

5.4.2 Target costing and incompleteness

Beyond network and project embeddedness, incompleteness illustrated how target costing involved temporal complexity in different dimensions. Initially during *the concept phase*, target costing was conducted in a fog. Robotics realized costs had to be reduced, but the solution was not clear. Through discussions with local sales offices, the project team began to identify "customer hang-ups". A challenge at this state was to estimate the timing of customer demands. Would General Motors want a smaller cabinet in 1994 or could it wait until 1996-97? Trying to make sense, target costing progressed through trial-and-error. Furthermore, as the supplier relationship with DriveSys showed, target costing was not directed by one party. Instead, DriveSys proactively suggested a pre-study to identify cost reduction opportunities.

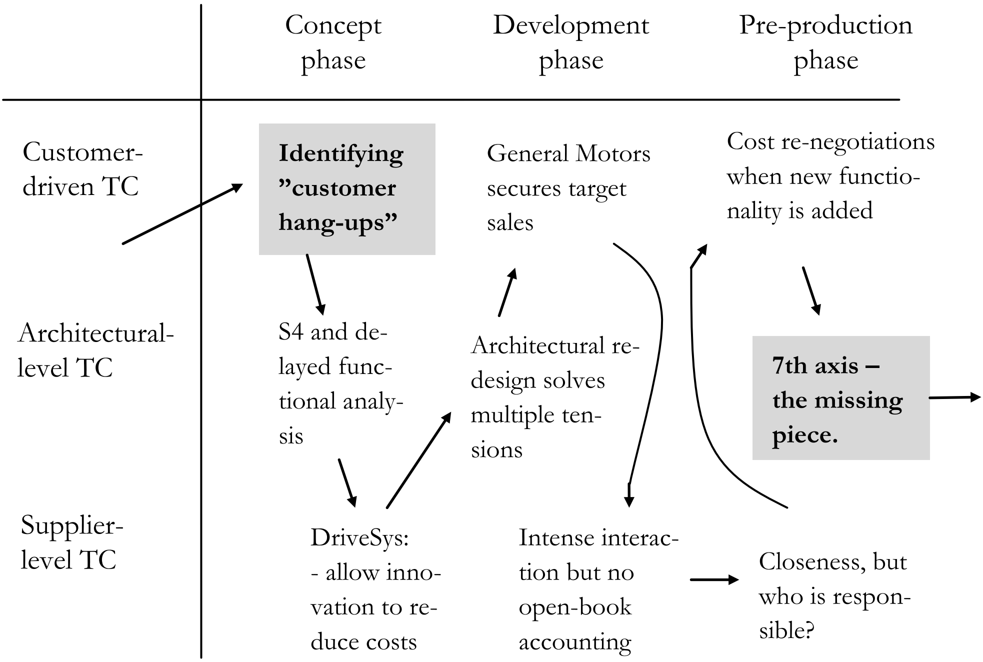

Figure 5.5: Target costing dynamics in ALFA

During *the development phase*, figure 5.5 shows how target costing had do deal with a number of unexpected opportunities and problems. On the one hand, General Motors became a lead customer which secured target sales and gave valuable customer feedback. On the other hand, by synchronizing development to General Motors' deadlines, technical flexibility was reduced and the development rhythm changed. As the project manager says:

> The project changed from being a development project to becoming a delivery project. As with all projects with small delays and other surprises, I had to cut drastically in the functionality. Everything that was not absolutely crucial was moved to the next year. The cost control was also tough, because GM had bought it at an underpriced margin.

During the development phase, architectural-level target costing focused on reducing costs while simultaneously trying to develop a smaller cabinet. Initially, it had seemed difficult, but when the new communication technology was discovered a number of pieces fell in place; costs were reduced, the cabinet became smaller and suppliers were positive since design flexibility increased. The re-design therefore linked customer, architectural and supplier level target costing.

Finally, during *the pre-production phase*, unexpected events continued to color the target costing process. For example, BMW and Volvo became new lead customers which increased the time pressure to deliver on time. Similar to other phases, target costing was related to "grey zones." For example, with constant modifications, a central issue was to re-negotiate what was included. Furthermore, these re-negotiations were similar among customers and suppliers. For example, when General Motors wanted additional functionality, Robotics argued this was "outside the specification" at the same time as Robotics tried to convince DriveSys that technical modifications were "inside the specification." Interpreting and negotiating cost consequences for technical modifications were therefore a common practice during the entire target costing process in ALFA.

6 BETA: target costing under time pressure

In this chapter, we focus on target costing under time pressure. More specifically, it will be shown how target costing functions when there is a large customer order already from the start. In BETA, what initially was seen as a customer re-design eventually grew into a formal product development project. BETA therefore illustrates how target costing operates when cost containment is the main focus. Rather than reducing costs, the main focus in BETA was to ensure customer deliveries without spending *too* much money on modifications.

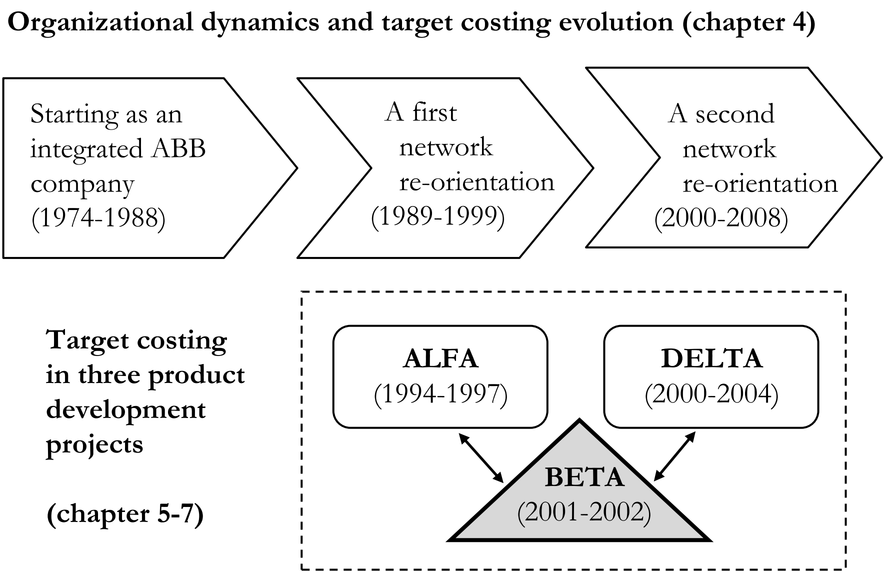

Figure 6.1: BETA – target costing under time pressures

6.1 Target costing during the concept phase

6.1.1 Starting with a potentially large order from BMW

BETA took form in the spring of 2001. After having an annual production pace of 12,000-13,000 robots by December of 2000, new forecasts had modified production predictions to as low as 8000 robots for 2001. Similar signs were common all over the world. Beyond the unstable stock markets and the dot.com crash, large Swedish companies such as Ericsson also imagined that the New Economy might be vanishing. To secure sales volumes, Robotics therefore re-focused attention on automotive customers. As the project manager for BETA describes:

> BMW was offering us a very larger order, 4-5000 robots, or at least many thousands of robots. However, for different reasons, BMW did not like ALFA. We therefore made a customization for them. First prototypes, … demonstration examples, just to show them something.

Because of potential revenues, a discussion around customization began. Most of all, BMW was concerned with systems functionality and wanted to incorporate the customer module within the Industrial Control System. However, Robotics' development department hesitated. In contrast to BMW's wishes, DELTA aimed at *reducing* the cabinet size. To spend resources developing a larger Industrial Control System did not seem like a good option. On the other hand, it was a very big order and future sales were not as optimistic as they had been six months earlier. To win time, sales engineers were given a limited budget to develop a prototype. By doing that, Robotics hoped to qualify for the final negotiations at BMW. Earlier experience from General Motor had showed many things could change along the way.

However, parallel to the BMW order, Robotics in France faced similar problems. The two biggest customers, Peugeot and Renault were also investing in new robots and they were not satisfied with ALFA.

As figure 6.2 illustrates, in addition to integrating the customer module, they also wanted improved usability. For example, to reduce service time Peugeot and Renault wanted to place contacts in the front. This was considered important because when robots stopped, it had been estimated that every minute of downtime cost $10,000.

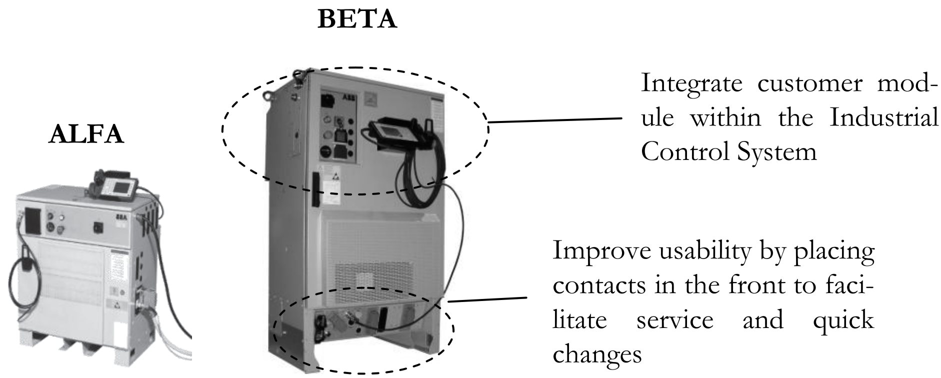

Figure 6.2: Central modifications in BETA

Robotics therefore faced a dilemma which involved short and long-term trade-offs. On the one hand, BMW, Peugeot and Renault could secure sales in the short term. On the other hand, from a long-term perspective, these customer requirements was counterproductive to DELTA. As figure 6.2 shows, instead of reducing the height, BETA actually increased the height when the customer module was integrated into the Industrial Control System.

6.1.2 Contracting Design-Net under time pressure

Even though BETA had a development budget it was not clear who would do the job. Most serial suppliers were developing DELTA and it was difficult to find a supplier that could be responsible for the entire re-design. At this time, a new type of company, Design-Net was formed. Seeing the trend towards outsourcing, Design-Net was a Swedish network of mechanical and engineering companies. By working together under one brand name, the goal was to attract larger industrial companies such as ABB and Ericsson.[20] Describing Design-Net's strategy, one of the owners says:

> You can say the idea was good, but the timing terrible. We had the mechanical company with about 160 employees, but realized we had to fill the cabinets with content. So we bought ElectroTest to get the testing and electronical capability. However, we were still too small to be a supplier for Ericsson. So I thought about the network idea and brought together some of the best people I know in Sweden. It took us about a year just to discuss ideas and get the concept in place.

To get pilot customers, Design-Net arranged several workshops. Present at the workshops were top management from large companies, university scholars and politicians. Because of the workshops and personal contacts within the ABB Group, Robotics and Design-Net came in contact. In fact, two members in Design-Net were already suppliers, but on an individual basis. With time pressure and through personal recommendations, contract discussions progressed quickly. Based on technical requirements from BMW, the general outline was drafted on the phone and then written down in an e-mail. As the Design-Net owner recalls:

> It was damn simple, those contracts. They were based mostly on trust. I think that is important and a strong Swedish tradition. To do business with an American company… then it takes forever because they read everything literally. For us Swedes, a contract is a base for continuous discussions.

Compared to large platform projects, several new issues were tested in BETA. First, Design-Net was given a project management responsibility for

---

[20] Design-Net has a similar structure as the formal networks in Denmark described by Sof Thrane and other accounting researchers (Lind and Thrane 2005, Mouritsen and Thrane 2006, Thrane 2007). However, instead of focusing on accounting within Design-Net, BETA shows how formal networks operate as suppliers.

the entire re-design. Previously, Robotics had managed the architectural design and then suppliers like DriveSys had been responsible for individual components. Secondly, since BETA was not seen as very risky, it was a less detailed contract. Most effort was spent on discussing the functional deliveries and the project target cost. Describing the background, the Design-Net owner says:

> It started with… the sales department went to the purchasing manager and said that if they wanted the BMW deal, they needed to re-design ALFA. But the purchasing manager initially said "we don't have any resources!" Then, someone came up with the idea that it could be outsourced. So I sold him a package. He wanted to buy hours, but I refused.

Even though Robotics outsourced project management, contract negotiations also included a larger scope. More specifically, from Design-Net's perspective, it would have been even better if Robotics had outsourced both design and production. However, since Robotics felt this was too much of a risk, the two parties agreed on a design contract worth 7 million kronor (about 800,000 euros).

6.1.3 Formalizing BETA to reduce costs and secure quality

During the summer of 2001, tensions increased between departments within Robotics. On the one hand, key account managers wanted speed and customization since satisfying "their" customer was important. On the other hand, product management and production wanted standardization. For them, it was important that BETA was easy to produce. As one product manager describes the situation:

> We had a sales organization that ran customer projects and a product organization that was responsible for products. Sales was much quicker and flexible, did not optimize cost, quality or how it was produced. It was more "we have an order, we have to fix it!" When several customers wanted the same thing, we realized it was time to make a standard product of out of this.

The development of BETA was also highly related to other parallel projects. As figure 6.3 shows, Robotics had recently finished the development of Voyager, the new large robot generation. Having the capacity to lift 500 kg, Voyager was the strongest robot in the world but needed reference customers. Instead of cost reduction, the target cost for BETA was therefore allowed to increase by 10% compared to ALFA.

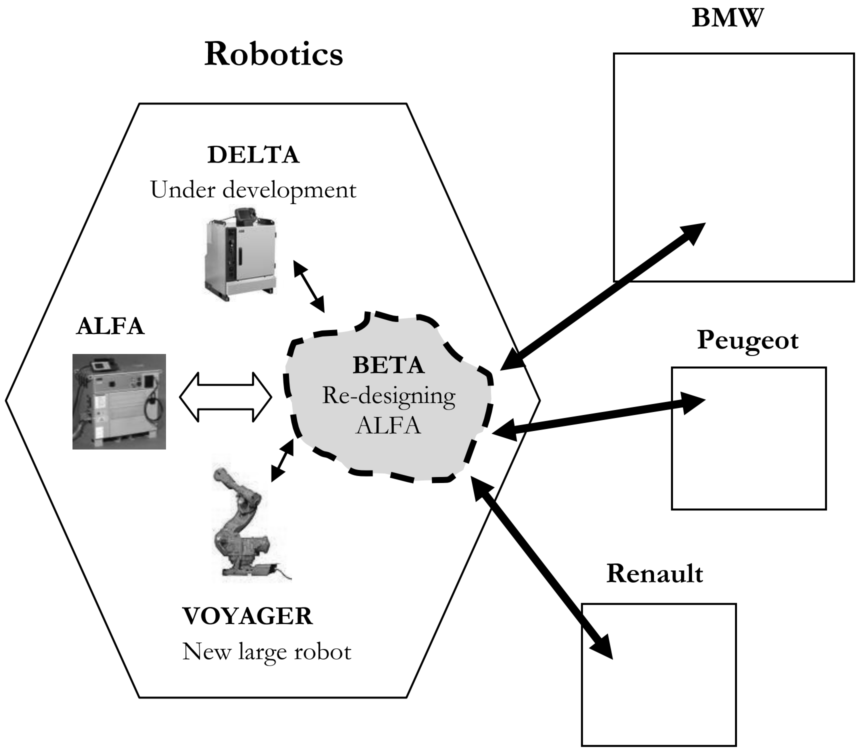

Figure 6.3: Connections between BETA, parallel projects and customers

After formalizing BETA, additional project members were added to the project team. Design-Net was still responsible for project management, but it was decided to increase the scope and customize BETA to more robots than just the large Voyager robots. Describing the expanded scope, the project manager from Robotics says:

> In August 2001, we made the decision to customize BETA to more robots than Voyager, even to 1400, 2400, 4400, the entire portfolio basically. We also increased the number of customer options. Quite a difference from the first ideas with one single article number to BMW.

To summarize, during *the concept phase*, BETA emerged from a customer adaptation to a formal project. A central issue was improvisation and working under time pressure. Based on the technical specification from BMW, a prototype was developed in close co-operation with the new supplier Design-Net. When Peugeot and Renault also showed interest, BETA got a financial platform to become a "real" project.

6.2 Target costing during the development phase

6.2.1 Robotics takes over project management

In September 2001, several pre-studies were initiated. However, due to the time pressure, the goal was not to maximize cost reductions but to see how design changes could be minimized. Through functional analysis, pre-studies therefore focused on identifying potential risks in making re-designs. The analysis began within BETA. How could components be modified? If size was increased, could this harm functionality? Even though costs were not analyzed in detail, a key issue was to identify the main cost drivers. Pre-studies also analyzed interdependencies on a systems level. This involved interdependencies with robots and production equipment. For example, a central issue was to ensure that BETA was easy and cost-efficient to produce. As the Design-Net owner says:

> Our goal with the mechanical design was to use those who had experience from the floor. If you have not been on the floor, you add details where it is not needed. It can be really expensive to produce.

Even though Design-Net had considerable experience, controversies around customization and standardization continued. Describing the tensions, the Design-Net owner says:

> We wanted to meet the customer face-to-face, but this was controversial. You know, to hear their requirements in detail on how the computer should be assembled, serviced, the disk and other stuff. We helped the sales manager to run this within Robotics. But they were stubborn; it could not be more article numbers.

Despite the internal debate, giving Design-Net project management responsibility seemed successful. As one Robotics manager described the first months of development:

> Even though we outsourced the entire project, we had a steering committee. It was quite interesting because… you can say that everything was presented very positively. We are on schedule, the cost is going to be this low and it looks great. You just sat there and enjoyed!

However, during the fall of 2001, the first signs of problems appeared. Initially, they involved design methodology. Being a small design company, Design-Net relied on speed as a mean for development. Robotics on the other hand needed drawings and processes to be more structured to ensure that critical activities were not forgotten. A Robotics technical manager says:

> The first time I got suspicious was when I got what they called "the drawings folder." Then I started to understand… at first it looked good, but when you looked more carefully you discovered cable drawings with pencil notes. "Is this really the way to do it", I asked them. "No, but one can manufacture the systems based on it" was their answer. They had designed it like it would be sent to the local shop. I mean, we cannot send that to a large volume producer.

Realizing the different design cultures, the steering committee therefore decided to in-source project management to Robotics. At this point, the pre-studies had also concluded that BETA could not be handled as an isolated project. Describing the challenges of outsourcing, the Robotics project manager says:

> To outsource to an external consultant… it is naïve to think it solves itself. It requires a lot from us as well. It is impossible for an external company to come in here and know the requirements we have.

Interviewees from Design-Net also acknowledge the difficulties of working with a big company. According to one engineer, Robotics was not ready to outsource the entire design. The technical consequences were larger than expected and it often took time to get feedback. As the Design-Net owner says, describing the different company cultures:

> We agreed at the top level, but it did not sink in on the floor. It is like Michael Jackson's "Moonwalk." They think they move, but nothing happens. Working weekends was difficult. We worked 24 hours, 7 days a week. Even during Christmas.

6.2.2 The loss of target sales when BMW chooses another robot supplier

In November 2001 BETA took an unexpected turn. BMW decided to give the large robot order to Kuka, a German robot manufacturer. According to Robotics engineers, there were both financial and technical motives behind the decision. Financially, BMW did not want Robotics to become too powerful, so by giving the order to Kuka, BMW felt long-term prices and service would be secured. From a technical perspective, the timing between Robotics' development projects and the BMW order was also unfortunate. The new Voyager robots had just been introduced and BETA was a modification of an old Industrial Control System. The loss of BMW affected BETA financially since both product and project costs were based on target sales estimates. To miss one of the biggest orders hurt. Technically, the loss meant less. The new functionality was still needed for Peugeot and Renault. As the project manager says:

> In November 2001 we found out that we wouldn't get BMW. However, Renault and Peugeot were still alive. All the new functionality that had been added was only marginally affected.

6.2.3 Supplier crisis – time pressure creates unexpected costs

In early 2002, BETA made another organizational change. Instead of using Shop-P, a local production supplier specialized in prototypes, the serial supplier for Industrial Control Systems, Serial-P came on board. An initial task was to deliver the first prototypes in March 2002. This was only two months away and Design-Net and Serial-P had never worked together. The development rhythm was increased. Several Robotics managers noted that Design-Net seemed to spend project resources faster than expected. As one technical manager says:

> They never warned us, but you could just see it. We got weekly reports how much money was spent. You could see that this is never going to work. However, before the budget was spent, they always said "don't worry," but then afterwards, they wanted more money.

However, even though prototypes were delivered on time, new problems emerged that increased costs more than expected. For example, it was discovered that the design developed by Design-Net did not fit the production processes at Serial-P. More specifically, 200-300 different screw holes did not fit the cabinet that Serial-P was producing. As the Robotics project manager for BETA describes:

> They had used the wrong screws… or at least we thought they had used the wrong screws in their design. That is more than 200-300 screws including the design drawings. It takes a very long time to change that. But Design-Net said this would be no problem, it was just a matter of adopting the production processes at Serial-P.

Analyzing the problem, a senior engineer at Design-Net argued that the problem was with Serial-P. According to him, they were not used to working with the latest production methods. On the other hand, using the same production process for ALFA and BETA, Serial-P argued Robotics or Design-Net was to blame. BETA was now facing a number of problems. Peugeot and Renault wanted quick deliveries, unexpected costs had escalated and Design-Net and Serial-P were not used to working together.

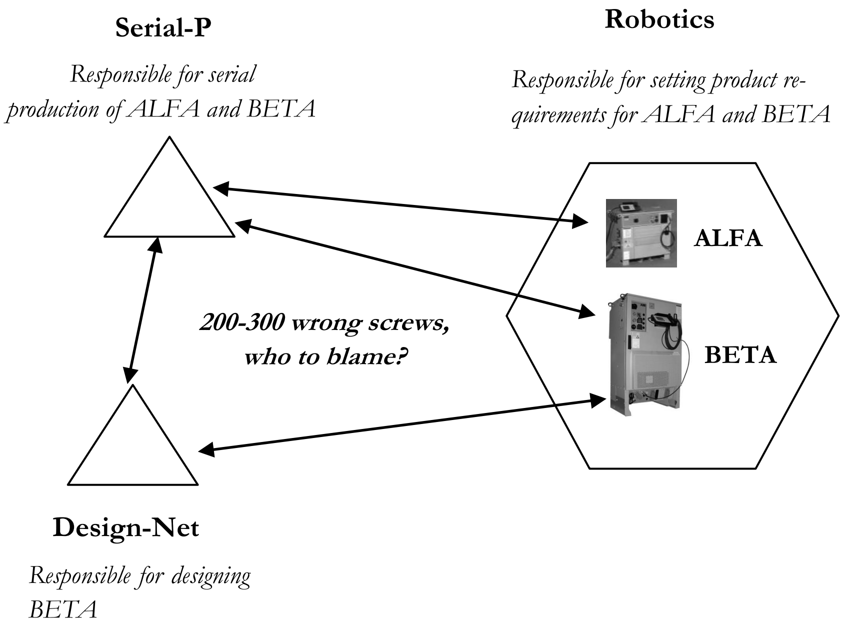

Figure 6.4: Problems of assigning responsibility in a supplier network

To get more structure and control, Robotics decided to change the contract with Design-Net. Instead of a fixed cost, Design-Net was forced to report hours. Describing the problems with the first contract, the project manager at Robotics says:

> It was not a good contract. They came up with a draft and we signed without really thinking about the consequences. But on the other hand, considering all the changes, how could you write a contract?

According to several Design-Net interviewees, the new contract changed the working climate, because it highlighted "we" and "them." Reflecting on the second contract, the Design-Net owner argues:

> The biggest negative change for Design-Net occurred when Robotics wanted to purchase hours. It was not good for Design-Net and I think it was not good for Robotics either. They got less for their money.

To summarize, during *the development phase*, BETA had experienced several big problems. Among customers, Robotics had lost the BMW order to Kuka, complexities had increased due to integration with other products and among suppliers it had been difficult to coordinate design activities at Design-Net and Serial-P. What had begun as a promising project during the concept phase had now become more costly and technically complex during the development phase.

6.3 Target costing during the pre-production phase

6.3.1 Cost containment while handling customer time pressures

In April, Peugeot and Renault sent back feedback on the first prototypes. Even though Robotics, Design-Net and Serial-P were all aware that changes had to be made, they were surprised at the volumes of redesigning needed. More specifically, in total more than 250 revisions were requested. Describing how it was difficult to refuse customer modifications, the project manager at Robotics says:

> If customers say "we must have it", then they do. If it is an order of several thousand robots, you don't have much choice. You damn well better fix it.

Even though most revisions were necessary, there was still an issue of distributing the unexpected cost increases. For example, after discussing the screws problems it was decided that Robotics and Design-Net should share the cost of about 600,000 kronor (about 70,000 euros). As the D-Network owner says:

> Many times the customers [Peugeot, Renault] did not know how they wanted it… they innovated along the way. This caused discussions… sometimes Robotics did not want to pay for the additional work.

On the other hand, cost negotiations led to reflection and learning. For example, to avoid further cost increases, weekly telephone meetings began with Robotics, Design-Net and Serial-P. Often these meetings were cross-functional, including people from purchasing, development and production. As the Robotics project manager says:

> During the spring, we began with telephone conferences once a week. That was really good. We had people from purchasing, design and production present. And then of course a fixed agenda to see that things progressed. That was good.

However, despite increased coordination, unexpected problems continued. For example, when Peugeot got the second prototypes they did not like the cooling. Previously, dirt had entered the systems and to avoid this, the Peugeot engineers demanded that Robotics make a re-design. At first, Robotics hesitated. Could the cooling be re-designed at this stage? There was no time and the project costs had already hit the roof. After discussions both in France and in Sweden, a compromise was agreed upon. More specifically, the air currents could be directed away from critical components which meant that only a minor adjustment had to be made. According to the project manager, the idea came from France, but was tested and implemented by Robotics, Design-Net and Serial-P. Summarizing the ongoing problem-solving, the project manager says:

> A key thing was that Serial-P was located in Sweden. It was much easier to communicate. If they had been abroad, the deadlines would have been impossible. That is just a fact.

6.3.2 Cost increases when supplier production is not coordinated

In the fall of 2002 BETA was finally coming to an end. Technical modifications had been dealt with and all the components had been imported into Robotics' IT-system. During September, Robotics and Serial-P therefore ran what was called a "full scale test," which included the production of fifteen to twenty Industrial Control Systems in a short time period. This way, both parties discovered problems in production and logistics. Except for the "full scale test," it was also important to implement Peugeot's and Renault's customized options. As a Design-Net engineer says:

> Customers integrate the robots in different ways. Some want the newest technologies, while others want an old fashion IO that is reliable. When they get a new robot system, they just want to take out the cables from the old system and plug in the new one.

After the full scale tests, serial production began in October 2002. The first systems went to Renault because Peugeot's customizations had not been finished. However, soon demand was higher than production could manage. Serial-P was taken by surprise since estimates from Robotics had been much lower. As the project manager says:

> We ramped up very quickly. Maybe it was 40-50 systems a week. Serial-P had not planned this. They were not prepared. They needed to step up considerably. We even had to send people from here to help them assemble everything.

A main cause behind the problems was a lack of communication. Serial-P had tried to get estimates, but the BETA project team had not gotten updates from Peugeot and Renault. On the other hand, it was difficult to influence automotive customers. They had a large network of suppliers that delivered into their new factories. Reflecting on the changed development rhythm and the financial consequences it had for Serial-P, the Project Manager describes:

> Serial-P called and asked how much they needed. We told them what we thought and added "if you can't make it, you can't." That was stupid. They directly stuck that to us. It is things like that you learn from.

6.3.3 Closing BETA but having a to-do-list left

In the beginning of 2003 the final development gate was passed and BETA was officially ended. One main reason to make this final announcement was to end technical modifications. Instead, quality problems were put in a to-do-list which could be downgraded. An example was the door frame seal. When BETA was assembled, the door frame seal fell apart. Similar to the screw problem, it was difficult to assign responsibilities. Was it a poor design or had Serial-P done a poor assembly? Because of the problems in sorting out responsibilities the door frame seal kept being on the to-do-list well into 2003. Beyond financial responsibilities, the gate model was also used for reflection and learning. For example, in each gate, the project team needed to stop and consider if all activities had been carried out. As the project manager says:

> [The gate model] is important in getting all the relevant feedback so you do not forget anything, that you have a formal revision. Have we checked this and that? I think that's great. Though we have a habit of rushing through these gates a little too quickly. But it's better to have a gate than not.

Since gates sometimes were rushed, an important part of reflection occurred when something went wrong and became costly. This was called "learning money." In BETA, coordinating Design-Net, ramping up production and fixing the door frame seal were three examples. Describing BETA, the project manager ends by saying:

> We developed a product the customer was satisfied with and we kept the deadlines pretty well. Then we made a lot of mistakes. Initially, we did not control Design-Net… ramping up production… then of course the door frame seal. But on the other hand, it is things like that you learn from. Learning money.

6.4 Concluding discussion

6.4.1 Target costing and embeddedness

To conclude this case, the description of BETA has shown how target costing was embedded in a network of close relationships. Rather than a single customer like BMW or a single supplier like Design-Net, the case has illustrated how target costing processes were influenced by interaction in multiple relationships and among parallel projects.

Starting with *customer-driven target costing*, Robotics interacted with multiple functions and hierarchal levels within BMW. A primary cause was the importance of understanding the customer's production processes. For example, BMW wanted a larger Industrial Control System to ensure specific customer modules could be placed within the cabinet. Acknowledging the difference between product and systems functionality is therefore a central part of customer-driven target costing. Another part involved linkages to other customers. For example, BETA could not be started until Peugeot and Renault wanted a larger cabinet and when BMW dropped out, this reduced the financial profitability of the entire project. Handling multiple and sometimes conflicting demands thereby became a key part of customer-driven target costing.

Moving to *architectural-level target costing*, figure 6.5 shows how BETA was related to other projects. BETA started out as a small customization of ALFA but was also connected to DELTA and Voyager. With these technical interdependencies, it was difficult to break down BETA into modules with clear-cut interfaces and sub-targets. Instead, temporary interfaces were set which were then revised as the development process moved along. For example, the scope of BETA was increased when customers wanted to run BETA with multiple robot models and not just the large robot generation, as was previously expected.

On a supplier level, figure 6.5 further shows how *supplier-level target costing* focused primarily on Design-Net and Serial-P. Outsourcing development work, the target cost to Design-Net involved project costs and as a consequence their focus was on BETA and less on cost synergies with other products. In contrast, being the serial supplier for all Industrial Control Systems, Serial-P focused more on production costs and how to develop a standardized concept for several products. As a consequence, having different ambitions, tensions soon built up between the two suppliers and as this chapter described, a big clash occurred when the choice of screws required additional production adaptations.

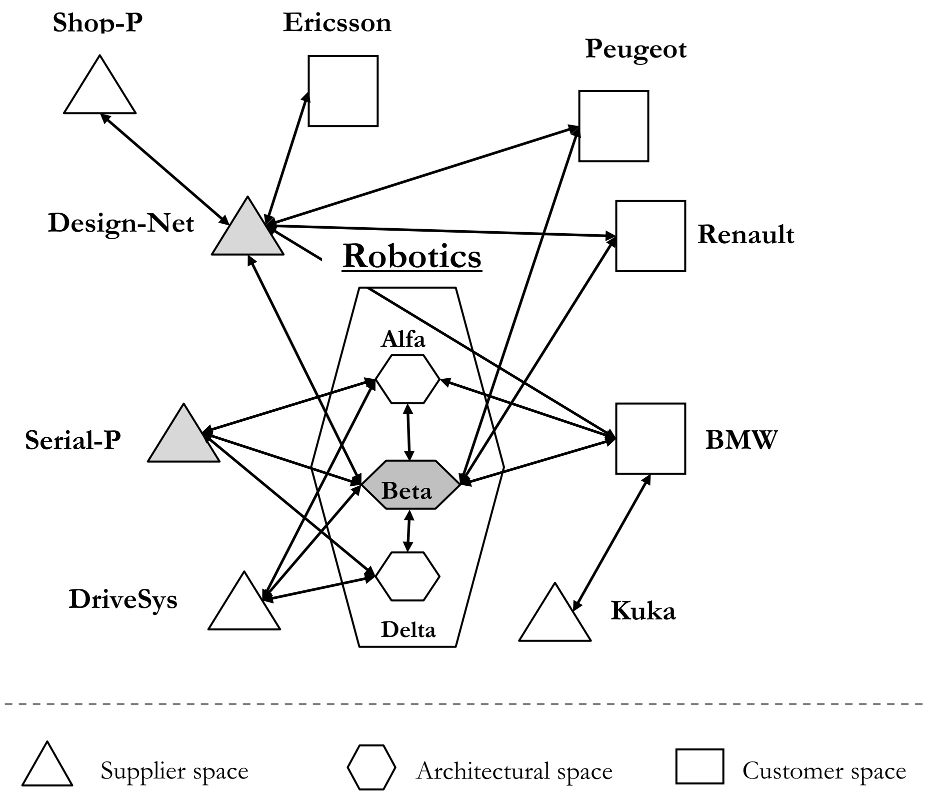

Figure 6.5: Network and project embeddedness in BETA

Furthermore, with changing customer needs, BETA also showed connections between customer, architectural and supplier spaces. For example, tensions between customization and standardization involved actors from several spaces. While Robotics' sales department, Design-Net and key customers argued for customization, product management, production and Serial-P highlighted the need for standardization. Even though the theoretical framework distinguished three different sub-processes, BETA showed how boundaries were more fluid in practice.

6.4.2 Target costing and incompleteness

Temporary alliances and fluid organizational boundaries can be further understood if target costing is related to incompleteness.

For example, as *the concept phase* demonstrated, BETA grew into a project though initially it was never meant to be. Initially, the goal was only to satisfy BMW and keep product development to a minimum. As figure 6.6 shows, it was first when Peugeot and Renault showed similar interests that Robotics realized it would be too costly to do individual customizations. Another troubling aspect was the time pressure. In contrast to ALFA, there was limited time for supplier audits and detailed negotiations. Instead, Robotics and Design-Net signed a quick deal when both parties saw mutual benefits.

During *the development phase*, a number of unexpected events occurred. At first, to avoid additional costs, it was discovered that BETA could be integrated with other products. Rather than treating the project separately, interdependencies to other components and production processes were identified. Secondly, BMW decided to buy robots from Kuka, which reduced the overall target costing sales of BETA. However, having already started with Peugeot and Renault, stopping the project was not seen as an option. On a supplier level, tensions emerged over project costs. When development required new features, Design-Net argued the fixed price was not enough. However, instead of compensating Design-Net, Robotics changed the contractual arrangements and started to buy consulting hours to increase cost control.

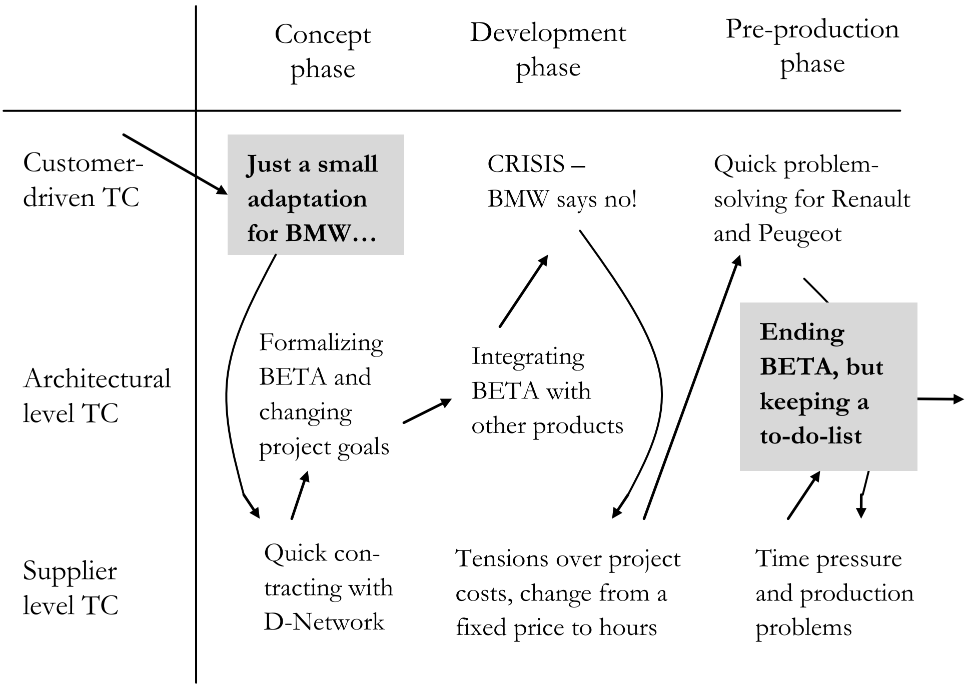

Figure 6.6: Target costing dynamics in BETA

The non-linear target costing process continued during *the pre-production phase*. At first, Robotics had to work intensively with Peugeot and Renault to minimize cost increases. When technical problems such as cooling were discovered, the problems constantly put a pressure on the target cost. Grey zones were a constant issue which often involved both customers and suppliers. For example, when Peugeot and Renault wanted to ramp up production, Robotics had to negotiate cost compensation with Serial-P to finish on time. In the end, BETA was also finished despite having a to-do-list. With all the technical modifications, it was argued that the project had to end and move to a less intensive phase. Finishing the project was also a way of re-negotiating financial arrangements with suppliers. For example, even though the door frame seal did not work perfectly, project closure enabled Design-Net and Serial-P to get their money and a confirmation that activities beyond this period would mean additional project or material costs.

7 DELTA: formalized target costing

Having described "first attempts" in ALFA and "time pressure" in BETA, this chapter describes how target costing became more formalized and detailed. More specifically, learning from previous projects, a central goal in DELTA was to act "professionally" and not allow unclear responsibilities or escalating project costs. DELTA also demonstrates a reversed project dynamic. Rather than *adding* customer functionality, DELTA shows a process of *reducing* functionality to improve product profitability. What started as an ambition to create a revolutionary product therefore ended four years later with a more incremental design.

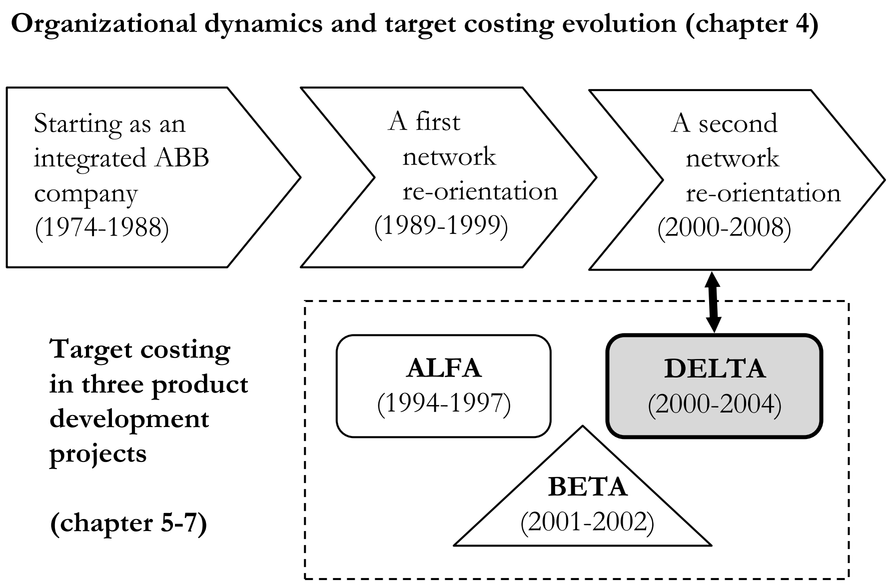

Figure 7.1: DELTA – formalizing target costing

7.1 Target costing during the concept phase

7.1.1 Two customer pre-studies and trying to convince DaimlerChrysler

Even though DELTA officially began in 2000, a first customer pre-study was initiated already in 1997 directly after ALFA was finished. Seeing the growing importance of software, focus in this pre-study was on "intelligent functionality." In total, Robotics conducted thirteen interviews with both automotive customers and new "Potentials". The interviews followed a structured format and focused on technical issues. However, despite the high ambition, the pre-study was never finished because resources were needed elsewhere. As the pre-study report summarizes:

> The project [pre-study] was started in March 1997 and during spring a user study was carried out. Unfortunately more urgent activities appeared and the activity level has ever since been very low.

As a complement, a second customer pre-study was therefore initiated in 1998-99. This time, focus was on concrete product features. Nine interviews were made with different customers. Similar to the first pre-study, many of the customers were geographically close. For example, Volvo became a representative for the Ford Group and Saab for the General Motors Group. Describing the process, one sales manager says:

> Today, when we design new products, we try to incorporate the unique demands of the big automotive customers in our standard product. In DELTA we have focused on General Motors, BMW, DaimlerChrysler… and of course Renault. But it is very difficult. There are always more demands than resources. It is just to pray we have not excluded something too valuable.

During the course of the two pre-studies, MultiMove emerged as an important "customer hang-up." As figure 7.2 shows, MultiveMove means that several robots can work together. Except for the technical benefits, MultiMove also has a cost advantage because only one Industrial Control System is needed to control the robots.

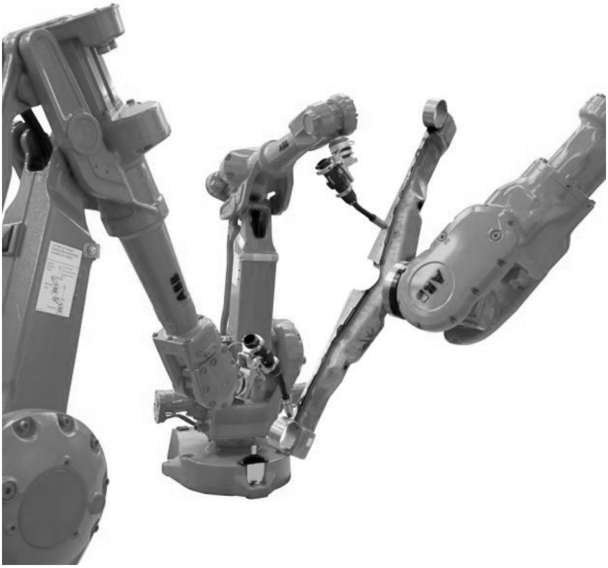

Figure 7.2: MultiMove – moving several robots at the same time

Even though MultiMove became an important customer functionality in DELTA, the idea was discovered earlier. For example, General Motors had shown interest in synchronized robot movements already in ALFA. However, at that point it was considered too risky so the idea was postponed for later projects. During the late 1990s, two events strongly contributed to including MultiMove in DELTA. First, Yaskawa, another robot supplier, launched a similar customer functionality. In fact, it was so successful that Robotics lost a number of customer orders to Yaskawa when they did not offer MultiMove. A direct request from DaimlerChrysler also contributed to the decision to make MultiMove one of the key features in DELTA. With the need to continuously win large automotive orders, the hope was that DaimlerChrysler would play the same important role in DELTA as General Motors had played in ALFA.

A second "customer hang-up" concerned the size. Similar to ALFA, customers wanted smaller Industrial Control Systems. Particularly new "Potentials" such as Foxconn, IKEA and US Postal Service wanted flexible and smaller cabinets. Based on customer pre-studies, a first version of the Market Requirement Specification (MRS) emerged in 1999-2000. Even though the MRS was updated and revised five times during DELTA, it was initially a document of about sixty pages. As one Robotics engineer says:

> In the last couple of years, we have started to make a more formal market requirement specification. Now product development and the sales department go together and write down what the customers want. We need to listen to the market… but of course it's easier said than done.

Cost reduction was a key issue in the MRS. Emphasizing how product development was central in achieving a cost advantage, the MRS stated:

> From the cost reduction standpoint, the product cost level of today's ALFA system is too high (e.g. margins are too low). Over time competition will also force us to continuously reduce the prices. Independent of how much customer value we can add to the system, there is an upper limit price tag.

Similar to ALFA, the overall target cost was set at minus 25%. This was calculated based on 4% annual cost reductions from automotive customers and a product life cycle of five to six years. Furthermore, the overall target cost was divided into three systems configurations representing different customer groups.

As table 7.1 illustrates, the highest target cost was for food and electronics companies. Nestlé and Foxconn can be seen as representatives for these "Potentials." A significant reason this system had the highest target cost was an integrated PC with software. On the medium level, we find automotive customers and their tier-1 suppliers. Based on the technical specification from General Motors, the target cost for this system was indexed at 100. Finally, there was a minimum systems configuration which did not have any customized options. It was used to get a picture of the lowest cost possible. The difference between the highest and lowest system target cost was about 35%. This means if the minimum configuration had a target cost of $8500, the picking and packing configuration had a target cost of $12,000.

System configuration	Customers	Target cost[21]
Picking and packaging	Food and electronics	$12,000
Arc welding	Automotive, tier-1	$10,000
Minimum	Small customers with limited customization needs	$8,500

Table 7.1: Target cost for different system configurations

Except for specific target cost for each systems configuration, customer-driven target costing also involved estimating sales volumes. Initial predictions showed that sales could grow from 9000 robots to as much as 18000 robots per year in 2005. A main cause was the estimated growth for "Potentials." If customers such as Foxconn, IKEA and US Postal Service began with robot automation, the new DELTA systems would be a large financial success.

Furthermore, customer-driven target costing also included estimates about the date when DELTA would be the standard Industrial Control System. Since DELTA was estimated to be 25% cheaper than ALFA and BETA it was important to quickly migrate as many customers as possible to the new system. In fact, after 2004, only the biggest customers would be allowed to purchase ALFA and BETA. Describing importance of satisfying large customers, the sales manager says:

> Except for prioritizing main functionality, we often know about coming projects… that maybe a customer wants 1000 robots. Then we have to

[21] Due to confidentiality the real numbers are not revealed, only the relationship between them, for example around 35% between the highest and lowest target cost.

> make sure our product also covers that. We look at it from many different perspectives. It is not simple… it is damn complex.

7.1.2 Reducing costs by integrating design and production

Experience from both ALFA and BETA had demonstrated that significant cost reductions could be achived by integrating design and production. In DELTA, the production department therefore had a sub-project manager within the core project team. Explaining his responsibility, the production project manager says:

> I guess my role is to make sure the product is easy to produce… economically and quality wise. This means I am part of the design meetings, trying to affect the technical decisions. For example, to make sure we work efficiently with logistics and keep the number of components down. To think of purchasing volumes and discuss with suppliers how they should send the stuff to us.

The importance of design-production integration was also incorporated in Robotics' Supplier Development Model. As table 7.2 illustrates, the supplier development model had five major themes: (1) production plan, (2) tools and methodology, (3) logistics, (4) critical components and (5) sub-suppliers. The list had been developed over time and in many cases, it had been a major crisis that had demonstrated the necessity of updating the supplier development model. For example, the unexpected cost increased that had occurred in both ALFA and BETA had shown the need for a more structured approach.

However, creating a stronger integration between design and production also helped to solve quality problems. More specifically, when robots stopped at important customers such as General Motors and Daimler-Chrysler quick problem-solving was crucial. For example, as was previously described, estimates had shown that every minute of downtime in an automotive factory could cost about $10,000. By then having a structured model that had reviewed production processes at suppliers and sub-suppliers, potential risk areas could more rapidly be identified. In this way, designing "production-friendly" solution had multiple roles; was used to reduce costs during development, but also helped to solve complex quality problems.

Themes	Activities with suppliers
Production plan	Plan how the production process should be built up at the supplier.
Tools and methodology	• Testing policy • Statistical process control • Design for Assembly and Design for Manufacturing • Process Failure-Mode-Effect-Analysis (FMEA) • Joint quality control measurement system
Logistics	Plan how the logistical process should be built up
Critical components	Secure critical components at an early stage
Sub-suppliers	Create a joint policy with supplier for handling sub-suppliers.

Table 7.2: Production activities in the supplier development model

7.1.3 Towards a "professional" supplier relationship

When DELTA began many there was a growing concern that suppliers needed to be more "professional." Even though closeness provided benefits, project members argued that more routines were needed even at this level. This was particularly true for DriveSys since the drives had suffered from quality problems.

The change in dealing with suppliers became evident when DriveSys suggested a joint pre-study. Similar to ALFA, DriveSys argued that an aggressive target cost could be set if close co-operation were to continue. For example, DriveSys estimated that increased integration with other components could save 20-30%. However, Robotics did not prioritize the pre-study. Instead, they focused on comparing and benchmarking DriveSys with other drive suppliers. Reflecting on Robotics' response a DriveSys manager says:

> We wanted to involve ABB, but that discussion did not go anywhere. I guess I can understand it. It is difficult to prioritize long-term solutions when people are trying to solve short-term problems.

To facilitate comparison among suppliers, formalized standards became the norm. For example, supplier selection followed a five step process carried out in a cross-functional team. Describing this increased formalization, a DriveSys manager says:

> Yes, they sent us a real RFQ as we say, a "Request For Quotation." They had specified a number of issues they wanted answered. We knew they compared us with other suppliers. If not, it became obvious when they invited us to Västerås. They gather all suppliers physically on the same day.

In addition to cost reductions, benchmarking suppliers during the selection process was also used for testing technical ideas. Since the target cost was highly related to the functional specifications, Robotics wanted to discuss different technical concepts and its cost consequences. As one Robotics engineer describes:

> In the beginning, we did not want to deal with nine [suppliers], so we thought that if we talked to a lot of people, we would get a feeling for… we had some ideas, some pre-ideas. We wanted to float those and see if they were good or not.

However, at the same time as Robotics wanted to discuss their ideas, large suppliers also tried to sell their standard solution to avoid expensive customizations. Remembering one particular supplier, a Robotics engineer says:

> They wanted to impose their solution on us. When we said no they just would not accept it. That made us feel… they were not offering us what we

> were interesting in. We also felt that they would be a difficult partner, if we could not even agree before they got the contract.

After a prolonged period of comparing suppliers, three finalists were left; DriveSys, ABB Drives and Yaskawa. Before the final decision, each department involved in the DELTA project team summarized their recommendation in a SWOT-analysis. In contrast to ALFA, the project team did not choose DriveSys. Instead, ABB Drives was recommended because even though Yaskawa had done a good job, they were seen as too much of a risk since Yaskawa also sold robots.

However, the recommendation by the project team was overruled by Robotics' top management. Since DriveSys had been a long-term supplier, the issue was brought up to top management within both companies. After significant quality assurances from DriveSys, top management within Robotics placed a higher value on the relationship than the project team did. Wanting to avoid risks it was therefore decided to continue with DriveSys.

To summarize, during the concept phase, target costing became more formalized. In customer-driven target costing, two pre-studies were conducted and a detailed Market Requirement Specification was written. In architectural-level target costing integration between design and production was prioritized and a number of production activities were included in the supplier development model. Finally, in supplier-level target costing, the goal was to become "more professional". For example, Robotics turned down a joint pre-study with DriveSys and instead concentrated on benchmarking drive suppliers through SWOT analysis, and requiring formal Requests For Quotations to facilitate comparisons.

Even though improvisation was still important, compared to ALFA, the target costing process began to look more like "text-book" examples (e.g. Ansari and Bell 1997, Cooper and Slagmulder 1997) where focus was more on planning and trying to discipline suppliers. However, as will be seen, this was about to change as new unexpected discoveries soon emerged.

7.2 Target costing during the development phase

7.2.1 A revolutionary suitcase design solves multiple tensions

Based on the customer pre-studies, the project team began to investigate technical solutions. Describing initial problems with the cabinet size, a project member says:

> Our work was based on a pre-study the marketing side had conducted. It said that floor space was an important parameter for selling systems in the future. I remember that we had to negotiate and interact intensively with our suppliers to get their solutions to fit the new cabinet.

Conducting functional analysis, a radical solution emerged. Instead of having one cabinet, the new architecture could be developed into different "suitcases." The advantage with this extreme modularization was that customers could place "suitcases" wherever they wanted. For example, since new "Potentials" often had smaller factories, they could place one "suitcase" below the conveyor belt and another next to the robot. By designing DELTA this way, the size of each robot cell would shrink which would enable customers to have more robots within the same factory.

Functional analysis was further improved by formalizing decision-making into a technical forum. In ALFA and BETA, functional analysis had often been done through informal "corridor decisions". Even though this had facilitated rapid decision making, it had drawbacks. For example, sub-projects were not always informed about changes, causing double work. Describing the benefits of a more formalized approach, a project manager says:

> Our technical forum is one of the really positive things. There you deal with technical decisions that are more general than what can be handled in the sub-projects. It involves price, quality and even the interface between hardware and software. There we have a very cross-functional group from the entire company. From product managers, the main project manager and

> most often all the project managers for the sub-projects. We have a technical coordinator that is responsible for an "open issues list." He assigns a person who is responsible for each issue. In general, we strive for consensus decisions.

The use of checklists was another way to improve functional analysis. The checklists had two parts, one before project start and one during development. The checklists were also used to avoid unexpected costs. For example, by remembering key activities, project target costs would not be increased.

However, despite increased focus on planning and formalization, improvisation was still needed. One main reason was that MultiMove became more complex than expected. Describing how DELTA kept adding sub-projects, a project member says:

> DELTA constantly grew bigger. Most of all the software. It is very complex and has many areas. Sub-projects were added all the time. From the beginning we had two and in the end it was up to five or six sub projects.

The unexpected project complexity in DELTA also affected suppliers. For example, when Robotics was busy coordinating internal activities there was less time for giving feedback. On the other hand, Robotics felt they compensated suppliers since the target cost was re-negotiated as fast as a technical modification was needed. As one Robotics project manager describes:

> The classical example is that you have a target cost that should not change. However, we always seem to change the technical specifications during the project. When that happens... the component rarely gets cheaper. If something becomes more costly they [the suppliers] are quick to add to the project as well as the product target cost.

7.2.2 "Professionalism" creates problems

On a supplier level, development with DriveSys started in August 2001. Since supplier selection had taken longer than expected, the initial plans had already been delayed. Describing the time pressure, a DriveSys manager says:

> During the selection, we tried to break down everything into concrete activities. We made cost estimates and had a time schedule. But then, we were fighting alternatives, which at least Robotics presented as "off-the-shelf" products. So demands on time were very tough.

Compared to ALFA there were two main differences in DELTA. First, both project managers from Robotics and DriveSys were new. They had not been part of ALFA or the problem-solving with different re-designs projects. Secondly, target costs and deadlines were tougher in DELTA. With the ambition of becoming "more professional," focus shifted from joint interests to company interests. Describing the change, a Robotics project member says:

> Before, we did a lot of things that were their responsibility. This time it is a much sharper boundary. This is your responsibility and this is ours. We try to run this professionally.

To reduce costs, a critical decision involved component integration. Should the drive have an integrated 6-pack?[22] Beyond reduced costs, increased integration would also make the drives smaller. However, a 6-pack had disadvantages. If a quality problem occurred, the entire drive system had to be replaced, and an integrated 6-pack was also heavier. The increased weight

---

[22] A drive system consists of one drive for every axis (often a robot motor) it is running/driving. A critical design decision is then to choose the modularity of the system. For example, in ALFA, the drive system consisted of three 2-packs for large robots and two 3-packs for smaller robots.

was not favored by Robotics' key account managers. Emphasizing quick customer service, a heavy drive was seen as a disadvantage.

After discussing back and forth it was decided to go with an integrated 6-pack. DELTA needed to reach the target cost and DriveSys also argued that quality could be improved. A product manager at Robotics describes how it was not a clear-cut decision:

> The modularity of the drive system was a hot issue. We chose to do a 6-pack, all axes in one module. That was very controversial, since we got a heavy and expansive spare part. With quality problems some people argued it could be a mess to send them all over the world. However, we did not change, mostly for cost reasons but also since Fanuc also had introduced a similar drive.

From September to December 2001, DriveSys worked intensively with the software to ensure that the drive could start communicating with the Industrial Control System. In fact, the time pressure was so tough it was not possible to use gate-models. As one Robotics engineer describes it:

> The first thing was to try to fix the communication protocol. So there was a lot of information going back and forth. We wanted them to design and develop it and then we would keep an eye on what they were doing and make suggestions how we felt it should progress.

Tensions and frustration gradually emerged. In ALFA, resource sharing had been a key issue. However, in DELTA, DriveSys was not allowed to borrow testing equipment. Instead, Robotics argued DriveSys should build their own. Since this was costly, DriveSys settled for a compromise, a simulation tool. Reflecting on how "professionalism" changed interaction patterns, a DriveSys manager says:

> It was not the same… you called each other because you had to. Before, we called each other because we wanted. Maybe, the old way was good because many times feathers did not turn into hens.

With limited feedback and new views on project management, a crisis occurred when the first prototypes did not work in March 2002. A Robotics project member describes the frustration:

> We expected we would be able to run a motor with the first prototype. That was the first big crisis we had with DriveSys. Because, when the prototype arrived, it was a long way from being ready to run a robot.

DriveSys felt Robotics was unfair. With a tight schedule and limited feedback, project cost had started to escalate. In fact, a technical manager at DriveSys argued their development budget had almost doubled compared to initial estimations. With a prototype that did not work and increased costs both parties realized how critical the situation was. To avoid further arguments, a joint workshop was arranged. Except for project members, senior managers from both Robotics and DriveSys participated. During the workshop, both sides got the opportunity to tell "their side of the story". Describing the crisis, a senior manager at DriveSys says:

> We had a crisis during the spring of 2002… they did not think we had done anything, while we felt we were almost on track. Ok, we were a bit late, but it was not anything drastic. During the workshop we realized the difference… ABB did not think we had begun, while we thought we were almost done.

7.2.3 CRISIS – automotive customers refuse to buy the suitcase design!

Among customers, it had become evident the New Economy would remain a dream. Both automotive customers and "Potentials" had reduced their investments and the predicted target sales volumes of 18000 robots in 2005 needed to be revised. As a consequence, the VEGA product development program was drastically redued and Apollo, the crown jewel of VEGA was closed down. As an internal memo reads:

> Apollo, the largest project ever run by Robotics, was canceled before passing Gate 3. The main reason for closing the project was the PIP cost cutting

> program and the drastically increased risk and complexity in managing parallel releases from the Apollo and Delta projects. The parallel release was a result of the delayed Apollo CTRL release schedule.

In the fall of 2002 it was DELTA's turn. At this point, the first prototypes had been delivered. Even though the idea of modular "suitcase" architecture had been discussed, this was the first time a full prototype was demonstrated. Quite soon, critique came up. As one Robotics manager describes it:

> People started to mumble in the corridors. After some time, a sort of revolt movement grew. At first, you did not want to see it. It was too terrible to be true. We would never consider a re-design so late in the project. But after awhile, everyone realized this was the only option.

A main problem was that suitcases were too radical for automotive customers. More specifically, problems in BETA had shown that quality needed to receive a higher priority. Describing the situation, a project member says:

> I felt something was bound to happen. I mean, it felt damn strange with some solutions… A main thing was cables. I felt this is not going to cut it. We do not have a good solution. We cannot continue to say "this will work out", especially not when that point was passed way back.

One reason while these quality issues had not been critically examined was that the new "Potentials" had been prioritized in the beginning of DELTA. However, in the fall of 2002 things had changed. Instead of radical solutions Robotics had decided to re-focus on automotive customers. Describing the situation another project member says:

> Initially we focused on the consumer industry but then we changed to automotive [customers] over time. When this happened, automotive said they had never fitted the concept. But, I mean it was not the goal to please them, but to target the rest… 30-40% of the market. Automotive would be addressed first after testing DELTA on other customers.

When the re-design was evident, different alternatives were considered. A central issue was to evaluate how much functionality that could be re-used to avoid further cost increases. Suppliers had already invested in production tools and customers were asking for the new generation of Industrial Control Systems. After weighting pros and cons, it was decided to re-start DELTA in two projects, one for hardware and one for software. A lesson from the development phase was that DELTA had grown too big. Coordination had become too complex. As a senior engineer argues:

> One thing that did not work well in DELTA was that… for many reasons many technical initiatives landed in the same project. In the end, the project became too complex. I think that is a… the risk exposure increases.

To summarize, during *the development phase* it became evident how difficult it is to find an appropriate level of formalization. On the one hand, the formalization of functional analysis reduced problems with corridor decisions. On the other hand, "professionalism" created a crisis in the supplier relationship with DriveSys. Due to limited interaction, "feathers turned into hens" as one of the DriveSys managers said.

Furthermore, even though Robotics had formalized the process of collecting customer input, a major crisis occurred when automotive customers did not accept the radical suitcase modularity. In fact, DELTA was closed down and re-started in two smaller projects, one for hardware and one for software. In contrast to ALFA and BETA, the pre-production phase therefore shows how a company can recover from such as devastating crisis.

7.3 Target costing during the pre-production phase

7.3.1 Project re-start creates time for new cost reductions

Even though the magnitude of the technical problems had gradually become evident, a close down was a surprise both for the project team and suppliers. As one project member expresses it:

…it is like moving the goal line or changing sports right in the middle of it. Today, we are not playing tennis, because we have decided to play badminton. There we are…stranded …it's a little of that right now. The components in the cabinet are designed for another concept… We can't do anything but our best to deal with the situation.

Another project member describes the situation as chaotic. Since it was late in the development process, many suppliers had started to purchase material and invest in production equipment and personal. Describing suppliers' frustration, the project member says:

I think they were in shock. Many of them had build production lines and stood ready to ramp up production. Then you have a stop. I am sorry, we'll have to postpone…

Before the re-design, all major suppliers were invited to Robotics. Except for the project team, several senior managers attended the meeting. An important message was that DELTA would be finished. Instead of three suitcases, DELTA would be divided into two modules. Describing the situation, a project member says:

The consequence is… I mean, they are professional in most cases. They agree to the changes… but, how should I put it, I am not sure they trust us really the next time… no…

However, the re-design also opened up for new opportunities. For example, DELTA had time to incorporate robot production. Up to 2003-2004, Robotics had not used robots in their own production. With a delay a window of opportunity opened up. In a similar way, the project team re-evaluated components to reduce the target cost. As one project manager describes the cost-reduction process:

After the re-start, we went through every item of the technical specification which we then discussed on the technical forums. We did what we call "SMASH-analysis". For example, we added logistical costs for adding

> another article number and not just the material costs. It was a lot of cost focus then.

On the other hand, technical modifications also added costs. For example, when the drives were assembled, the holes connecting the drive with the cabinet were not placed directly under each other. As a consequence, Robotics had to compensate DriveSys for a smaller modification on the drives. Describing how technical medications both increased and reduced costs, a project manager says:

> Small things come up all the time. I guess the PRS [Product-Requirement Specification] was agreed upon three years ago… But even with a handshake, there are always new demands. "This would be good to have…" So you try to adapt and maybe you are successful. I definitely think we could have lowered the product cost if we had had the right information from the beginning.

7.3.2 Combining both "family" and "professional" aspects gives results

On a supplier level, both Robotics and DriveSys realized working routines had to change. First of all, interaction intensity needed to increase. Before the crisis, Robotics and DriveSys had only communicated once or twice a month. Often, there was no fixed agenda but more of a check-up on how DriveSys was doing. Instead, a joint decision was made to begin with weekly meetings. Meetings were held primarily over the phone, but included cross-functional representation from both Robotics and DriveSys. All meetings also had a set agenda with three parts: software, hardware and open issues. Describing the weekly meetings, a Robotics project manager says:

> The weekly meetings really helped, because it meant that rather than having little problems building up to a crisis, there were just lots of little problems which are always easier to deal with.

To avoid misunderstandings, a "master" document was also created. During the week, both parties entered current status, problems and if anything strange had happpended. By doing so, both coordination and control was facilitated. Beyond visualizing activities, working routines also created a shared development rhythm. Before the crisis, both parties had trouble with the rhythm. Robotics had set tight deadlines and DriveSys had not communicated in time when they were late. Being self-critical, one Robotics project member says:

> I am sure they also have opinions about us… and accurately so… We are not smart in all situations. For example, I think we can be a bit unclear. We probably give feedback of the last minute. They get panicked when deadlines are so short. I think there is a lot of stuff like that.

Describing the importance of information flow, another Robotics project member says:

> We came in with no personal relationships with them. We just expected them to work in a particular way. We got a lot of experience with suppliers and I could see that the honesty, the open flow of information is the key to making this work.

Another way to develop trust was to create shared expectations about deliveries. For example, a principle cause to the crisis was that Robotics had expected a drive that could be tested in the Industrial Control System, while DriveSys thought the ambition of the first prototype was "a drive that was well on its way." To avoid misunderstandings, software deliveries were therefore divided into "black" and "white." A "black" delivery meant Robotics knew it was not fully tested while a "white" delivery meant it was an official release that DriveSys had tested. Describing the change, one Robotics project manager says:

> Now, if I send an e-mail where I say that I have noticed that this is strange they will do everything it takes to fix that problem… They very much drive their issues. It is kind of perfect (laugh).

Cost discussions were still a big part of DELTA since both Robotics and DriveSys had tougher financial demands compared to ALFA. Describing the importance of financial awareness, a DriveSys engineer says:

> ABB is a very demanding customer… ABB is a big company so… they pressure us quite a bit. They want both quality and low price. I think they have gotten that so far… but there is always an end to. We also have to make a profit.

Financial discussions were particularly related to unexpected cost increases. In ALFA, this informal "give and take" had been handled between the project managers. Having a constant dialogue as well as a strong position within each company, this worked out well. In DELTA, it was more difficult. Project managers were new, internal demands were tougher and the initial crisis had created distrust. Describing financial discussions around milestones, one Robotics project member says:

> They were very focused on getting us to agree that they had done something and that they had fulfilled some requirements so we could release some extra amount of cash.

7.3.3 Losing DaimlerChrysler but recovering with Benteler

On a customer level, DaimlerChrysler had emerged as a lead customer. Being a strong advocate for MultiMove, Robotics had even started a separate project to win the DaimlerChrysler order. Describing the process of answering more than 300 technical questions, a Robotics manager says:

> There are fields for comments and there you try to communicate your advantages. Most issues can be solved, one way or another… If you also have additional unrequested functionality, you try to use this. Perhaps attach a Powerpoint. A lot of… general marketing is done. We have participated in conferences within Daimler where they have all their engineers. Showed them demo cells to try to create a buzz. Especially with MultiMove, that has been demanded.

However, despite DaimlerChrysler's interest in MultiMove, Robotics lost the order. Similar with BETA, the German robot manufacturer KUKA won. Robotics only got minor volumes. Without a lead customer, focus shifted towards tier-1 suppliers. During the 2000s, these robot customers had become more important. A close customer was Benteler, a family-owned company in Germany. Specializing in arc welding, Benteler worked closely with both Peugeot and Renault. Also wanting MultiMove, Benteler became a suitable substitute. Describing the change, a Robotics manager says:

> The idea was to develop MultiMove for Mercedes. We had prototypes and everything. By accident, I was in a taxi with our German technical manager when he found out we lost the order. We only got a few crumbs. However, parallel to this our arc welding guys had done a great job at Benteler, which is a tier-1 supplier to the automotive industry. They had agreed on 200 systems with MultiMove. So we changed and used Benteler as a lead user.

Through direct observation, I participated in the "go ahead" meeting in March 2004. The meeting was held in Robotics' top management conference room. Even though the table could hold 12-15 people, this was not enough. Around the table and along the walls were members from design, production, sales, quality, logistics and production. "Shadowing" the Project Manager, I was briefly introduced and then sat down in the back[23]. The central issue during the meeting was if DELTA was ready or not. Was the quality good enough for Benteler? Sales, product management and the DELTA project team wanted a "go ahead". After the crisis and the large re-design, it was important to introduce the product. On the other hand, the quality manager reminded the group about previous projects. For example,

[23] There was no formal seating, but it seemed to follow seniority. At the head of the table, closest to the whiteboard was the chairman and the project manager of DELTA. Moving down, functional managers sat, for example the sales, design and production managers. These were mostly men between 40-55 years old. Along the walls sat project members or junior managers who were mostly in their 30's.

when Robotics launched S4, functionality had not been ready[24]. The quality manager looked around the room and asked if Robotics was in a similar position now?

Acknowledging the problem, the project manager argued that risks were reduced because of component "carry-overs" from previous projects and because Benteler was an old and trusted customer. Still, several line managers agreed that sales would have to wait before initial evaluation. From a target costing perspective, focus was on quality, project resources and possible risks. Reducing the cost was not prioritized at this point. Instead, the meeting gave DELTA the go ahead and suggested further cost reductions would start when DELTA was tested and in serial production.

The Benteler delivery project began in April 2004. Experienced managers were chosen as project leaders and, similar to the project with General Motors ten years earlier, a joint project team was formed with Benteler. During the summer of 2004, the first pre-series came out. According to one of the project managers, all systems were delivered on time. Still, there were also problems:

> Initially, they wanted more functionality, but we had to compromise to get everything in place… I mean… when are you done? Development never really ends. Of course, we wished we could do more… improve quality… There were several updates with Benteler, but then again, you always have small problems in the beginning.

Intense interaction and problem-solving continued during the fall of 2004. One reason was Benteler's production layout. Instead of single robots, DELTA was directly run with MultiMove. The increased technical com-

---

[24] S4 was the software and computer part of the ALFA generation. Technically, it was perhaps the most important project during the 1990's. It introduced a new motion control technology (how the robot moves) and software architecture. By doing that, customizations became easier, cycle-times were reduced and robots became more accurate.

plexity increased costs more than expected. Describing the process, a product manager says:

> We had a detailed follow-up on each steering committee meeting. During development, initial cost estimates were turned into concrete numbers… Until the end, it looked very good: the cost was steadily reduced and we thought we would reach the target cost. Then, in the end – puff! – everything went straight the other way. A number of late and costly components had been estimated too optimistically.

As a consequence of the unexpected cost increases, the target cost was not reached. Instead, a number of cost-reduction activities immediately began when DELTA ended in November 2004.

7.4 Concluding discussion

7.4.1 Target costing and embeddedness

Starting with *customer-driven target costing*, DELTA demonstrated how target costing occurred together with a few large customers. For example, a separate sub-project was created to fully understand the needs of DaimlerChrysler. DELTA further illustrated several challenges with target costing. First, it was difficult to get resources to finish pre-studies and when customer feedback was collected, tensions emerged between different customer needs. For example, it was difficult to add more functionality which automotive customers required at the same time as new "Potentials" wanted DELTA to be reduced in size.

Moving to *architectural-level target costing*, DELTA showed how cost reductions also occurred on multiple levels. On the one hand, it was important to break down DELTA into smaller modules, but on the other hand the technical boundaries kept changing. For example, re-designing the suitcase modules required changes in several interfaces. Another challenge in the architectural space was found in parallel projects. As figure 7.4 illustrates, when DELTA started it was part of the VEGA program which included both robots (Voyager) and software (Apollo). However, problems of synchronization occurred when Apollo was closed down and Voyager finished. Architectural-level target costing therefore managed costs by combining and re-combining components both within and across parallel projects.

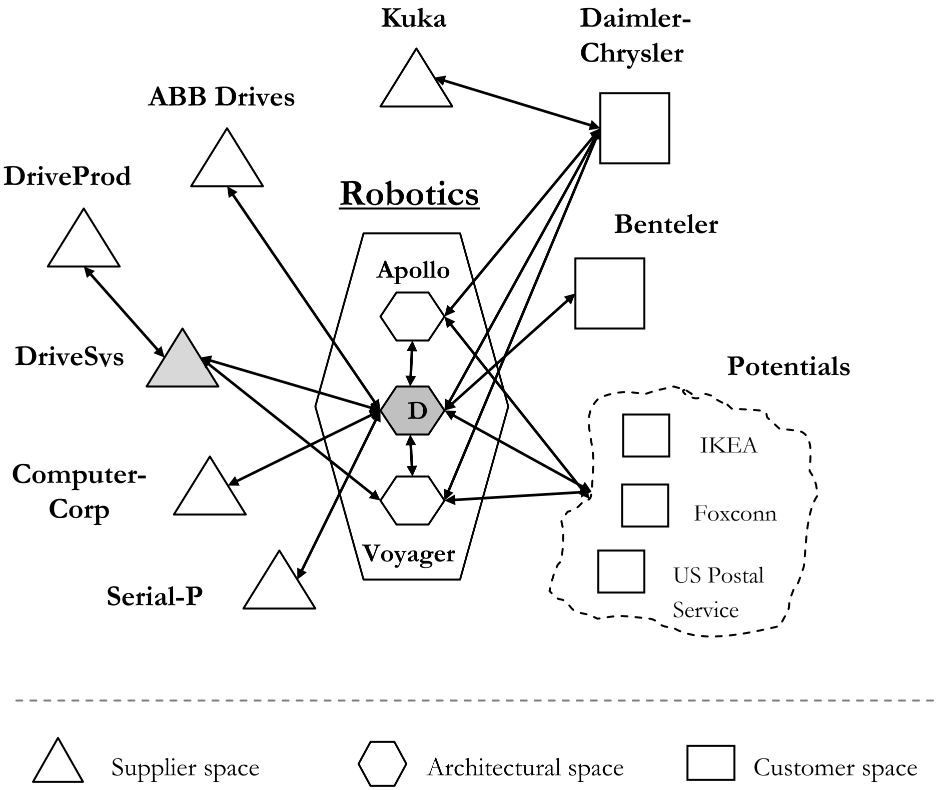

Figure 7.4: Network and project embeddedness in DELTA

Regarding *supplier-level target costing*, DELTA illustrated problems with "professionalism". Learning from previous projects, Robotics' ambition was to clarify responsibilities and avoid escalating project costs. However, less interaction created confusion and parallel work. For example, DriveSys spent additional resources to reach deadlines and Robotics also had increased costs when testing activities needed to be re-scheduled. Another part of supplier-level target costing involved large suppliers such as Computer-Corp. In contrast to DriveSys, it was difficult for Robotics to get priority since these suppliers had other important customers[25]. For example, when Robotics did the re-design and wanted prototype material, it was challenging to convince a large supplier in Asia to re-schedule their production to fit in a limited number of prototypes.

7.4.2 Target costing and incompleteness

An interesting pattern in DELTA was that the project began with grand plans and was trimmed when the New Economy vanished. Throughout this process, DELTA experienced a number of crises; the project was closed down, it was re-designed and DaimlerChrysler chose KUKA, another robot manufacturer.

Starting with *the concept phase*, target costing focused on understanding new potentials. Even though specific automotive customers such as DaimlerChrysler were dealt with, the priority was on customers such as IKEA, US Postal Service and Foxconn. During this phase, it was also important to understand the consequences of a larger customer base. For example, to reduce costs, DELTA was the first platform project where the production department was part of the core team. Earlier projects had involved production staff, but this was one of the first projects with production related project goals. Suppliers were also affected when Robotics tried to address both old partners and new potentials. For example, smaller- and often local suppliers were replaced and as figure 7.5 shows, Robotics began to move towards "professional" supplier relationships.

Continuing with *the development phase*, this phase was characterized by a number of unexpected events. First, suitcase modularity emerged as a solu-

---

[25] Problems with large global suppliers are also described in chapter 4.3 and the discussion of "riding the wave" suppliers.

tion to handle customer tensions. When new potentials wanted a smaller cabinet at the same time as DaimlerChrysler wanted MultiMove, this seemed too complicated. However, by dividing the cabinet into smaller suitcases, a compromise emerged. Still, new problems kept coming up. On a supplier level, Robotics and DriveSys went through a local crisis when the drives were late, and when automotive customers saw prototypes of DELTA, a major crisis occurred. In fact, the project was temporarily closed and re-started as one hardware project and one software project. The automotive customers who initially had not been as influential therefore forced a re-design which delayed DELTA for several months.

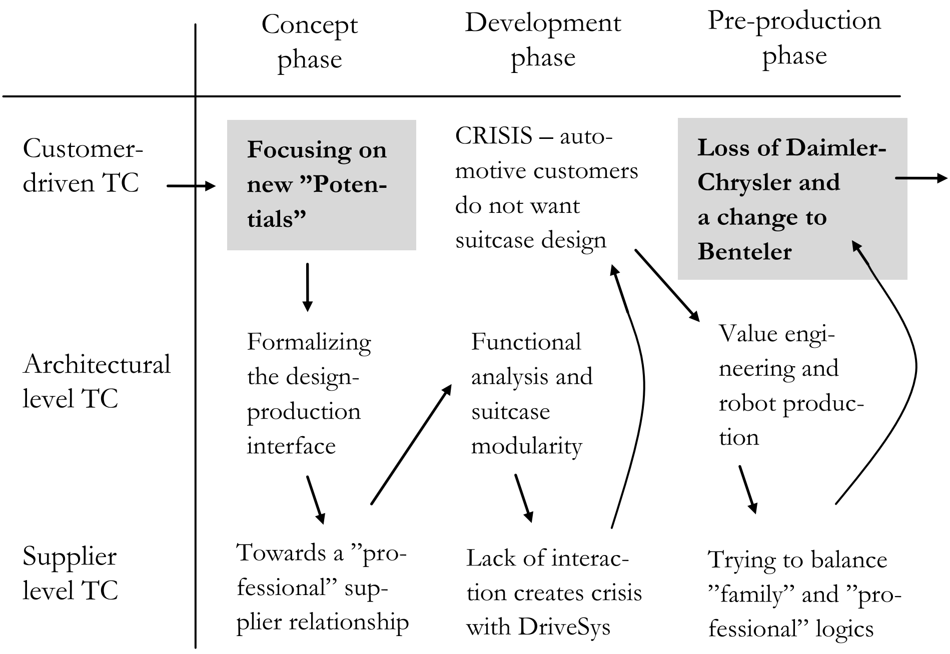

Figure 7.5: Target costing dynamics in DELTA

During *the pre-production phase*, target costing faced new challenges. At first, the re-design escalated and started to involve more interfaces. For example, adopting DELTA to robot production caused changes to a number of technical interfaces. Since these changes were done together with suppliers, negotiating modifications became a frequent practice. However, one of the largest changes during the pre-production phase was the loss of Daimler-Chrysler. Despite the inclusion of MultiMove, DaimlerChrysler chose Kuka as their robot supplier. Robotics therefore had to find a new customer. Fortunately, this materialized when Benteler decided to buy a large number of robot systems. The target costing process was therefore filled with improvisation to deal with unexpected events.

8 Target costing and embeddedness: a cross-case analysis

Having described target costing in ALFA, BETA and DELTA, it is now time to return to the research questions introduced in chapter two. More specifically, chapter eight focuses on network and project embeddedness by analyzing customer-driven, architectural-level and supplier-level target costing. For each sub-process central patterns will be described followed by a section where the findings are analyzed in relation to previous research. By following this structure, the reader first gets to know the central elements within each sub-process before the results are problematized in relation to the key research fields in this thesis; target costing, inter-organizational accounting and accounting-and-new product development.

8.1 Customer-driven target costing

Analyzing the three projects, two patterns will be specifically highlighted for customer-driven target costing. First, regarding a *single customer relationship*, customer-driven target costing was characterized by interaction and negotiations. Not only did Robotics use target costing, so did General Motors and DaimlerChrysler. The empirics therefore showed how Robotics was not a passive supplier. Instead, customer-driven target costing occurred on multiple levels where it was important to create alliances to identify and understand how customers prioritized different functionalities.

However, customer-driven target costing also had to deal with synergies and tensions between customers on a *network level*. For example, while "Potentials" such as Foxconn wanted the suitcase modularity in DELTA, automotive customers such as DaimlerChrysler argued it was too risky. Handling tensions both on a dyadic level as well as on a network level were therefore two central patterns in customer-driven target costing.

8.1.1 Target costing in a single customer relationship

As all three cases showed, a critical aspect in customer-driven target costing was to explore win-win situations. For example, as was shown in ALFA, at the same time as Robotics needed a reference customer to secure target sales levels, General Motors' purchasing department needed a new robot supplier to challenge Fanuc. Instead of quantitative surveys involving a large number of customers, Robotics needed to create win-win solutions with a few large customers.

With insiders on several hierarchal levels, a main challenge in customer-driven target costing was to understand how the customers used their robots. For example, as all three development projects described, there were two main types of customer functionality; product functionality and systems functionality. *Product functionality* described features of the individual product, in this case the Industrial Control System. This type of functionality was standardized, regardless if the robot system was integrated with the customer's production system or not. *Systems functionality* on the other hand was developed when several products or services were combined. For example, it was the joint interaction between Robotic and General Motors that made them discover how computer power could be used to integrate ALFA with General Motors' production equipment.

Since systems functionality emerged in close interaction, leaving room for flexibility was an important issue in customer-driven target costing. Early development therefore focused on "customer hang-ups." Instead of calculating the profitability of each function, focus was on identifying functionality which could win or lose future orders. For example, an important "customer hang-ups" in ALFA was to reduce the size of the Industrial Control System. The prioritization of other customer functionality was then based on how it would affect the "customer hang-up."

An important document that linked product and systems functionality was the customer's technical specification. Since decisions to purchase robots involved individuals from different departments and different levels, it was not until a specific functionality was included in the customer's technical specification that Robotics could expect a more long-term commitment.

Negotiating modifications was also an important part of customer-driven target costing. In fact, handling modifications was a central element in managing costs. For example, when General Motors wanted additional functionality, there were tough negotiations to see how these unexpected costs would be distributed between Robotics and General Motors. The importance of negotiations for understanding customer-driven target costing was also seen in DELTA. Having MultiMove as a "customer hang-up", Robotics interacted intensively with DaimlerChrysler. A separate subproject was even formed just to cope with DaimlerChrysler's more than 300 technical requirements. Rather than analyzing a mass market, customer-driven target costing had an interactive *relational character*, either in dealing with development of insider relationships or in learning how robots could reduce costs in future production systems.

Compared to the large platform projects, BETA illustrated both similarities and differences. On the one hand, there was a similarity in that customer-driven target costing was interactive and order-driven. For example, Robotics created prototypes to meet the goals set up by BMW, and individuals on several hierarchal levels were involved. However, in contrast to ALFA and DELTA, BETA was not started until it was absolutely necessary. In fact, Robotics tried their best to avoid a costly development effort. It was not until both Peugeot and Renault had put forward similar requests that the costs of these customizations motivated the start of a "real" project. The type of product development project therefore affected how target costing was initiated. For large platform projects, the central goal was cost reduction, and because of this, the project was started before any large customers had committed. In contrast, for customer projects such as BETA, it was the size of customizations that forced Robotics into a new development projects. Initially, the goal was just to contain cost, but if customizations became too complex, a totally new project was formed to ensure quality and long-term cost control.

8.1.2 Target costing in multiple customer relationships

A second aspect of customer-driven target costing was the process of handling *tensions between different customers*. As BETA illustrated, the project was first allowed to start when the BMW order was complemented with Peugeot and Renault. Before customer synergies were achieved, Robotics did all they could to minimize customizations for BMW. A key challenge in customer-driven target costing was therefore to calculate if customer functionality could be re-used in other customer relationships. In many instances this was easier said than done because the specific customer often offered such a large order that Robotics could afford the cost of smaller customizations if the entire contract was won.

Customer-driven target costing on a network level also involved *indirect third parties*. More specifically, the goal of reaching target sales volumes was seriously affected when KUKA convinced BMW that they were a better robot supplier. Even though Peugeot and Renault purchased several hundred robots each, the loss of nearly two thousand robots drastically changed the estimated profit of BETA. The difference between financial success and financial failure therefore rapidly changed when the largest customer decided to leave for another robot supplier.

Network embeddedness was also demonstrated in ALFA and DELTA. For example, in ALFA, Robotics had first to handle tensions between key customers regarding the cooling system, and during the pre-production phase time pressure increased when BMW and Volvo were added as lead customers. Even though General Motors was the most important customer in ALFA, customer-driven target costing also involved an analysis of these other network effects because target sales for ALFA could not be met by only selling to General Motors.

In DELTA, network embeddedness involved a considerable amount of improvisation. For example, a significant crisis emerged when key automotive customers refused to purchase DELTA, and during the pre-production phase, Robotics had to quickly replace DaimlerChrysler with Benteler when DaimlerChrysler chose to give a large part of their order to Kuka.

8.1.3 Connections to research literature

As Nicolini et al (2000) observed, there is a need to find new ways of understanding target costing in close customer relationships. This section therefore links customer-driven target costing at Robotics to empirical observations made in previous research literature.

A starting point for problematizing customer-driven target costing can be found in Nixon's study of 1998. Even though Nixon has an intra-organizational focus, he describes how the case company CCM Ltd uses target costing in relation to an Iranian customer. In contrast to many other studies on target costing, the most important target cost is the customer's operating cost and not the product cost itself. For example, the Iranian customer compensates CCM Ltd for adding a recycling function late in the development process because it reduces the overall operating cost. Nixon's observations share many similarities with customer-driven target costing at Robotics.

There are also other empirical observations that support customer-driven target costing. For example, Cooper and Slagmulder (1999) describe how Toyo Radio had a few large business-to-business customers. Similar to Robotics, revenues were order-driven and the top ten customers made up 60-70% of revenues. Mouritsen et al (2001) also describe target costing practices that are similar to customer-driven target costing. For example, the case company NewTech sold customized solutions where customer interaction was critical. Other empirical studies that support customer-driven target costing are Swenson et al (2003) who describe the cost of customization at Boeing and Everaert et al (2006) who show how target costing is done interactively with large automotive customers.

Still, as Nicolini et al (2000) conclude, explicit empirical and theoretical work has been lacking. By highlighting the interactive and embedded nature of target costing, this thesis brings new perspectives to the target costing literature. For example, rather than analyzing a market as Cooper and Slagmulder (1997) do, continuous dialogue was important for Robotics to get a commitment and learn about the customer problem. Furthermore, as all three projects demonstrated, Robotics started with one customer but finished each project with another lead customer. The use of target costing to explore win-win situations was therefore a difficult but central task, regardless if it involved a platform or a customer development project.

The empirics also give reason to discuss the boundaries of customer-driven target costing. For example, in line with Cooper and Slagmulder (1997), market-driven target costing was used for smaller customers. Without the need for customized solutions, Robotics grouped customers in different segments and treated them in a similar way. For example, DELTA had three system configurations with different target prices. In line with observations made by Davila and Wouters (2004), it was also difficult to apply target costing to new customers such as IKEA, Foxconn and US Postal Service. With limited experience, these customers did not have the knowledge to give valuable feedback about future development projects. Similar to medical equipment customers in Davila and Wouter (2004), the new "Potentials" therefore illustrated when target costing was difficult to apply.

Moving beyond target costing, there are interesting links to broader accounting literatures. Starting with inter-organizational accounting, there is a growing body of literature that deals with customers (Mouritsen 1999, Håkansson and Lind 2004, Lind and Strömsten 2006, Thrane and Hald 2006, Cäker 2007). However, even though network embeddedness has been emphasized, none of the articles focus on the project level or take a longitudinal perspective. For example, Håkansson and Lind (2004) and Lind and Strömsten (2006) offer static frameworks and while Mouritsen (1999) and Cäker (2007) provide detailed studies, they primarily focus on single customer relationships. On the contrary, Thrane and Hald (2006) discuss how several customers are dynamically connected over time. However, except for mentioning a key American customer, there is limited description on how tensions between *specific* customers are handled. This thesis does not provide any final answers. However, it has taken an additional step by showing how customer priorities and compromises are made on a project level, and how accounting is used both proactively and reactively to deal with these networking processes.

Regarding the literature on accounting-and-new product development, the theoretical chapter pointed out how few studies had taken an interest in inter-organizational processes. For example, even though Davila (2000) discusses the importance of customers, none of his projects specifically describe how customers are involved in the development projects. Similarly, even though Ditillo (2004) describes the complexity of developing new customer functionality, there is no discussion of how different customers are prioritized. A neglect of customer perspective can also be seen in the recent review by Davila et al (2009). Even though it describes the problems of applying a plan-and-implement control logic, there is no discussion of interactive negotiation processes, a central element in customer-driven target costing.

8.2 Architectural-level target costing

Focusing on project embeddedness, architectural-level target costing deals with intra-organizational target costing. An initial pattern was *architectural cost reductions*. Rather than focusing only on cost reductions within individual components, Robotics identified large cost reductions by addressing all the components in the product architecture simultaneously. For example, in ALFA cost reductions were found by re-designing several components when the new communication technology was introduced.

A second pattern that also showed the importance of incorporating *parallel projects*. For example, since Robotics delivered large customer solutions connections to other products became important. Rather than isolated islands, project boundaries were fluid which made it difficult to evaluate the result of target costing. For example, even though DELTA was closed down, this did not reflect negatively on the project team.

8.2.1 Architectural cost reductions within the product

A central characteristic of architectural-level target costing was the focus on component integration. In ALFA, architectural cost reductions were exemplified by the introduction of the new communication technology. Before the technology was discovered, ALFA faced several problems. There was no good technical solution for reducing the cabinet size, and cost reductions on individual components were difficult to find. The communication technology therefore became an answer for solving both technical and cost problems. As the project manager of ALFA said:

> Cost-reductions were found in many places. One thing led to another. We made a large concept change. Some things became more expensive, while others became cheaper. Most of all, we saved money by reducing the size and making it easier to produce.

Architectural cost reductions were also described in DELTA. To reach the target cost without sacrificing the MultiMove functionality, the project team was allowed to develop the radical suitcase modularity. Similar to the communication technology, this was a high-risk solution, but since it solved a number of problems it was allowed. A central issue for architectural cost reductions was therefore to establish a sense of urgency and then link technical and financial problems to the proposed solution.

BETA further showed how departments within Robotics mobilized both customers and suppliers to create this sense of urgency. On the one hand, the customization camp involving the sales department and the BETA project team argued that customization was necessary to win large customer orders. On the other hand, there was the standardization camp where product management, logistic and purchasing departments focused on reducing costs. For example, when BMW was complemented with Peugeot and Renault, the standardization camp formalized BETA's project structure to save costs, and when pre-studies illustrated connections to other products, they made sure standard components were used.

Architectural cost reductions (or increases) were therefore debated and negotiated between two camps within Robotics. As a consequence, target costing and value engineering involved multiple actors both within and outside Robotics, and negotiations were linked both to target sales and target costs.

8.2.2 Architectural cost reductions across products

A second pattern in architectural-level target costing was found in the connections between parallel projects. With unpredictable interdependencies, target costing in one project affected and was affected by parallel projects. For example, when DaimlerChrysler wanted the MultiMove functionality in DELTA, the product development team for the new large robots (Voyager) had to estimate potential cost increases if MultiMove was developed.

Tensions between parallel projects were also described in ALFA and BETA. An early example was the delay in the S4 project and the ramifications it had for ALFA. When the software was not finalized in S4, ALFA could not conduct functional analysis because too many technical interdependencies were left open. The problems in S4 also affected project resources in ALFA. More specifically, since Robotics focused hard on finishing S4, ALFA had to start with a much smaller project team than initially planned.

The case of BETA further demonstrated how a project could be initiated in response to parallel projects. In the spring of 2001 DELTA was far from finished. Early prototypes were available, but DELTA could not be delivered to BMW. At the same time, BMW did not want ALFA. They argued ALFA did not have enough space for customer-specific equipment and that maintenance was difficult to do. Starting BETA therefore became a pragmatic compromise. At first it was seen as an isolated project, but during the pre-studies it became clear that cost reductions were possible only if BETA was related to other parallel projects.

Parallel projects also affected project evaluation. For example, the cost of developing BETA became much higher than expected and in DELTA the project was closed down, while DriveSys considered it "only delayed". Furthermore, even though the Robotics' project manager in DELTA did not continue, this was not seen as a failure. Rather, several interviewees argued that she had performed well, but that the project had grown too complex. With hidden and unpredictable interdependencies, project evaluation was therefore more *reflexive* than absolute. There were no clear-cut lines between success and failure. Instead, reflection and learning played an important part. As the project manager commented on the cost increases and the overall performance of BETA:

> We developed a product the customer is satisfied with and we kept the deadlines pretty well. Then we made a lot of mistakes… But on the other hand, it is things like that you learn from. Learning money.

Another reason to avoid strict evaluation rules was the difficulty of forecasting the final cost. For example, DELTA was expected to reach the target cost until the very end of the project when components unexpectedly became much more costly. At this point, since DELTA was already part of the customer order for Benteler and since Robotics had spent millions of kronor on development, an additional cost reduction project was initiated instead of terminating the project. Learning and customer commitments therefore both contributed to fostering a reflective rather than absolute evaluation practice.

8.2.3 Connections to research literature

Unpredictable interdependencies and blurred organizational boundaries are issues which have received limited attention within target costing. Seeing product development as a rational plan, cost reductions have primarily been identified within one company and then carried out within individual components. For example, Cooper and Slagmulder (1997) describe how product-level target costing is carried out by a cross-functional team where the senior engineer decides the technical and organizational boundaries.

However, practice studies of target costing have started to problematize how target costing is actually conducted. For example, Hansen and Jönsson (2005) show the difficulties of making departments share information freely and Nixon (1998) illustrates the challenges of setting clear target cost goals if the underlying technology is not known. Moving one step further, Davila and Wouters (2004) even argued that target costing is too bureaucratic and time consuming to even begin with. Ending their article, Davila and Wouters (2004) further call for more research regarding links between target costing and other cost management practices:

> This paper raises important questions for future research. First, are the cost management practices presented in the paper complements or supplements to target costing? If they are complements, then how does target costing interact with these other practices? (p.24)

The concept of architectural-level target costing can be seen as a contribution to this discussion. In line with Cooper and Slagmulder (1997), Nixon (1998) and Hansen and Jönsson (2005), target costing at Robotics was used within projects. Even though project goals included technology and time aspects, they were not separated from cost goals. Rather, all three development projects demonstrated pragmatic compromises involving revenues, costs and non-financial goals. For example, BETA was not formalized into a real project until Peugeot and Renault were added and in ALFA target cost goals were adjusted when General Motors wanted new customer functionality.

Furthermore, architectural-level target costing seems to incorporate some of the elements discussed by Davila and Wouters (2004). For example, the concepts of "product platforms" and "modular design for costs" which are central to Davila and Wouters have close similarities to descriptions in ALFA, BETA and DELTA. Architectural-level target costing can therefore be seen as bridge between earlier discussions of target costing because it shows how target costing does not have to be detailed nor have to focus on single projects.

Regarding inter-organizational accounting, architectural-level target costing contributes to an understanding of blurred boundaries between intra and inter-organizational activities (Mouritsen et al 2001, Håkansson and Lind 2004, Seal et al 2004, Coad and Cullen 2006, Thrane and Hald 2006, van der Meer-Kooistra and Scapens 2008). By focusing on the project level, it was shown how intra and inter-organizational activities mutually affected each other. For example, it was difficult to start BETA because regular suppliers were already occupied with DELTA. Compared to previous research literature, this thesis therefore shows that boundaries between intra and inter-organizational activities can be extended in two ways. First, by highlighting the difference between organizational level and project level, one sees that boundaries can be integrated or fragmented on one level but not on the other. For example, in DELTA, the project team at Robotics wanted to replace DriveSys, but was overruled by top management because on an organizational level DriveSys was seen as one of the most important suppliers for Robotics. In this sense, a single relationship can be both integrated and fragmented, highlighting potential simplifications in previous research which has primarily dealt with the organizational level.

Secondly, by avoiding to treat customers and suppliers as homogeneous groups, this thesis has demonstrated the limitations of arguing that boundaries to "customers" or "suppliers" are integrated or fragmented. For example, the claim by Thrane and Hald (2006) that integration was stronger across inter-organizational boundaries than across intra-organizational boundaries seems too simplified. For example, even though Robotics integrated activities with individual customers and individual suppliers, the empirics also show that simultaneously there was strong integration between departments as well as fragmentation with other customers. For example, in ALFA, while Robotics created stronger bonds with General Motors, links to other important customers such as Chrysler and Ford weakened.

Regarding the literature on accounting-and-new product development, architectural-level target costing helps to extend recent process perspectives. For example, in line with both Mouritsen et al (2009) and Jörgensen and Messner (2009, 2010), this thesis finds that temporary compromises guide the development work forward. When the final solution cannot be seen at the start of the project, accounting in the form of target costing is used to explore different paths. An extension of this thesis is the importance of acknowledging project embeddedness. When companies develop complex, multi-technology products, temporary compromises often involve several projects simultaneously. An interesting question for further research could therefore be to study how short and long-term translations described by Mouritsen et al (2009) involve project embeddedness, or how accounting and strategizing involve project embeddedness.

8.3 Supplier-level target costing

The third sub-process was supplier-level target costing, where an initial pattern involved overlapping target costing processes. Not only did Robotics have financial targets, so did their suppliers. Similar to the customer side, Robotics could therefore not implement target costing unilaterally. Instead, target costing was interactive, fluid and partial.

A second pattern was seen in supplier embeddedness. More specifically, to reduce costs or avoid unexpected cost increases, target costing went beyond single suppliers. For example, before a target cost was negotiated with DriveSys, information about sub-suppliers and other customers was gathered. The importance of acknowledging network embeddedness was also important for problem-solving. Even though Robotics gave DriveSys a significant responsibility, several other suppliers were often involved before a compromise was reached.

8.3.1 Target costing in a single supplier relationship

A central characteristic of supplier-level target costing was the importance of interaction and negotiations. For example, as was shown in both ALFA and DELTA, it was difficult to say if Robotics or DriveSys initiated the dialogue around new cost targets. In the beginning of ALFA, DriveSys helped to specify the technical requirements and even though Robotics chose to conduct their own pre-study in DELTA, DriveSys intensified the discussion about a new development project.

Instead of a detailed cost goal, target costing served as a platform for evaluating different technical solutions. For example, a central element in ALFA was the modularization of drives. To reach the target cost, modularization in the form of 2-packs and 3-packs emerged as a pragmatic compromise which both reduced costs and enabled DriveSys to meet the functional requirements set by Robotics. Target costing therefore created a structure to explore win-win situations. There were also instances where individual company interests were emphasized. A first example was the lack of open-book accounting. Even though Robotics and DriveSys shared detailed information, this did not include financial calculations. Instead specific costs were combined into overall target costs, one for the product and one for the project. According to DriveSys, it was not meaningful to have an open-book agreement when Robotics had outsourced both design and production.

To understand the links between target costing and open-book accounting, table 8.1 helps to map out the importance of acknowledging supplier responsibility. For example, with DriveSys which had a functional responsibility, there was intense interaction, but no open-book accounting. DriveSys cared about costs, but were not willing to share detailed cost information with Robotics since they both designed and produced the drives.

Name of supplier	**Supplier responsibility**	**Target costing focus**	**Open-book accounting**
DriveSys	Function	Product cost	No
Design-Net	Design	Project cost	Yes/No
Serial-P	Production	Production cost	Yes

Table 8.1: Target costing in three types of close supplier relationships

In contrast, Design-Net focused more on customer satisfaction since they were responsible for project design and had no responsibility for future product costs. For Design-Net, target costing focused on the project cost. Initially, there was no open-book agreement, but when contractual arrangements changed, Design-Net had to specify hours in an open-book fashion. Finally, a third type of target costing was briefly illustrated in the relationship with Serial-P. In contrast to DriveSys and Design-Net, Serial-P was a production supplier where Robotics did the design and Serial-P produced the cabinets. This relationship had an open-book agreement. More specifically, since Robotics was responsible for design and purchased "production capacity" from Serial-P, Robotics had to be an active partner to reach the target cost. Table 8.1 therefore shows how different types of supplier responsibility created different incentives for using target costing together with open-book accounting.

8.3.2 Target costing in multiple supplier relationships

A second characteristic of supplier-level target costing was network embeddedness. To reduce costs, a central task was to manage tensions between standardization and customization. On the one hand, Robotics wanted to standardize supplier selection to be able to compare suppliers manufacturing the same component (e.g. different drive suppliers). However, it was also important to motivate individual suppliers to take initiative during supplier selection. Initially, during the concept phase, the target cost was used to signal expectations and get suppliers to understand the stringent requirements automotive customers placed on Robotics. By estimating a target cost range and giving out preliminary technical specifications, interaction and negotiations began.

However, balancing standardization and customization was difficult. For example, when should Robotics stop comparing offers? If interaction with DriveSys resulted in a satisfactory solution that reached the target cost, was further exploration necessary? As was illustrated, ALFA and DELTA followed two different approaches. In ALFA, the "family logic" focused on customization. DriveSys was part of the joint pre-study and was the frontrunner during the entire supplier selection process. In DELTA, the opposite happened. Emphasizing a "professional logic" Robotics declined the joint pre-study with DriveSys and tried to standardize supplier selection processes between DriveSys, Yaskawa and ABB Drives. During supplier selection, the target costing process was characterized by more formal processes and guidelines. For example, each supplier had to go through design and quality audits and was ranked on both financial and non-financial elements. Instead of informal customization to receive supplier commitment, the formal supplier selection process in DELTA relied on benchmarking and comparisons in reaching the target cost.

A second type of network embeddedness involved integration between different components (e.g. between a drive and a computer). For example, to develop MultiMove in DELTA, it was necessary to change several supplier relationships simultaneously. Target costing around the drive was therefore connected to the development of the computer, the cabinet and the cables. Since the product architecture could be designed in many different ways, target costs were set in ranges to enable flexibility. For example, both Robotics and DriveSys knew the drive system in DELTA had to be reduced in the range of 20%. However, whether it was 18% or 25% depended on the technical solution and cost reductions on an architectural-level. Beyond beating other drive suppliers, a central concern for DriveSys was interdependencies to other component suppliers. For example, winning a large share of the product architecture was not a guarantee for financial profitability, because if problems occurred in relation to other components, costs could increase and reduce profitability. The wrong screws in BETA was an example of such "interface problems." Design-Net had chosen a screw that did not fit the production processes at Serial-P. Design-Net argued that the fault lay in the production process while Serial-P argued the design was poorly executed. In the middle of this was Robotics, who had two large customers waiting for a delivery. A technical problem between two suppliers therefore risked escalating to other customers as well. Realizing the financial implications of a delay, Robotics and Design-Net therefore reached a compromise to avoid such escalations.

Finally, a third type of network embeddedness concerned suppliers' customers. This was important because when components also included many different technologies, cost reduction opportunities were found through indirect connections. For example, since DriveSys bought electronics from various global giants, it was important for Robotics to conduct a larger and more extended analysis of both DriveSys' customers as well as their sub-suppliers. These network-level analyses began during supplier selection. For example, by using functional analysis it was possible to identify critical sub-suppliers and potential sources for both cost reductions and cost increases. However, this knowledge was also useful to handle new problems that were discovered. For example, by recognizing interdependencies on a network level, Robotics and DriveSys could identify a technical solution for the 7th

axis that did not require any re-design on other components. Managing network interdependencies in various ways was therefore an important aspect of supplier-level target costing.

8.3.3 Connections to research literature

In contrast to customer and architectural-levels, there has been more research on supplier-level target costing. For example, Agndal and Nilsson (2009) describe similar target costing practices to what this study has done. Studying the relationship between a Swedish automotive customer and a gear system supplier, they find that the supplier's management accounting plays an important part in the target costing process. Similar to DriveSys, target costing signals expectations and can be used by both the customer and the supplier.

However, in contrast to earlier studies which emphasized either planning (Cooper and Slagmulder 1997) or improvisation (Mouritsen et al 2001, Agndal and Nilsson 2009) this study shows how target costing has multiple roles and that these roles can occur simultaneously. For example, at the same time as Robotics conducted formal quality audits in the relationship with DriveSys, they also interacted in more informal ways to solve unexpected problems in other supplier relationships.

Target costing also varied depending if the supplier had a functional, project, or production responsibility. Information exchange and cost reduction processes were not the same for DriveSys, Design-Net and Serial-P. For example, in line with both Cooper and Slagmulder (2004) and Agndal and Nilsson (2009), suppliers with a functional responsibility did not use open-book accounting, while production suppliers did. An empirical contribution of this thesis is Robotics' relationship with Design-Net, as previous studies have focused on functional or production responsibilities, ignoring suppliers which are only responsible for the design.

Another contribution of this thesis is to link target costing to three types of network embeddedness. As was demonstrated, a supplier could be connected to other suppliers manufacturing the *same component* (e.g. drives), suppliers manufacturing *complementary components* (e.g. computers or cables) and *indirect connections* to other customers and suppliers. As this thesis has shown, including the network level is critical for both understanding the setting of target cost goals as well as working toward reaching them. Furthermore, the three types of network embeddedness also help to understand the multiple roles of target costing. For example, to maintain flexibility, target cost goals followed a range because Robotics could not know in advance exactly how each component would look when they were integrated with other components or parallel projects.

Moving beyond target costing, the findings of this thesis can also add to inter-organizational accounting. For example, even though a number of studies have emphasized network embeddedness (Tomkins 2001, Håkansson and Lind 2004, Lind and Strömsten 2006, Chua and Mahama 2007, Miller and O'Leary 2007, Lind and Thrane 2010), few studies have shown how this network embeddedness relates to suppliers on a project level. For example, both Håkansson and Lind (2004), and Lind and Strömsten (2006) focus on customers, and while Tomkins (2001) discuss the importance of having a portfolio perspective, his claims are made without any empirical data.

Chua and Mahama (2007) and Miller and O'Leary (2007) show how suppliers are embedded in wider network structures. For example, studying the Australian telecom company OzCom, Chua and Mahama illustrate how supplier A is embedded with OzCom's relationship with supplier B and Miller and O'Leary discuss how Intel co-operated with suppliers to develop the next generation of semiconductor technology. However, since both studies focus on an organizational level, we know less about the micro-processes within specific product development projects. For example, in addition to showing three types of network embeddedness, this study also shows the dynamics of how different suppliers are combined and re-combined in terms of planned efforts both to reduce costs and to improvise when problems occur.

In relation to the literature on accounting-and-new product development, supplier-level target costing adds an inter-organizational perspective which is presently lacking. For example, even though Davila (2000) and Ditillo (2004) discuss the importance of combining planning and improvisation, this challenge is not related to either individual suppliers or network embeddedness between suppliers. Recent process-based studies such as Mouritsen et al (2009) and Jörgensen and Messner (2009, 2010) have also neglected to include suppliers in their analysis. For example, despite focusing on multi-technology products, accounting calculations are not related to *specific* suppliers and the negotiation processes that occur when supplier embeddedness is dealt with. Even though this thesis primarily relates to target costing, this chapter has hopefully shown how network embeddedness and project embeddedness can add to broader accounting research.

9 Target costing and incompleteness: a cross-case analysis

The purpose of this chapter is to analyze target costing and incompleteness. More specifically, this chapter will analyze how target costing relates to path dependency, re-designs and development rhythm. Similar to chapter eight, each concept is analyzed separately and then related to broader accounting research literature. Having done that, this chapter moves on and analyzes how path dependency, re-designs and development rhythm are related to project phases. A central theme in this final part will be to show how target costing relies on both planning and improvisation and how these combinations are consistent in all project phases.

9.1 Target costing and path dependency

9.1.1 Customer functionality emerges over time

As the empirical chapters demonstrated, a challenge for Robotics was that many customer requirements were too complex to be developed in one project. For example, even though MultiMove was developed in DELTA, the first signs of its potential occurred already in ALFA when General Motors revealed the problem of coordinating several robots. In DELTA, the lost orders to Yaskawa, together with a strong request from DaimlerChrysler, then contributed to making MultiMove one of the key customer priorities.

The importance of path dependency was also illustrated in the development of the cabinet size. In ALFA, reducing the product's size became a customer hang-up but the development continued in both BETA and DELTA. On the one hand, there was a long-term trend towards reducing the cabinet size. For example, to appeal to "Potentials", it was decided to develop the suitcase modularity in DELTA. On the other hand, individual customers such as BMW wanted larger cabinets to have room for customized equipment. It was therefore a constant struggle to handle contradictory customer demands, though this drove the development forward.

Path dependency was also related to the customers' previous investments. For example, General Motors was willing to increase the target price if Robotics adopted ALFA to fit their development path. Having trained their production staff in one way, General Motors argued it was cheaper to pay Robotics than having to re-train their employees in new ways. An important observation is therefore that customer hang-ups cannot be isolated to single projects. Instead, they emerge through co-evolution where development occurs in partly contradictory directions. For example, even though the ambition in both ALFA and DELTA was to reduce the cabinet size, BETA showed how Robotics deviated from the long-term path if potential profits were large enough.

9.1.2 Supplier functionality emerges over time

The importance of path dependency was also illustrated in the supplier relationship with DriveSys. For example, as figure 9.1 visualizes, the drive was developed and modified in no less than six different product development projects between 1990 and 2005. The starting point was the S3 project when DriveSys replaced the internal ABB company, ABB Drives. Even though this was not a big platform project, the S3 project turned out to be important because the relationship grew stronger as a result of successful problem-solving. As a consequence, a much larger step was taken in ALFA when Robotics and DriveSys developed the modularized 2-pack and 3-pack drives.

However, path dependency was not isolated to large platform projects such as ALFA and DELTA. For example, as figure 9.1 shows, the problems with the 7th axis illustrated how target costing was difficult to delimit to single projects. On the one hand, it was important to reduce costs and finish ALFA. On the other hand, it was important to include the 7th axis functionality to avoid a large step cost. By conducting functional analysis together with customers and suppliers, different technical alternatives were explored before a compromise was reached.

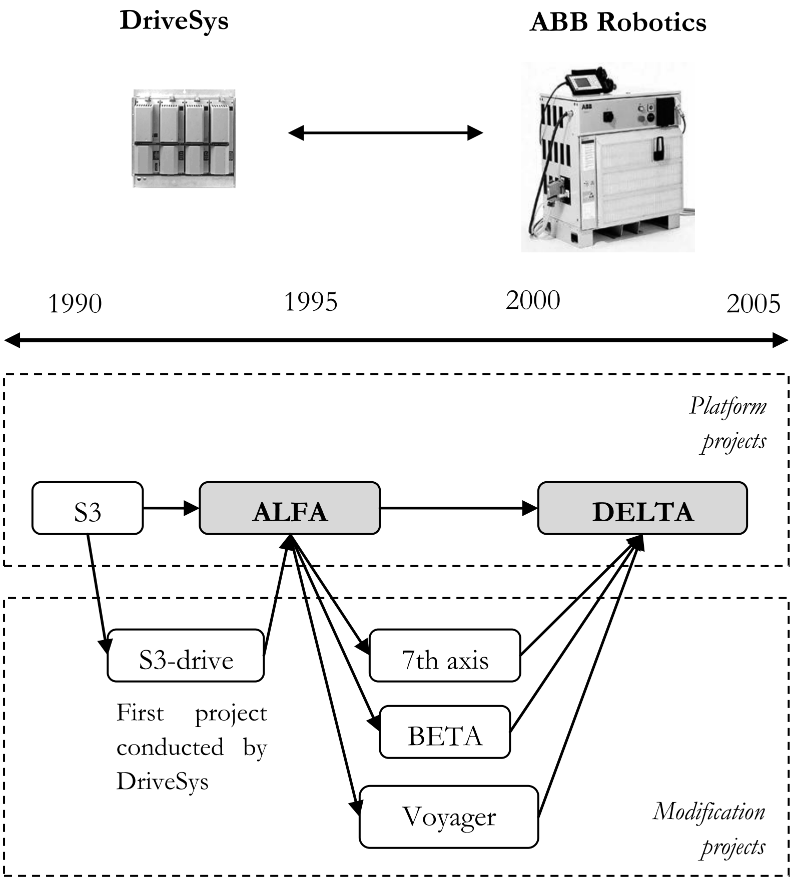

Figure 9.1: Development of the drive system over time

Furthermore, the drives in ALFA were also modified because of parallel projects. For example, when Voyager was finished earlier than DELTA, it was discovered that ALFA could not be run together with the large Voyager robots. As figure 9.1 illustrates, a smaller modification project was therefore initiated to increase the size of the ALFA drives. Similar to customer functionality, the development of supplier functionality therefore emerged in several product development projects. This was necessary both from a cost and a technical perspective because neither MultiMove nor the drives could be developed within one single project.

9.1.3 Connections to research literature

As was described in the theoretical chapter, path dependency has received limited attention within the target costing literature. Some authors note that product functionality is re-used in later projects (Mouritsen et al 2001, Davila and Wouters 2004, Agndal and Nilsson 2009), but there is less empirical description on how path dependency affects the target costing process.

This study begins to answer some of these questions. For example, as the empirics demonstrated, both customer and supplier functionality evolved over several projects. For each development project, Robotics did not start with a white paper but instead tried to build on earlier solutions. An important aspect of this thesis is that it links path dependency to both network and project embeddedness. Highlighting both this spatial and temporal complexity is important for understanding the actual practice of target costing. More specifically, even though there are a number of detailed studies of target costing practice (Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009), they have not shown how target costing is affected by previous projects and how this involves the integration of several customers, suppliers and parallel projects.

Regarding inter-organizational accounting, path dependency has not been the focus of much empirical and theoretical development. For example, as recent reviews have highlighted (van der Meer-Kooistra and Vosselman 2006, Caglio and Ditillo 2008), focus have primarily been on static conceptualizations of inter-organizational accounting. There are exceptions. For example, studying Intel and the development of semiconductor technology, Miller and O'Leary (2005, 2007) show how technology roadmaps facilitate long-term investment decisions among customers, suppliers and competitors. Similar to target costing at Robotics, these technology roadmaps do not specify an exact solution but instead give actors flexibility to negotiate various compromises.

This thesis complements Miller and O'Leary (2005, 2007) in two ways. First, it focuses on the project level, emphasizing the micro-processes for how compromises emerge. This is important, because even though Miller and O'Leary (2005, 2007) provide a detailed account at the industry level, there is less focus on how path dependency influences cost negotiations between customers and suppliers. Secondly, in contrast to Intel who is the dominant player within their network, this thesis has shown how Robotics reduced costs by "riding the waves". For example, regardless of what happened between Robotics and DriveSys, a critical issue for Robotics was to understand overall network dynamics. Rather than directing suppliers in a hierarchical manner, listening and adapting were key mechanisms for reducing costs.

A way of extending the "ride the wave" phenomenon could be to discuss accounting and inter-organizational risk management. For example, as one Robotics engineer said, it was difficult to calculate the evolution of network dynamics. It was possible to estimate when Dell or IBM wanted a new computer generation, but it was difficult to predict the direct consequences for Robotics. A closer examination of how companies use accounting numbers to calculate and predict risks in "riding the wave" processes could therefore add interesting knowledge to both target costing and risk management.

Regarding the field of accounting-and-new product development, this research literature has also been dominated by a static perspective. For example, drawing on contingency theory, a number of studies have linked product development contexts with accounting practices (Abernathy and Brownell 1997, Davila 2000, Bisbe and Otley 2004, Ditillo 2004). As a consequence, temporal aspects such as path dependency have received scant attention. For example, we do not know how accounting and knowledge complexity described by Ditillo (2004) evolves over time. A central theme in this chapter will therefore be to show how the time challenges of path dependency, re-designs and development rhythm could contribute to a more dynamic perspective of accounting-and-new product development.

9.2 Target costing and re-designs

The second time challenge was re-designs. As the empirical chapters illustrated, technical solutions were in constant flux due to the inherent incompleteness. This part therefore analyzes how re-designs were used both to reduce costs *and* to increase revenues. Similar to the discussion on path dependency, this section will also show how re-designs often required an integration of customers, suppliers and parallel projects.

9.2.1 Re-designs to reduce costs

To start with, a central issue in ALFA, BETA and DELTA was to reduce costs by re-designing technical solutions. Rather than following a plan-and-implement logic, there was a strong emphasis on combining planning and improvisation. For example, we can consider the new communication technology in ALFA. Initially there was a lot of uncertainty because it was unclear if the new technology would work. The project manager therefore initiated a discussion with the technical director. Would it be possible both to reduce costs and solve a technical problem? After having made a first estimate, it was decided to start a more detailed investigation involving key suppliers. In addition, using functional analysis, further opportunities emerged. For example, a Finnish supplier discovered how their component could be made more cheaply if the technical requirements could be adjusted. What had started as a problem of reducing the cabinet size then gradually grew into a much larger re-design effort.

A similar process of turning a problem into an opportunity was described in DELTA. After the close down, the ambition was to make "minor modifications." However, through trial-and-error, new opportunities were once again discovered. For example, when it was decided to implement robot production, this change unexpectedly required mechanical adjustments on the drives. Similar to the architectural re-design in ALFA, cost reduction opportunities therefore emerged gradually in close interaction with suppliers rather than being hierarchically directed by Robotics from the start.

On the other hand, these collective networking processes were also used to delimit technical development. For example, when the 7th axis problems were identified at BMW, Robotics interacted intensively with DriveSys and other suppliers to minimize the scope of the re-design. Both from a cost and time perspective, it was positive if the 7th axis could be handled locally and not have impact on surrounding components. The 7th axis can therefore be seen as an example of cost containment. Instead of reducing cost, the goal became to handle the technical problem as cost-efficiently as possible. More specifically, Robotics realized from the beginning that a 7th axis would mean a cost increase, but by understanding the technical problem, the re-design could be handled locally with DriveSys instead of including other suppliers.

9.2.2 Re-designs to increase sales

A second reason for making re-designs was to increase sales. With large customized orders, this was a common feature of customer-driven target costing. An illustrative example was the GMT 800 project in ALFA. Initially General Motors was offered the old S3 generation, which was then changed to the coming S4 generation. However, quite early on Robotics realized that General Motors wanted to add customer functionality that was not part of the initial frame contract. For example, after having spent six months in adding new functionality, re-designs were so large that it was almost a new product. As a consequence, tough re-negotiations were needed to set the new price. For example, as the description in ALFA demonstrated, Robotics financed a larger and more expensive computer memory with additional price increases on other parts.

Another example that showed how re-designs were used to increase sales occurred in BETA. In contrast to the two platform projects, BETA illustrated a different target costing process. Initially, the main goal was to minimize the scope of re-design. Robotics was already developing the larger DELTA project and to increase the size of the cabinet went contrary to long-term development path. On the other hand, the BMW order included more than a thousand robots, which meant increased sales on a systems level. Rather than focusing on the individual product, target costing in BETA therefore focused on the profitability of the entire customer order.

9.2.3 Connections to research literature

Re-design is an issue which has not been frequently discussed within the target costing literature. Seeing product development as a rational process, focus has been primarily on planning and follow-up (Ansari and Bell 1997, Cooper and Slagmulder 1997, 1999, Swanson et al 2003). As a consequence, target costing has often been portrayed as a static accounting practice where one dominant firm directs suppliers in a hierarchical manner (Davila and Wouters 2004, Hansen and Jönsson 2005). For large firms with stable product architectures, this hierarchal focus might be true. For example, it seems possible that global giants such as Toyota or Olympus could direct smaller suppliers on how to achieve cost reductions.

However, similar to Robotics there are studies that have discussed re-designs. For example, regarding customer-driven target costing, Nixon (1998) describes how an Iranian customer compensated CCM Ltd for an additional recycling facility. Regarding architectural-level target costing, Hansen and Jönsson (2005) show how unexpected re-designs within Volvo Cars relied on informal check-ups. Regarding supplier-level target costing, Agndal and Nilsson (2009) demonstrate how re-designs are facilitated by starting from a joint cost platform and then re-negotiating the parts that change.

Beyond confirming the results of these previous studies, this thesis moves one step further by showing how re-designs often require the *integration* of customer, architectural and supplier-level target costing. For example, in ALFA, BETA and DELTA, regardless if re-designs focused on increasing sales or reducing costs, connections to customers, suppliers and parallel projects were often analyzed before a decision was made. Because of the embedded nature of developing multi-technology products, it was not enough to negotiate a solution with a single supplier. By linking re-designs to network and project embeddedness, this thesis therefore contributes with a more distributed perspective on re-designs in target costing processes.

Regarding inter-organizational accounting, several studies have pointed to the need of understanding how accounting relates to negotiation processes (Tomkins 2001, Thrane and Hald 2006, van der Meer-Kooistra and Scapens 2008). For example, Tomkins places negotiations at the center of their conceptual article, while Thrane and Hald as well as and van der Meer-Kooistra and Scapens empirically describe how accounting is used to analyze different options in negotiations with customers and suppliers. However, since few studies have focused on the project level, negotiations related to re-designs have received limited attention. For example, we know little of how accounting is used to motivate re-designs or how accounting is used to distribute unexpected costs between companies.

This thesis has started to fill this gap. For example, my empirics have shown how target costing could trigger a re-design, as well as delaying re-designs that were not seen as profitable. In doing that, this thesis has added knowledge to the broader question of how accounting relates to organizational boundaries and the dynamics of integration and fragmentation. More specifically, within product development projects, it has been shown how re-designs can strengthen the relationship boundary with *specific* customers and suppliers while simultaneously weakening connections to others.

Regarding the literature on accounting-and-new product development, the focus on contingency theory has directed this research away from process perspectives. For example, even though some articles describe the need for re-designs (e.g. Davila 2000, Ditillo 2004), how accounting is used to negotiate re-designs is rarely described. An exception is Mouritsen et al (2009) who discuss how accounting calculations are used to frame product development in different ways. The authors describe their concepts of short and long-term translations as:

> Management accounting calculations add a new perspective to innovation activities. This happens in short translations where innovation activities are related to revenues, contribution margins and ABC margins, or in larger translations where innovation activities are linked with sourcing strategies and changes in the competences of firms through competing calculations. (p.747)

Target costing around re-designs illustrated such short and long translations. For example, we may consider the example of the new communication technology in ALFA. It can be seen as a short translation, because a central decision in allowing the re-design was to connect the technical functionality to large cost reductions. In contrast, the major crisis in DELTA can be seen as an example of a long translation because it involved multiple calculations that problematized DELTA in relation to Robotics' strategy of balancing old automotive customers with new "Potentials" such as IKEA, Foxconn and US Postal Service.

What this thesis also has shown is how short and long translations can involve calculations from several companies. For example, in BETA both the *customization* and *standardization* camps mobilizing calculations from both external customers and suppliers. For example, the customization camp rallied support by involving sales calculations from BMW, Peugeot, and Renault but also cost estimates from suppliers such as Design-Net. Management accounting calculations then not only linked inter-organizational spaces, these calculations emerge in interaction between several customers and suppliers.

9.3 Target costing and development rhythm

A third aspect of incompleteness is development rhythm and the challenge of handling time pressure and delays. What started as a balanced schedule often turned into problems when one sub-project was delayed or a key customer wanted extra functionality. This part therefore shows how development rhythm created unexpected costs and the need for cost containment.

9.3.1 Rushing deadlines creates unexpected costs

Handling time pressure was a central issue in all three development projects. For example, if a customer wanted additional functionality, this often created time pressure because development work had to progress at a much faster pace than planned. Since the target cost was negotiated during the concept phase, time pressure often resulted in tensions because it was sometimes unclear who would take on the additional cost.

The empirical material further showed how time pressure was handled differently in ALFA and DELTA. Emphasizing a "family" logic, time pressure was managed jointly in ALFA. For example, when DriveSys realized that the micro-computer in the drive was too small, Robotics and DriveSys jointly re-adjusted the schedules. In DELTA, time pressure was handled differently. By comparing and benchmarking suppliers, Robotics reduced the development time without consulting DriveSys. By arguing that other suppliers could use an "off-the-shelf" drive, tight deadlines were set. For example, even though DriveSys estimated that the first prototype would take one year, Robotics argued it had to be done in six months. Time pressure was further reinforced when Robotics was late with supplier selection. As a consequence, when DriveSys was awarded the development contract, there was only three months left to the delivery of the first prototype.

However, the main source of time pressure came from large customer orders. When General Motors and Peugeot had committed themselves, the cost of not delivering increased considerably. For example, if problems could not be solved, the end result could be a delay of an entire car introduction. Describing the large financial consequences for both Robotics and their customers, the BETA project manager said:

> If customers say "we must have it", then they do. If it is an order of several thousand robots, you don't have much choice. You damn well better fix it.

ALFA also highlighted how a customer order could change priorities within Robotics. During the concept phase, ALFA lost project resources to S4. However, when General Motors was connected to ALFA, the development rhythm changed. Instead of having to manage delays and lack of project resources, ALFA got resources at the cost of increased time pressure. Changing development rhythm in one target costing sub-process therefore affected other sub-processes.

9.3.2 Delays result in synchronization problems

Even though time pressure was a major challenge, so were delays. An early example was S4. When software development became more complex, this caused a delay not only in S4 but also in ALFA. Rather than conducting functional analysis according to the planned development rhythm, the wait created the need to improvise. For example, Robotics and DriveSys decided to investigate alternative technical solutions and also discussed how different results in S4 would impact the drive solution in ALFA. A similar pattern of improvisation was described in DELTA when the project had to be re-started. For example, without time pressure, Robotics had time to analyze each component to see if further improvements could be made. Modifying production processes were not part of the initial plan, but since the re-design of the suitcase modularity would take a number of months, this parallel activity could be fitted into the schedule.

Since both time pressure and delays increased project costs, considerable effort was also spent on maintaining a steady development rhythm. This began during supplier selection. By conducting design and production audits, it was possible to detect possible risk areas for unexpected cost increases. For example, by knowing sub-suppliers and their choice of component quality, Robotics and suppliers could proactively discuss potential problems. Joint investigation of risks also facilitated improvisation. For example, by having detailed protocols of design and production activities, it was easier to solve unexpected problems during development and pre-production phases.

9.3.3 Connections to research literature

Similar to path dependency and re-designs, development rhythm is an issue which can be further developed. Early contributions within target costing research such as Ansari and Bell (1997) and Cooper and Slagmulder (1997) highlight the need for iterations between customers and suppliers, but there is limited discussion how schedules are revised when unexpected events occur. A reason for this can be found in research design. If target costing focuses on best practice on an organizational level, it can be difficult to detect actual changes in development rhythms on a project level.

However, among practice studies, there are a few studies that have started to problematize the challenges of an uneven development rhythm. For example, studying a supplier dyad, Mouritsen et al (2001) describe how time pressure makes it difficult to apply a formalized plan-and-implement approach to target costing. Similar to Robotics, tensions were created when NewTech increased time pressure at the same time as they wanted the supplier to deliver increased cost reductions. To reach a compromise between contradictory demands, NewTech therefore selectively used target costing in the form of functional analysis. By not using detailed routines, target costing was used to create a shared language and structure supplier interaction. Another more extreme way of dealing with time pressure is to avoid target costing once and for all. As Davila and Wouters (2004) show, when customer deadlines becomes the primary focus, it can be easier start parallel cost reduction projects. Analyzing ALFA, BETA and DELTA, this thesis finds support both for Mouritsen et al (2001) and Davila and Wouters (2004). In BETA, improvisation and broad guidelines played a crucial part for making sure deadlines could be met. Evidence of parallel cost projects (Davila and Wouters 2004) were also shown, because in both BETA and DELTA, cost reduction programs were initiated directly after the official product development project had ended.

However, what has not been shown in previous literature is how time pressure and delays exist at the same time. When one takes a network perspective, target costing is often conducted in an environment that requires both faster *and* slower development rhythms. For example, to reach a compromise around the 7th axis, both time pressure and delays were required. On the one hand, it was important to quickly consult customers and suppliers, but on the other hand, when a compromise was identified, the re-design of the 7th axis was delayed because it was seen as more important to meet the customer deadlines to General Motors, BMW and Volvo. This thesis therefore shows that even though Robotics tried to follow the planned development rhythm, this rarely happened.

The challenge of combining planning and improvisation is also a central theme within broader accounting literatures. For example, studying a supplier relationship between two oil and gas companies in Holland, van der Meer-Kooistra and Scapens (2008) find that control can be seen as a *minimal structure*. It is called a minimal structure, because the control creates enough structure to enable joint planning, yet it allows the flexibility to improvise when needed. Empirically, a number of studies share this view of control. For example, within inter-organizational accounting, Håkansson and Lind (2004), Coad and Cullen (2006) and Thrane (2007) have described how accounting is used as a platform for identifying and negotiating joint compromises. Within the field of accounting-and-new product development, studies such as Davila (2000), Ditillo (2004) and Jörgensen and Messner (2009, 2010) have further described how accounting can be used both for planning and improvisation.

What this thesis adds to these studies is that planning and improvisation are linked to the time challenges of path dependency, re-designs and development rhythm. More specifically, this thesis has shown why and how such combinations of planning and improvisation occur. For example, regarding path dependency, Robotics planned to re-use development efforts from previous projects. To take a closer look at how path dependency, re-designs and development rhythms required both planning and improvisation, we now turn to the three project phases.

9.4 Target costing and project phases

9.4.1 Target costing during the concept phase

Even though the time challenges were present across all project phases, path dependency was particularly important during the *concept phase*. For example, as both ALFA and DELTA showed, both customer and supplier functionality often emerged in several development projects over time. To reduce costs, both planning and improvisation was needed. For example, the customer pre-studies in DELTA illustrated how Robotics focused on planning. To ensure that DELTA would only include functionality that customers wanted, the two pre-studies were systematically structured and carried out by a cross-functional team. The importance of planning was also illustrated among suppliers. For example, in both ALFA and DELTA, supplier selection was a structured process with deadlines and formal audits. In this way, target costing shared many characteristics that the normative studies of target costing have illustrated. For example, it was a planned and structured process (Cooper and Slagmulder 1997), it was organized within a cross-functional team (Ansari and Bell 1997) and it included a high level of customer focus (Swenson et al 2003).

However, when one analyzes the micro-processes, one sees that target costing during the concept phase also included improvisation. For example, in line with Agndal and Nilsson's (2009) description of the cost reduction process, Robotics and DriveSys needed several rounds of trial-and-error before a final compromise was reached. Initially, there was a target cost range, but to reach a win-win situation, improvisation was required during the negotiations. Improvisation was also needed in relation to customers. For example, in ALFA two key customers did not agree on the cooling solution and in DELTA, Robotics had to improvise when there was not enough time to finish the pre-studies.

This thesis therefore shows that both planning and improvisation are needed during the concept phase and that large cost reductions are identified by primarily focusing on path dependency.

9.4.2 Target costing during the development phase

During the *development phase*, large cost reductions were not as significant compared to the concept phase. For example, in the supplier relationships with DriveSys and Design-Net, it was the negotiations during the concept phase that primarily set the target cost and created large cost reductions.

However, since the technical solution could not be fully known, target costing had elements of both *cost reduction* and *cost containment* during the development phase. On the one hand, there was still room for cost reductions. For example, the new communication technology in ALFA reduced costs and the decision to integrate BETA with other products also contributed with cost synergies. On the other hand, the same technical incompleteness that reduced costs could also increase costs. For example, in ALFA it was discovered that the computer needed to be upgraded which meant an unexpected cost increase.

Re-designs during the development phase therefore focused on both cost reductions and cost containment. I call it cost containment, because even though cost would increase, Robotics did their best to "contain" the cost. For example, when the 7th axis needed to be re-designed, a number of customers and suppliers were contacted to contain cost increases.

Even though re-designs involved high degrees of improvisation, planning was still important. For example, due to the time pressure, the re-design of the 7th axis was not conducted right away. Instead, Robotics planned to do with it when ALFA had finished. Furthermore, planning was also important to ensure stability. More specifically, when a problem occurred in one relationship, it was crucial to ensure that new problems did not emerge in other relationships. For example, when BMW unexpectedly was lost in BETA, it became even more important to plan and execute the other customer orders for Peugeot and Renault.

This thesis therefore shows that both planning and improvisation are needed during the development phase and that re-designs can be related to both both cost reduction and cost containment efforts.

9.4.3 Target costing during the pre-production phase

During the *pre-production phase*, target costing focused primarily on cost containment. As both ALFA and DELTA showed, when commitment had been made to a lead customer, the main challenge was to deliver on time without creating too many cost increases. For example, in ALFA, Robotics introduced a "hot-line" directly to General Motors, BMW and Volvo. In DELTA there was a structured plan to ensure that Benteler got their robots as fast as possible. Still, despite plans there were several instances that required improvisation. For example, when the 7^{th} axis problem occurred at BMW, Robotics did not have time to re-design a new solution within ALFA. Instead, BMW was given two Industrial Control Systems, even though this was more expensive.

BETA stands out when it comes to cost containment and time pressure. As a customer project, there was constant time pressure. For example, in the beginning, BMW needed to have prototypes quickly and supplier selection of Design-Net was made without formal audits. Still, even though the project cost for BETA grew to be more than twice as much as calculated, cost management was still important. For example, costs were contained by increasing integration with other products and negotiating the responsibility for unexpected cost increases (e.g. problems with the screws).

As with the concept and development phases, many of these cost containment activities involved both planning and improvisation. For example, after the "screw crisis," it was a planned move to formalize the development process to avoid unnecessary project costs. Robotics also had a structured plan to ramp-up production. Still, planning needed to be complemented with improvisation. More specifically, since new problems constantly popped up, it became equally important to let go of initial plans and quickly improvise to solve problems at the lowest possible cost.

Regardless if it was a platform project or a customer project, and regardless if Robotics had experience of working with target costing or not, planning and improvisation was combined during all phases. That being said, there were also differences worth highlighting. For example, the concept phase focused on cost reduction specifically emphasizing path dependency; the development phase dealt with both cost reduction and cost containment through the challenge of re-designs; and the pre-production phase focus was on cost containment related to time pressure. From a target costing perspective, this thesis therefore shows that not only is planning and improvisation combined across project phases, these combinations can be linked to different cost focuses (cost reduction or cost containment) and different time challenges (path dependency, re-designs and development rhythm).

Furthermore, the empirics also showed that Robotics' experience of using target costing influenced the balance between planning and improvisation. For example, coming from an entrepreneurial culture, ALFA with its "family" logic had more emphasis on improvisation while DELTA with its "professional" logic had a stronger focus on planning. As the empirical chapter highlighted, a company's history therefore influenced how target costing was practiced. For example, a major reason why DELTA focused on planning and being "professional" was its experience from ALFA where too much improvisation had created problems, with unclear responsibilities and escalating project costs.

An important observation from this thesis is also that there is a significant difficulty in achieving a balance between planning and improvisation. More specifically, ALFA, BETA and DELTA all showed how Robotics ended up in *too much* planning or improvisation. For example, if ALFA experienced problems with too much improvisation, DELTA had problems with too much planning. Rather than arguing for "an optimal balance," this thesis therefore shows how the combination between planning and improvisation is a never ending process

10 Conclusions and future research

The concluding chapter of this thesis will be pursued in three parts. In section 10.1, I will return to the research questions and summarize the main findings of this thesis. Section 10.2 then goes beyond target costing and discusses the conclusions in relation to inter-organizational accounting and accounting-and-new product development. Finally section 10.3 proposes some ideas for future research.

10.1 Conclusions

10.1.1 Target costing and embeddedness

This thesis began with three short episodes from ABB Robotics. During one week we got a hint of target costing in actual practice. One central challenge in conducting target costing was embeddedness or the fact that the individual project was connected to customers, suppliers and parallel projects.

A first conclusion of this thesis relates to these interdependencies. More specifically, drawing on the theoretical concept of network embeddedness (e.g. Anderson et al 1994, Håkansson and Snehota 1995), this thesis has shown that a crucial aspect within target costing is the process of understanding connections between customers, suppliers and indirect third parties. Not only is it important to interact with individual customers and suppliers, when target costing occurs in a setting of multi-technology products, it is also essential to understand how decisions on a dyadic level affect the network level.

However, this thesis has also shown how target costing involves intra-organizational processes. More specifically, emphasizing project embeddedness (Engwall 2003, Lind and Dubois 2008), a second conclusion of this thesis is that target costing in individual projects is highly dependent on what happens in other parallel projects. For example, ALFA, BETA and

DELTA all demonstrated that cost reductions (or cost increases) could not be isolated to a single project. Instead, when customers buy large customized solutions, it becomes important to analyze cost decisions holistically on a system level instead of treating them in isolation.

The implication of these two conclusions is that context plays an important part for understanding target costing. Even though this study confirms previous research on supplier dyads (Cooper and Slagmulder 2004, Agndal and Nilsson 2009) or single projects (Nixon 1998, Hansen and Jönsson 2005), an extended spatial scope made it possible to analyze new issues. For example, customer-driven target costing showed the need for handling tensions between large customers, and supplier-level target costing demonstrated how a supplier could win a large share of the product architecture, but still be unprofitable because of integration problems to other suppliers.

Furthermore, the conclusions also have methodological implications. More specifically, since target costing studies rarely take a holistic approach, future studies might benefit from describing their research design more carefully. Is the focus on single dyads or networks? Are both intra and inter-organizational target costing included? When target costing processes are linked across various spaces, it seems that future studies (at least for multi-technology products) could benefit if the consequences of the chosen research design could be discussed in more detail.

10.1.2 Target costing and incompleteness

A third conclusion relates to incompleteness and the time challenges of path dependency, re-designs and development rhythm. More specifically, as chapter nine demonstrated, target costing involved both planning and improvisation.

During *the concept phase*, planning and improvisation was related to cost reductions and path dependency. Large cost reductions were achieved by re-using earlier solutions. For example, in both ALFA and DELTA it was important for Robotics to explore DriveSys's other customers to identify "big sellers" who could reduce costs. The implication of this is that large cost reductions can be found by exploring path dependency on a network level rather than focusing on isolated projects within a single company.

During *the development phase,* planning and improvisation focused on both cost reductions and cost containment. More specifically, since technical solutions were not fully known, target costing at this phase was focused on different types of re-designs. For example, sometimes as with the new communication technology in ALFA, Robotics could reduce costs, while at other times, such as in BETA, re-designs focused on containing a cost increase.

Finally, during *the pre-production phase*, focus was on cost containment. A primary reason for this was the stress caused by commitment to large customers. As the project managers for ALFA and BETA emphasized, time pressure was intense because large customers such as General Motors were simultaneously coordinating deliveries with a large number of other suppliers. Being part of the customer's ecosystem, cost reductions were therefore rarely possible at this phase. Instead, focus was on ensuring that previous cost reductions were not off-set by cost increases.

Since few studies within target costing emphasize project phases, the notion of cost containment has rarely been discussed in length. One implication of this study is therefore that future studies should include *both* cost reduction and cost containment. For example, instead of focusing on cost reduction in single supplier relationships (Cooper and Slagmulder 2004, Agndal and Nilsson 2009), future research can extend this study by detailing how planning and improvisation are combined in both cost reduction and cost containment activities on a network level.

To summarize how target costing relates to embeddedness and incompleteness, the central concepts are integrated into a framework displayed in table 10. To the left, the framework highlights customer, architectural and supplier-level target costing. Drawing on network embeddedness and project embeddedness, these sub-processes describe how target costing is *both* an inter-organizational and an intra-organizational process.

Target costing in time and space	**Concept phase:** Focusing on cost reduction by exploring path dependency	**Development phase:** Focusing on cost reduction and cost containment through re-designs	**Pre-production phase:** Focusing on cost containment and development rhythm
	Target costing activities involving network and project embeddedness		
Customer-driven target costing	Identify customer hang-ups and avoid tensions among key customers	Create commitment with lead customers and negotiate grey zones related to modifications	Reach customer deadlines and handle upcoming problems in cost efficient way
Architectural-level target costing	Identify critical interdependencies with parallel projects and estimate timing problems	Handle clashes with parallel projects, both in terms of delays and potential synergies	Get priority among parallel projects and contain costs by not starting new re-design efforts.
Supplier-level target costing	Identify opportunities to "ride the waves" on a network level to reduce costs	Cope with re-designs due to new customer demands and technical problems	Avoid quality problems and conduct quick problem-solving in cost efficient way

Table 10.1: Towards an interactive and network view of target costing

Emphasizing both cost reduction and cost containment, the horizontal axis in table 10.1 describes how the target costing process changes over time. For example, it shows how the concept phase primarily focuses on cost reduction and path dependency while the pre-production phase focuses on cost containment and development rhythm. To strengthen the empirical grounding of this framework, each cell contains an illustration. For example, while the cell in the upper left corner (customer-driven target costing during the concept phase) focuses on identifying customer-hang ups, a key challenge in the bottom right cell (supplier-level target costing during the pre-production phase) is solve upcoming problems in a cost efficient way.

Since the framework cannot portray the actual complexity of the target costing process, the examples in table 10.1 should not be taken as the full picture. Instead, the examples have been selected to illustrate how this thesis extends previous literature. For example, while research on intra-organizational target costing (Hansen and Jönsson 2005, Everaert et al 2006) has left out close customer and supplier relationships, research on inter-organizational target costing (Nicolini et al 2000, Cooper and Slagmulder 2004, Agndal and Nilsson 2009) has largely ignored parallel projects within companies. By integrating target costing within and across company boundaries, the framework in table 10.1 should therefore be seen as a first step towards an interactive and network view of target costing.

10.1.3 Some observations regarding target costing evolution

Having addressed how target costing processes are affected by embeddedness and incompleteness, this thesis has also made some observations regarding target costing evolution. More specifically, based on the empirics in chapter four which focused on the organizational level and the three cases of ALFA, BETA and DELTA, this thesis has shown how close customer and supplier relationships are central for understanding *why* target costing is adopted, and how history and learning play an important role in understanding *how* target costing changes over time.

Starting with the question of why target costing was adopted, one could interpret the empirical material in line with survey studies (e.g. Dekker and Smidt 2003, Ax et al 2008) and argue that target costing was adopted due to increased competition. For example, it was not until Robotics began to focus on large automotive customers in the early 1990s that cost reductions were seen as crucial for product development. Trying to compete with global robot manufacturers from Germany and Japan, Robotics adopted target costing due to increased competition.

Yet, what this thesis has shown is that "competition" can be too broad a term to portray the complexity that explains why target costing is adopted. For example, rather than addressing an anonymous "market," target costing was clearly linked to the development of close customer and supplier relationships. As ALFA showed, a significant reason Robotics introduced target costing was to remain profitable at the much lower price levels paid by concrete customers such as General Motors, Ford and Chrysler. Instead of describing the reason for adopting target costing as "competition" or "adapting to the environment," this thesis have shown that target costing adoption can be linked to network dynamics and the development of specific customer and supplier relationships.

In addition to understanding *why* target costing is adopted, this thesis has also shown *how* target costing evolves over time. More specifically, in response to learning experiences, target costing became more formalized over time. In ALFA, target costing followed a "family" logic emphasizing informal discussions and more general guidelines. This informal approach is in line with target costing practice studies that argue that target costing is not as detailed and hierarchal as textbooks prescribe (Nicolini et al 2000, Mouritsen et al 2001, Hansen and Jönsson 2005, Agndal and Nilsson 2009). However, after learning from problems in ALFA, target costing processes in DELTA became more formalized. Customers were interviewed in a more systematic manner and suppliers were compared and benchmarked using formal standards. This more formal approach to target costing is more in line with the Japanese research on target costing (Kato 1993, Cooper and Slagmulder 1997, 1999).

A conclusion from this thesis is therefore that an organization's culture and its learning experience seem to affect how target costing is applied. More specifically, it appears that the process of adopting target costing takes time and that it might take several years before a more formalized "textbook version" of target costing emerged. If company and project history influences target costing practice, this has implications for future studies. For example, from a methodological perspective, it seems important to explicitly discuss target costing experience. For example, case organizations in studies that criticize "textbook target costing" (Nicolini et al 2000, Mouritsen et al 2001, Jörgensen and Messner 2010), are all new users of target costing. In contrast, many of the Japanese "textbook organizations" such as Toyota, Olympus and Nissan (Cooper and Slagmulder 1997) have a much longer history at using target costing. Whether or not target costing experience drives the formality of target costing remains to be seen. However, based on this thesis, it seems that future studies can incorporate history more than that which has been done up to this date.

10.2 Implications for broader accounting literatures

10.2.1 Contributions to inter-organizational accounting

As was described in the theoretical chapter, inter-organizational accounting is a young field. In fact, up till the mid 1990s few accounting scholars had paid much attention to close customer and supplier relationships (Hopwood 1996). Despite a number of articles during the past 15 years, recent reviews have highlighted the lack of process studies. For example, Caglio and Ditillo (2008) conclude their review by calling for more research on processes and dynamics:

> More studies with an emphasis on processes and dynamics are needed. In fact, relationships can be expected to change throughout their life cycle, leading to opposite trajectories even though the starting point may have been the same. (p.895)

Studying both organizational and project levels, this thesis has offered two ways of conceptualizing such inter-organizational dynamics; time challenges and project phases. Starting with time challenges, chapter nine showed how few studied had combined an analysis of path dependency, re-designs and development rhythm. For example, even though Miller and O'Leary (2005, 2007) focused on path dependency, Thrane and Hald (2006) on re-designs and Chua and Mahama (2007) on development rhythm, none of the articles emphasize how these time challenges are related.

A contribution of this thesis is therefore its explanations of how path dependency, re-designs and development rhythms are combined and how this is particularly important in relation to network embeddedness. For example, as the 7th axis showed, BMW wanted this functionality to complement previous investments (path dependency), but since Robotics was pressured to reach customer deadlines (development rhythm), it was decided to develop the 7th axis functionality after ALFA had finished (re-design). This thesis has demonstrated that even though path dependency, re-designs and development rhythm can be analyzed separately, the highest potential might be a holistic analysis on a network level.

Another way to study dynamics is to focus on project phases. As BETA showed, relationship dynamics between Robotics and Design-Net involved many changes. For example, what started as a "love affair" during the concept phase, changed to a more traditional supplier relationship when costs started to escalate during the development phase. In relation to inter-organizational accounting, project phases are important for two reasons: first they are a concrete way to study micro-dynamics. For example, as the empirics showed, each phase had distinct activities and challenges that could be linked to accounting. Furthermore, with a more linear view on dynamics (van de Ven and Scott Poole 1995, Langley 1999), project phases also complement path dependency, re-designs and development rhythm that have a stronger emphasis on non-linearity.

Project phases also contributed with an explicit focus on the project level. As this thesis has demonstrated, inter-organizational accounting has largely focused on the organizational level, and has neglected micro-dynamics on a project level. For example, Miller and O'Leary (2005, 2007), Thrane and Hald (2006) and Chua and Mahama (2007) all focus on the organizational level. Furthermore, among inter-organizational accounting studies that discuss product development (e.g. Dekker 2004, Håkansson and Lind 2004, van der Meer-Kooistra and Scapens 2008) none of these focus on the project level. By combining embeddedness and incompleteness on a project level, this thesis therefore offers potential ways for developing inter-organizational accounting in future research.

10.2.2 Contributions to accounting-and-new product development

Accounting-and-new product development is also a young field that can be further explored in future studies (Davila et al 2009). Even though there were some early studies (e.g. Rockness and Shields 1984, 1988, Brownell 1985), the field did not take off until the late 1990s. In contrast to inter-organizational accounting, the growth has been slower and as Jörgensen and Messner (2010) write, "there is a worrying lack of knowledge of what it actually means to practice accounting in new product development" (p.186).

Drawing on product development research within the Industrial Network Approach and strategic management, this thesis has followed Jörgensen and Messner's (2010) suggestion of focusing on accounting practices. My initial contribution relates to network and project embeddedness. More specifically, this thesis has shown that a key quest for accounting in product development projects is to deal with customers, suppliers and parallel projects. This thesis therefore extends the field of accounting-and-new product development beyond single projects. This extension is important since the majority of empirical studies (e.g. Nixon 1998, Davila 2000, Ditillo 2004, Mouritsen et al 2009, Jörgensen and Messner 2009, 2010) have actually studied multi-technology products without focusing on the many interdependencies that exist between customers, suppliers and parallel projects.

Another contribution of this thesis is the development of a more dynamic perspective on accounting-and-new product development. For example, rather than matching accounting with knowledge complexity as Ditillo (2004) does, this study has shown how target costing processes include *both* cognitional and computational complexity. For example, even though cognitional complexity dominated during the concept phase, cognitional complexity was still evident during both development and pre-production phases when unexpected problems and opportunities emerged. In a similar way, even though computational complexity dominated during later phases, detailed supplier audits were examples of how Robotics tried to "keep track" of critical interdependencies during the concept phase.

In line with Jörgensen and Messner (2010), this thesis therefore argues that the field of accounting-and-new product development should move beyond contingency theory. Similar to how inter-organizational accounting has started to move beyond static theories such as transaction cost economics, this thesis has proposed that time challenges and project phases could be combined to enable a more dynamic perspective. For example, even though planning and improvisation was combined through all project phases, the three development projects showed how it was difficult to create a balance between planning and improvisation.

In fact, it was not until a crisis occurred that the parties began to move away from an either/or view. For example, both in DELTA and BETA, the empirics showed how crises were important for creating awareness that a combination of planning and improvisation was needed. As the product development literature has shown, control was therefore a continuous process of handling tensions (Brown and Eisenhardt 1997, Lewis et al 2002) and where crises was instrumental to making both parties realize a compromise was needed (Drazin et al 1999).

10.3 Suggestions for future research

This thesis has focused on a concrete management accounting process target costing. This is an important process because a large portion of a company's costs are decided interactively with customers and suppliers during product development. A suggestion for future research is a research agenda that integrates the fields of inter-organizational accounting and accounting-and-new product development.

Theoretically such integration could be done in a number of ways. For example, Actor-Network Theory has been used in both fields (e.g. Chua and Mahama 2007, Mouritsen et al 2009) and practice theory seems to offer interesting possibilities in capturing the link between accounting and product development (Jörgensen and Messner 2010). However, this thesis suggests that future research could explore the vast research literature within marketing, organizational theory and strategic management that actually studies inter-organizational relationships and product development.

More specifically, since researchers have already studied the interconnection between inter-organizational relationships and product development (e.g. Håkansson and Snehota 1995, Powell et al 1996, Uzzi 1997, Brady and Davies 2004) there is a good platform for further integration with accounting. For example, this thesis has used the concepts of embeddedness and incompleteness, but to capture the balance between planning and improvisation, there are other concepts such as *semistructures* (Brown and Eisenhardt 1997) and *minimal structures* (Kamoche and Cunha 2001) which have been picked up by accounting researchers (van der Meer-Kooistra and Scapens 2008) and could be further developed.

In terms of empirical data, this thesis suggests that future research continue with multi-technology products. A large majority of research articles within inter-organizational accounting, and accounting-and-new product development, already study such products which make this setting ideal for further development. However, future research can spend more time distinguishing between different types of multi-technology products (see Hobday et al 2005 for a review on this issue). For example, there seem to be at least *three different types of multi-technology products*. First, there are standardized products which have little customer embeddedness. Examples of this would automobiles, computers and consumer electronics. In relation to the time challenges, this category has to deal with time pressure and uneven development rhythms because consumer patterns are constantly changing.

A second category involves multi-technology products sold to business-to-business customers. These products are often integrated into customized solutions which mean that both network embeddedness and project embeddedness are high. Based on the empirics in this thesis, robots can be seen as an example of this category. Other examples are alarm systems, copper rod machies, and medical equipment. In relation to the time challenges, this category is particularly suited to the study of re-designs because network embeddedness and project embeddedness make it difficult to foresee all interdependencies from the start.

Finally, a third category of multi-technology products involves complex systems. These are large systems where each and every one is customized to the needs of a particular customer. Airplanes, semiconductors and telecom systems are examples within this category. For complex systems, network embeddedness is very high. Since the systems have a long life cycle, path dependency is a central feature. By acknowledging the differences among multi-technology products we can hopefully improve our understanding of contextual differences, and also strengthen the integration between inter-organizational accounting and accounting-and-new product development.

The focus on multi-technology products leads to a third suggestion; that we need more in-depth case studies. As this thesis has shown, this type of research can be difficult and frustrating. There is a need to collect data on multiple levels and data analysis rarely goes according to plan. However, if researchers do not take the time, how can we then claim a grasp of actual practice? A possible way forward could be to work in research teams. For example, one researcher could focus on the customer and another on the supplier. By focusing data collection in one organization but still having the opportunity to share views with colleagues, one could combine both depth and breadth.

In fact, it is quite interesting to observe that while the development of multi-technology products builds on co-operation between a large number of different organizations, the actual research of multi-technology products is often conducted by a single individual or a small team. Given the complexity of studying multi-technology products, it might be that future integration between inter-organizational accounting and accounting-and-new product development must occur through larger research projects. For example, with several research teams one could combine an analysis of the industry level (e.g. Miller and O'Leary 2007) with a study of the actual practices on a project level that this thesis have done.

Even though co-operation is far from easy, it might be that research projects that allow both individual flexibility and collective structure have the highest potential. For example, if the open-source movement has succeeded in organizing a large number of software engineers through a few clear rules (see Garud et al 2008 for a study about Linux and Wikipedia), who says that such minimal structures cannot be developed within academia? In fact, I believe that the future to innovative accounting research lies in not only in studying interesting phenomena such as multi-technology products, but also learning from these empirical settings and developing new innovative research designs.

Appendix I: Interviews

In table A1, the 99 interviews are structured based on which research phase and primary topic was discussed during each interview. To further describe which individuals have been interviewed, table A2-A5 shows details for each specific interview. For example, in table A2 one can see that three interviews were conducted with the management team and that two of these dealt with the theme of "dynamics" while one was about "context." If the same individual was interviewed more than once (see for example Purchaser A), the number of interviews and their topics are indicated. At the end of each table, interviews are summarized.

Theme/phase	Phase 1	Phase 2	Phase 3	Phase 4	Total
Technical Context	24	2	2	2	30
Organizational dynamics	14	1	1	3	19
Project DELTA	4	9	11	2	26
Project ALFA	-	4	9	1	14
Project BETA	-	-	7	3	10
Total	**42**	**16**	**30**	**11**	**99**

Table A1: The distribution of interviews according to research theme and research phase

Phase 1: 42 interviews (fall of 2002)					
ABB Robotics, detailed notes					
Department/theme	**Context**	**Dynamics**	**ALFA**	**BETA**	**DELTA**
Management team (3)					
Technology director		1			
Supply chain director		1			
Chief Financial Officer	1				
Purchasing (6)					
Purchasing manager		1			
Purchaser A	2	1			
Purchaser B	1				
Supply chain project manager					1
Development (7)					
Technical manager A	1	2			
Technical manager B	2				
Project manager A					1
Project manager B					1
Quality (3)					
Quality manager		1			
Quality engineer A	1				
Quality engineer B	1				
Production and logistics (7)					
Production manager A		1			
Production manager B	1				
Production manager C	1				
Production engineer	1				
Logistic manager	1				
Material planner A	1				
Material planner B	1				
Controllers (3)					
Controller A		2			
Controller B	1				

Sales (1)					
Sales manager A	1				
Follow-up interviews, ABB Robotics, detailed notes					
	Context	**Dynamics**	**ALFA**	**BETA**	**DELTA**
Purchasing (3)					
Purchasing manager		1			
Purchaser A	1				
Purchaser B	1				
Development (1)					
Project manager B					1
Quality (1)					
Quality engineer A	1				
Production and logistics (3)					
Production tester	1				
Logistic manager	1				
Material planner B	1				
Controller (2)					
Controller A		1			
Controller B	1				
DriveSys, detailed notes					
Development (1)					
Technical manager A		1			
Sales (1)					
Key account manager		1			
In total, 42 inter-views in phase one	**24**	**14**			**4**

Table A2: Interviews during phase one

Phase 2: 16 interviews (spring of 2003)					
ABB Robotics, detailed notes					
	Context	**Dynamics**	**ALFA**	**BETA**	**DELTA**
Purchasing (2)					
Supply chain project manager					1
Purchaser A					1
Development (10)					
Technical manager A			1		
Technical manager B			1		
Project manager A					1
Project manager B			1		1
Project manager C			1		1
Project manager D					1
Project member					1
Senior company specialist		1			
Quality (3)					
Quality engineer A	1				1
Quality engineer B					1
Production and logistics (1)					
Production tester	1				
In total, 16 interviews in phase two	**2**	**1**	**4**		**9**

Table A3: Interviews during phase two

Phase 3: 30 interviews (spring of 2004 – summer of 2005)					
ABB Robotics, tape recorded					
	Context	**Dynamics**	**ALFA**	**BETA**	**DELTA**
Development (11)					
Technical manager A		1		1	
Technical manager B			1		
Project manager A					1
Project manager B					1
Project manager D				2	
Project manager E					1
Project manager F			1		
Senior company specialist			1		
Corporate Research manager	1				
Production and logistics (3)					
Production manager C				1	
Production engineer					1
Production tester					1
Sales (6)					
Sales manager B			2		
Sales manager C					1
Customer order manager	1				
Product manager A			1		
Product manager B					1
DriveSys, tape recorded					
Development (4)					
Technical manager A			1		
Technical manager B			1		
Project manager					1
Project member					1
Quality (1)					
Quality engineer					1
Sales (2)					
Key account manager			1		
Product manager					1

Design-Net, tape recorded					
Management team (2)					
Owner				1	
CEO				1	
Development (1)					
Project member				1	
In total, 16 interviews in phase three	**2**	**1**	**9**	**7**	**11**

Table A4: Interviews during phase thre

Phase 4: 11 interviews (2007-2009)					
ABB Robotics, 7 interviews tape recorded, 1 interview detailed notes					
	Context	**Dynamics**	**ALFA**	**BETA**	**DELTA**
Development (4)					
Technical manager A		1		1	
Technical manager C					1
Technical manager D			1		
Sales (4)					
Product manager B					1
Sales manager B		1			
Sales manager D	1				
Sales manager E	1				
Design-Net, detailed notes					
Management team (1)					
Owner				1	
Development (1)					
Project manager				1	
Magnusson-in-Genarp, detailed notes					
Management team (1)					
Owner		1			
In total, 11 interviews in phase 4	**2**	**3**	**1**	**3**	**2**

Table A5: Interviews during phase four

Appendix II: figures

Appendix III: tables

References

Abernethy, M., and Brownell, P. (1997). Management Control Systems in Research and Development Organizations: The Role of Accounting, Behavioural and Personnel Controls. *Accounting, Organizations and Society*, Vol 22, Issue 3-4, pp.233-248.

Agndal, H., and Nilsson, U. (2009). Interorganizational cost management in the exchange process. *Management Accounting Research*, Vol 20, Issue 1, pp.85-101.

Ancona, D.G., and Caldwell, D.F. (1992) Bridging the Boundary: External Activities and Performance in Organizational Teams. *Administrative Science Quarterly*, Vol 37, Issue 4, pp.634-665.

Ancona, D.G., Okhuysen, G., and Perlow, L. (2001). Taking Time to Integrate Temporal Research. *Academy of Management Review*, Vol 26, Issue 4, pp.512-526.

Anderson, J., Håkansson, H. and Johanson, J. (1994). Dyadic business relationships within a business network context. *Journal of Marketing*, Vol 58, Issue 1, pp.1-15.

Anonymous. (1981). Robot centres aim to boost customer service. *The Industrial Robot*, June 1981, pp.92-95.

Anonymous. (1981). The catalyst who gave ASEA's robot division a new impetus. *The Industrial Robot*, September 1981, pp.158-161.

Anonymous. (1986). GMF Robotics slims to weather US storms. *The Industrial Robot*, September 1986, pp.136.

Ansari, S., Bell, J. and the CAM-I Target Cost Core Group (1997). *Target Costing – The Next Frontier in Strategic Cost Management*. Chicago: Irwin.

Ansari, S., Bell, J. and Swenson, D. (2006). A Template for Implementing Target Costing. *Cost Management*, Sept/Oct 2006, pp.20-27.

Ansari, S., Bell, J. and Okano, H. (2007). Target Costing: Uncharted Research Territory. *Handbook of Management Accounting Research*, Eds. C. S. Chapman, A. G. Hopwood and M. D. Shields, pp.507-530. Oxford, Elsevier.

Araujo, L., Dubois, A., and Gadde, L-E. (2003). The Multiple Boundaries of the Firm. *Journal of Management Studies*, Vol 40, Issue 5, pp.1255-1277.

Ax, C., Grevé, J., and Nilsson, U. (2008). The impact of competition and uncertainty on the adoption of target costing. *International Journal of Production Economics*, Vol 115, Issue 1, pp.92-103.

Baker, T., Miner, A., Eesley, D. (2003). Improvising firms: bricolage, account giving and improvisational competences in the founding processes. *Research Policy*, Vol 32, Issue 2, pp.255-276.

Baker, T., and Nelson, R. (2005). Creating Something from Nothing: Resource Construction through Entrepreneurial Bricolage. *Administrative Science Quarterly*, Vol 50, Issue 3, pp.329-366.

Baraldi, E. (2003). *When Information Technology Faces Resource Interaction: Using IT Tools to Handle Products at IKEA and Edsbyn*. Dissertation, Department of Business Administration, Uppsala University, Uppsala.

Baraldi, E., and Strömsten, T. (2009). Controlling and combining resources in networks – from Uppsala to Stanford, and back again: The case of a biotech innovation. *Industrial Marketing Management*, Vol 38, Issue 5, pp.541-552.

Bisbe, J., and Otley, D. (2004). The effects of the interactive use of management control systems on product innovation. *Accounting, Organizations and Society*, Vol 29, Issue 8, pp.709-737.

Boland, R., Sharma, A., and Afonso, P. (2008). Designing management control in hybrid organizations: the role of path creation and morphogenesis. *Accounting, Organizations and Society*, Vol 33, Issue 7-8, pp.899-914.

Brady, T., and Davies, A. (2004). Building Project Capabilities: From Exploratory to Exploitative Learning. *Organization Studies*, Vol 25, Issue 9, pp.1601-1621.

Brown, S., and Eisenhardt, K. (1995). Product Development: Past Research, Present Findings and Future Directions. *Academy of Management Review*, Vol 20, Issue 2, pp.343-378.

Brown, S., and Eisenhardt, K. (1997). The Art of Continuous Change: Linking Complexity Theory and Time-paced Evolution in Relentlessly Shifting Organizations. *Administrative Science Quarterly*, Vol 42, Issue 1, pp.1-34.

Brownell, P. (1985). Budgetary systems and the control of functionally different organizational activities. *Journal of Accounting Research*, Vol 23, Issue 2, pp.502-512.

Brusoni, S., and Principe, A., (2001). Managing Knowledge in Loosely Coupled Networks: Exploring the Links between Product and Knowledge Dynamics. *Journal of Management Studies*, Vol 38, Issue 7, pp.1019-1036.

Brusoni, S., Prencipe, A., and Pavitt, K. (2001). Knowledge Specialization, Organizational Coupling and the Boundaries of the Firm: Why do Firms Know More Than They Do? *Administrative Science Quarterly*, Vol 46, Issue 4, pp.597-621.

Caglio, A., and Ditillo, A. (2008). A review and discussion of management control in inter-firm relationships: achievements and future directions. *Accounting, Organization and Society*, Vol 33, Issue 7-8, pp.868-898.

Carlsson-Wall, M., Kraus, K., Lind, J. (2009). Accounting and Distributed Product Development, *The IMP Journal*, Vol 3, Issue 1, pp.2-27.

Carlsson-Wall, M., and Kraus, K. (2010). Target costing in inter-organizational relationships and networks, *Accounting in Networks*, Eds. Håkansson, H., Kraus, K., and Lind, J., pp.184-210, New York, Routledge.

Carlsson-Wall, M., Kraus, K., and Lind, J., (2010). Strategic management accounting in business-to-business networks. *working paper*.

Carr, C., and Ng, J. (1995). Total cost control: Nissan and its UK supplier partnerships. *Management Accounting Research*, Vol 6, Issue 4, pp.347-365.

Cäker, M. (2007). Customer Focus – An Accountability Dilemma. *European Accounting Review*, Vol 16, Issue 1, pp.143-171.

Chua, W.F., and Mahama, H. (2007). The Effect of Network Ties on Accounting Controls in a Supply Alliance: Field Study Evidence. *Contemporary Accounting Research*, Vol 24, Issue 1, pp.47-86.

Coad, A., and Cullen, J. (2006). Inter-organisational cost management: towards an evolutionary perspective. *Management Accounting Research*, Vol 17, Issue 4, pp.342-369.

Cooper, R. (1996). Costing techniques to support corporate strategy: evidence from Japan. *Management Accounting Research*, Vol 7, Issue 2, pp.219-246.

Cooper, R., and Chew, W.B., (1996). Control tomorrow's costs through today's designs. *Harvard Business Review*, Vol 74, Issue 1, pp.88-97.

Cooper, R., and Slagmulder, R. (1997) *Target costing and value engineering*. Portland: Productivity Inc.

Cooper, R., and Slagmulder, R. (1999). *Supply Chain Development for the Lean Enterprise – Interorganizational Cost Management*. Portland: Productivity.Inc.

Cooper, R., and Slagmulder, R. (2004). Interorganizational cost management and relational context. *Accounting, Organization and Society*, Vol 29, Issue 1, pp.1-26.

Covaleski, M.A., and Dirsmith, M. (1988). The use of budgetary symbols in the political arena: An historically informed field study. *Accounting, Organizations and Society*, Vol 13, Issue 1, pp.1-24.

Davies, P. (1985). Clio and the Economics of QWERTY. *Economic History*, Vol 75, Issue 2, pp.332-337.

Davila, A. (2000). An empirical study on the drivers of management control systems' design in new product development. *Accounting, Organizations and Society*, Vol 25, Issue 4-5, pp.383-409.

Davila, A., and Wouters, M. (2004). Designing cost-competitive technology products through cost management. *Accounting Horizons*, Vol 18, Issue 1, pp.16, 13-26.

Davila, A. (2005). The Promise of Management Control Systems for Innovation and Strategic Change, Ed. C. Chapman, *Controlling Strategy – Management Accounting, and Performance Measurement*, pp.37-61, Oxford: Oxford Press.

Davila, A., Foster, G., and Oyon, D. (2009). Accounting and Control, Entrepreneurship and Innovation: Venturing into New Research Opportunities. *European Accounting Review*, Vol 18, Issue 2, pp.281-311.

Dekker, H. (2003). Value chain analysis in interfirm relationships: a field study, *Management Accounting Research*, Vol 14, Issue 1, pp.1-23.

Dekker, H., and Smidt, P. (2003). A survey of the adoption and use of target costing in Dutch firms. *International Journal of Production Economics*, Vol 84, Issue 3, pp. 293-305.

Dekker, H. (2004). Control of inter-organizational relationships: evidence of appropriation concerns and coordination requirements. *Accounting, Organizations and Society*, Vol 29, Issue 1, pp.27-50.

Ditillo, A. (2004). Dealing with uncertainty in knowledge-intensive firms: the role of management control systems as knowledge integration mechanisms. *Accounting, Organizations and Society*, Vol 29, Issue 3-4, pp.401-422.

Drazin, R., Glynn, M.A., and Kazanjian, R.K. (1999). Multilevel theorizing about creativity in organizations: a sensemaking perspective. *Academy of Management Review*, Vol 24, Issue 2, pp.286-307.

Dubois, A., and Gadde, L-E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research*, Vol 55, Issue 7, pp.553-560.

Dubois, A., and Araujo, L. (2006). The relationship between technical and organisational interfaces in product development. *The IMP Journal* Vol 1, Issue 1, pp.28-51.

Dyer, W., and Wilkins, A. (1991). Better Stories, Not Better Constructs to Generate Better Theory: A Rejoinder to Eisenhardt. *Academy of Management Review*, Vol 16, Issue 3, pp.613-619.

Edmondson, A., and McManus, S. (2007). Methodological fit in management field research. *Academy of Management Review*, Vol 32, Issue 4, pp.1155-1179.

Eisenhardt, K. (1989). Building theories from case study research, *Academy of Management Review*. Vol 14, Issue 4, pp.532-550.

Eisenhardt, K. (1991). Better Stories and Better Construct: The Case for Rigor and Comparative Logic. *Academy of Management Review*, Vol 16, Issue 3, pp.620-627.

Eisenhardt, K., and Graebner, M. (2007). Theory Building From Cases: Opportunities and Challenges. *Academy of Management Journal*, Vol 50, Issue 1, pp.25-32.

Ekman, P. (2006). *Enterprise systems and business relationships – the utilization of IT in the business with customers and suppliers*. Dissertation, School of Business, Mälardalen University.

Ellram, L.M. (2000). Purchasing and Supply Management's Participation in the Target Costing Process. *Journal of Supply Chain Management*, Vol 36, Issue 2, pp.39-51.

Ellram, L.M. (2002). Supply management's involvement in the target costing process. *European Journal of Purchasing and Supply Management*, Vol 8, Issue 4, pp.235-244.

Ellram, L.M. (2006). The implementation of target costing in the United States: Theory versus Practice. *The Journal of Supply Chain Management*, Vol 42, Issue 1, pp.13-26.

Engwall, M. (2003). No project is an island: linking projects to history and context. *Research Policy*, Vol 32, Issue 5, pp.789-810.

Engwall, M., and Westling, G. (2004). Peripety in an R&D drama: Capturing a Turnaround in Project Dynamics. *Organization Studies*, Vol 25, Issue 9, pp.1557-1578.

Ethiraj, S., and Levinthal, D. (2004). Modularity and Innovation in Complex Systems. *Management Science*, Vol 50, Issue 2, pp.159-173.

Everaert, P., Loosveld, S., Van Acker, T., Schollier, M., Sarens, G. (2006). Characteristics of target costing: theoretical and field study perspectives. *Qualitative Research in Accounting and Management*, Vol 3, Issue 3, pp.236-263.

Farjoun, M. (2010). Beyond Dualism, Stability and Change as a Duality. *Academy of Management Review*, Vol 35, Issue 2, pp.202-225.

Ford, D., and Håkansson, H. (2006). The idea of interaction, *IMP Journal*. Vol 1, Issue 1, pp.4-27.

Garud, R., Jain, S., and Tuertscher, P. (2008). Incomplete by Design and Designing for Incompleteness. *Organization Studies*, Vol 29, Issue 3, pp.351-371.

Garud, R., and Karnöe, P. (2001). Path creation as a process of mindful deviation. Eds., Garud, R. and Kärnöe, P. *Path Dependency and Path Creation*, pp.1-38, Mahwah, NJ: Lawrence Earlbaum.

Garud, R., and Karnöe, P. (2003). Bricolage versus breakthrough: distributive and embedded agency in technology entrepreneurship. *Research Policy*, Vol 32, Issue 2, pp.277-300.

Garud, R., Kumaraswamy, A. and Karnöe, P. (2010). Path Dependency or Path Creation? *Journal of Management Studies*, Vol 47, Issue 4, pp.760-774.

Gersick, C. (1994) Pacing Strategic Change: The Case of a New Venture, *Academy of Management Journal*, Vol 37, Issue 1, pp.9-45.

Grandori, A. (1997). An Organizational Assessment of Interfirm Coordination Modes. *Organization Studies*, Vol 18, Issue 6, pp.897-925.

Granovetter, M. (1985). Economic Action and Social Structure: The Problem of Embeddedness. *The American Journal of Sociology*, Vol 91, Issue 3, pp.481-510.

Gressetvold, E. (2004). *Product Development – Effects on a Company's Network of Relationships*. Disseration, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Trondheim.

Håkansson, H. (Ed), (1982). *International Marketing and Purchasing of Industrial Goods, An Interaction Approach*, Wiley.

Håkansson, H., and Ford, D. (2002). How should companies interact in business markets? *Journal of Business Research*, Vol 55, Issue 2, pp.133-139.

Håkansson, H., and Lind, J. (2004). Accounting and network coordination. *Accounting, Organizations and Society*, Vol 29, Issue 1, pp.51-72.

Håkansson, H., and Lind, J. (2007). Accounting in an Interorganizational Setting. *Handbook of Management Accounting Research*, Eds. Chapman, C., Hopwood, A., Shields, M., pp.885-902, Oxford: Elsevier.

Håkansson, H., Kraus, K., and Lind, J. (2010). *Accounting in Networks*. New York: Routledge.

Håkansson, H., and Snehota, I. (1989). No Business Is an Island: The Network Concept of Business Strategy. *Scandinavian Journal of Management*, Vol 5, Issue 3, pp.187-200.

Håkansson, H., and Snehota, I. (1995). *Developing Relationships in Business Networks*. London: Routledge.

Håkansson, H., and Waluszewski, A. (2002). *Managing Technological Development. IKEA, the environment and technology*. London: Routledge.

Håkansson, H., and Waluszewski, A. (2002b). Path dependence: restricting or facilitating technical development? *Journal of Business Research*, Vol 55, Issue 7, pp.561-570.

Halinen, A., and Törnroos, J-Å. (2005). Using case methods in the study of contemporary business networks. *Journal of Business Research*, Vol 58, Issue 9, pp.1285-1297.

Hansen, A., and Jönsson, S. (2005). *Target Costing and Coordination – Framing Cost Information Sharing in New Product Development*, Accounting in Scandinavia – The Northern Lights. Eds. Jönsson, S. and Mouritsen, J., pp.219-241, Copenhagen: Liber and CBS Press.

Hargadon, A., and Sutton, R.I. (1997). Technology Brokering and Innovation in a Product Development Firm. *Administrative Science Quarterly*, Vol 42, Issue 4, pp.716-749.

Henderson, R.M., and Clark, K. (1990). Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms. *Administrative Science Quarterly*, Vol 35, Issue 1, pp. 9-30.

Hjelmgren, D. (2005). *Exploring the Interplay between Standard Products and Customer Specific Solutions*. Dissertation, Department of Technology Management and Economics, Chalmers University of Technology.

Hobday, M., Davies, A., Prencipe, A. (2005). Systems integration: a core capability of the modern corporation. *Industrial and Corporate Change*, Vol 14, Issue 6, pp.1109-1143.

Hoegl, M., and Weinkauf, K. (2005). Managing Task Interdependencies in Multi-Team Projects: A Longitudinal Study. *Journal of Management Studies*, Vol 42, Issue 6, pp.1287-1308.

Hopwood, A. (1996). Looking across rather than up and down: on the need to explore the lateral processing of information. *Accounting, Organization and Society*, Vol 21, Issue 6, pp.589-590.

Hopwood, A. (2005). After 30 years. *Accounting, Organizations and Society*, Vol 30, Issue 7-8, pp.585-586.

Järvensivu, T., and Törnroos, J-Å. (2010). Case study research with moderate constructionism: Conceptualization and practical illustration. *Industrial Marketing Management*, Vol 39, Issue 1, pp.100-108.

Jörgensen, B., and Messner, M. (2009). Management Control in New Product Development: The Dynamics of Managing Flexibility and Efficiency. *Journal of Management Accounting Research*, Vol 22, Issue 1, pp.99-124.

Jörgensen, B., and Messner, M. (2010). Accounting and strategising: A case study from new product development. *Accounting Organizations and Society*, Vol 35, Issue 2, pp.184-204.

Kajüter, P., and Kulmala, H. (2005). Open-book accounting in networks. Potential achievements and reasons for failure. *Management Accounting Research*, Vol 16, Issue 2, pp.179-204.

Kamoche, K., and Cunha, M. (2001). Minimal Structures: From Jazz Improvisation to Product Innovation. *Organization Studies*, Vol 22, Issue 5, pp.733-765.

Kato, Y. (1993). Target costing support systems: lessons from Japanese leading companies. *Management Accounting Research*, Vol 4, Issue 1, pp.33-47.

Keating, P. (1995). A Framework for Classifying and Evaluating The Theoretical Contributions of Case Research in Management Accounting. *Journal of Management Accounting Research*, Fall 1995, pp.66-86.

Kraus, K. (2007). *Sven, inter-organisational relationships and control – A case study of domestic care of the elderly*. Dissertation, Department of Accounting, Stockholm School of Economics.

Kraus, K., and Lind, J. (2007). Management control in inter-organisational relationships. *Issues in management accounting*, Eds. Hopper, T., Scapens, R W. and Northcott, D., pp.269-296. Harlow: Prentice Hall.

Langley, A. (1999). Strategies for theorizing process data. *Academy of Management Review*, Vol 24, Issue 4, pp.691-710.

Lewis, M., Welsh, M.A., Dehler, G., Green, S. (2002). Product Development Tensions: Exploring Contrasting Styles of Project Management. *Academy of Management Journal*, Vol 45, Issue 3, pp.546-564.

Lincoln, Y.S., and Guba, E.G. (1985). *Naturalistic Inquiry*, Newsbury Park, CA: Sage.

Lind, F. (2006). *Resource Combining Across Inter-organizational Project Boundaries*. Dissertation, Department of Technology Management and Economics, Chalmers University of Technology.

Lind, F., and Dubois, A. (2008). Analysing Dimensions and Consequences of Project Embeddedness. *The IMP Journal*, Vol 2, Issue 3, pp.2-18.

Lind J., and Thrane, S.(2005). Network accounting. *Accounting in Scandinavia – The Northern Lights*. Eds. Jönsson, S. and Mouritsen, J., pp.115-137, Copenhagen: Liber and CBS Press.

Lind, J., and Thrane, S. (2010). Towards Accounting in Network Settings, *Accounting in Networks*, Eds. Håkansson, H., Kraus, K., and Lind, J., pp.60-79. New York: Routledge.

Lukka, K., and Granlund, M. (2002). The fragmented communication structure within the accounting academia: the case of activity-based costing research genres. *Accounting Organizations and Society*, Vol 27, Issues 1-2, pp.165-190.

Lukka, K. (2005). Approaches to case research in management accounting: The nature of empirical intervention and theory linkage. *Accounting in Scandinavia – The Northern Lights*. Eds. Jönsson, S. and Mouritsen, J., pp.375-399, Copenhagen: Liber and CBS Press.

Lundgren, A. (1995) *Technological Innovation and Network Evolution*. London: Routledge.

Macintosh, N., and Scapens, R. (1990). Structuration theory in management accounting. *Accounting, Organizations and Society*, Vol 15, Issue 5, pp.455-477.

Miller, P., and O'Leary, T. (2005). Capital Budgeting, Coordination, and Strategy: A Field Study of Interfirm and Intrafirm Mechanisms. Eds. C. Chapman, *Controlling Strategy – Management Accounting, and Performance Measurement*, pp.151-182, Oxford: Oxford Press.

Miller, P., and O'Leary, T. (2007). Mediating instruments and making markets: Capital budgeting, science and the economy, *Accounting, Organizations and Society*, Vol 32, Issues 7-8, pp.701-734.

Mouritsen, J. (1999). The flexible firm: strategies for a subcontractor's management control, *Accounting, Organizations and Society*, Vol 24, Issue 1, pp.31-55.

Mouritsen, J., Hansen, A. and Hansen, C. Ø. (2001). Interorganizational controls and organizational competencies: episodes around target cost management/functional analysis and open book accounting. *Management Accounting Research*, Vol 12, Issue 2, pp.221-244.

Mouritsen, J., Hansen, A. and Hansen, C. Ø. (2009). Short and long translations: Management accounting calculations and innovation management. *Accounting, Organization and Society*, Vol 34, Issues 6-7, pp.738-754.

Mouritsen, J., Thrane, S. (2006). Accounting, network complementarities and the development of inter-organisational relations. *Accounting, Organizations and Society*, Vol 31, Issue 3, pp.241-275.

Nicolini, D., Tomkins, C., Holti, R., Oldman, A. and Smalley, M. (2000). Can Target Costing and Whole Life Costing be Applied in the Construction Industry?: Evidence from Two Case Studies. *British Journal of Management*, Vol 11, Issue 4, pp.303-324.

Nixon, B. (1998). Research and development performance measurement: a case study. *Management Accounting Research*, Vol 3, Issue 3, pp.329-355.

Penrose, E. (1959). *The Theory of the Growth of the Firm*, Oxford: Oxford University Press.

Penrose, E. (1960). The Growth of the Firm, A Case Study: The Hercules Powder Company. *Business History Review*, Vol 34, Issue 1, pp.1-23.

Powell, W., Koput, K.W., and Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, Vol 41, Issue 1, pp.116-145.

Revellino, S., and Mouritsen, J. (2009). The Multiplicity of Controls and the Making of Innovation. *European Accounting Review*, Vol 18, Issue 2, pp.341-369.

Rockness, H.O., and Shields, M. (1984). Organizational control systems in research and development. *Accounting, Organizations and Society*, Vol 9, Issue 2, pp.165-177.

Rockness, H.O., and Shields, M. (1988). An empirical analysis of the expenditure budget in research and development. *Contemporary Accounting Research*, Vol 4, Issue 2, pp.568-581.

Scapens, R. (1990). Researching Management Accounting Practice: The Role of Case Study Methods. *British Accounting Review*, Vol 22, Issue 3, pp.259-281.

Scapens, R.W., Bromwich, M., (2001) Management Accounting Research: the first decade, *Management Accounting Research*, Vol 12, Issue 2, pp.245-254.

Scapens, R.W. (2004). *The role of theory in case study research*, working paper presented at the Doctoral Summer School in Management Accounting 17-21 July, Siena, Italy

Seal, W., Berry, A., and Cullen, J. (2004). Disembedding the supply chain: institutionalized reflexivity and inter-firm accounting, *Accounting, Organizations and Society*, Vol 29, Issue 1, pp.73-92.

Shank, J.K., Fisher, J. (1999). Target costing as a strategic tool. *Sloan Management Review*, Vol 41, Issue 1, pp.73-82.

Shields, M. (1997). Research in Management Accounting by North Americans in the 1990's. *Journal of Management Accounting Research*, Vol 9, Issue 1, pp.3-61.

Strömsten, T., and Waluszewski, A. (forthcoming). Governance and Resource Interaction in Networks: The Role of Venture Capital in a Biotech Start-up. *Journal of Business Research*.

Sobrero, M., and Roberts, E.B. (2001). The Trade-off Between Efficiency and Learning in Interorganizational Relationships for Product Development. *Management Science*, Vol 47, Issue 4, pp.493-511.

Staudenmeyer, N., Tripsas, M., and Tucci, Christopher (2005). Interfirm Modularity and Its Implications for Product Development. *Journal of Product and Innovation Management*, Vol 22, Issue 4, pp.303-321.

Sosa, M., Eppinger, S., and Rowles, C. (2004). The Misalignment of Product Architecture and Organizational Structure in Complex Product Development. *Management Science*, Vol 50, Issue 12, pp.1674-1689.

Swenson, D., Ansari, S., Bell, J. and Il Won, K. (2003). Best Practices in Target Costing. *Management Accounting Quarterly*, Winter 2003, pp.12-17.

Swenson, D., Buttross, T., Il-Woon, K. (2005). Using the CAM-I Diagnostic To Evaluate Readiness for Target Costing. *Cost Management*, May/June, pp.41-48.

Sydow, J., Lindkvist, L., and DeFillippi, R. (2004). Project-Based Organizations, Embeddedness and Repositories of Knowledge: Editorial. *Organization Studies*, Vol 25, Issue 9, pp.1475-1489.

Tani, T., Okano, H., Shimizu, N., Iwabuchi, Y, Fukada, J., and Cooray, S. (1994). Target cost management in Japanese companies: current state of the art. *Management Accounting Research*, Vol 5, Issue 1, pp.67-81.

Tani, T. (1995). Interactive control in target cost management. *Management Accounting Research*, Vol 6, Issue 4, pp.399-414.

Tatikonda, M., and Rosenthal, S. (2000). Successful execution of product development projects: Balancing firmness and flexibility in the innovation process. *Journal of Operations Management*, Vol 18, Issue 4, pp.401-425.

.

Thrane, S., and Hald, K. (2006). The emergence of boundaries and accounting in supply fields: The dynamics of integration and fragmentation. *Management Accounting Research*, Vol 17, Issue 3, pp.288-314.

Thrane, S. (2007). The complexity of management accounting change: Bifurcation and oscillation in schizophrenic inter-organizational systems. *Management Accounting Research*, Vol 18, Issue 2, pp.248-272.

Tomkins, C. (2001). Interdependencies, trust and information in relationships, alliances and networks. *Accounting, Organizations and Society*, Vol 26, Issue 2, pp.161-191.

Ulrich, K. (1995). The role of product architecture in the manufacturing firm. *Research Policy*, Vol 24, Issue 3, pp.419-440.

Uzzi, B. (1997). Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness. *Administrative Science Quarterly*, Vol 42, Issue 1, pp.35-67.

Van de Ven, A., and Scott Poole, M. (1995). Explaining Development and Change in Organizations. *Academy of Management Review*, Vol 20, Issue 3, pp.510-540.

Van der Meer-Kooistra, J., and Scapens, R. (2008). The governance of lateral relationships between and within organizations. *Management Accounting Research*, Vol 19, Issue 4, pp.365-384.

Van der Meer-Kooistra, J., and Vosselman, E. (2000). Management control of interfirm transactional relationships: the case of industrial innovation and management. *Accounting, Organizations and Society*, Vol 25, Issue 1, pp.51-77.

Van der Meer-Kooistra, J., and Vosselman, E. (2006). Research on management control of interfirm transactional relationships: Whence and whither. *Management Accounting Research*, Vol 17, Issue 3, p.227-237.

Van Maanen, J., Sörensen, J., Mitchell, T. (2007). The Interplay Between Theory and Method, Introduction to Special Topic Forum. *Academy of Management Review*, Vol 32, Issue 4, pp.1145-1154.

Wedin, T. (2001). *Networks and Demand. The Use of Electricity in an Industrial Process*, Dissertation, Department of Business Studies, Uppsala University.

Westerlund, L. (2000). *Människans förlängda arm – en bok om industrirobotens historia*, Stockholm: Informationsförlaget.

Von Corswant, F. (2003). *Organizing Interactive Product Development.* Dissertation. Department of Operations Management and Work Organization, Chalmers University of Technology, Gothenburg.

Yoshikawa, T., Innes, J., Mitchell, F. (1994). Applying functional cost analysis in a manufacturing environment. *International Journal of Production Economics*, Vol 36, Issue 1, pp.53-64.

Zander, I., and Zander, U. (2005). The Inside Track: On the Important (But Neglected) Role of Customers in the Resource-Based View of Strategy and Firm Growth. *Journal of Management Studies*, Vol 42, Issue 8, pp.1519-1548.

Östman, L. (2009). *Towards a General Theory of Financial Control for Organisations*. Stockholm: EFI The Economic Research Institute.

The Stockholm School of Economics

A complete publication list can be found at *www.hhs.se/research/publications*. Books and dissertations are published in the language indicated by the title and can be ordered via e-mail: *efi.publications@hhs.se*.

A selection of our recent publications

Books

Barinaga, Ester (2010). *Powerful dichotomies.*

Ericsson, Daniel (2010). *Den odöda musiken.*

Ericsson, Daniel (2010). *Scripting creativity.*

Holmquist, Carin (2011). *Kvinnors företagande – kan och bör det öka?*

Lundeberg, Mats (2011). *Improving business performance: a first introduction.*

Melén, Sara (2010). *Globala från start. Småföretag med världen som marknad.* Forskning i Fickformat.

Mårtensson, Pär och Mähring, Magnus (2010). *Mönster som ger avtryck: Perspektiv på verksamhetsutveckling.*

Sjöström, Emma (2010). *Ansiktslösa men ansvarsfulla.* Forskning i fickformat.

Wijkström, Filip (2010). *Civilsamhällets många ansikten.*

Engwall, Lars (2009). *Mercury meets Minerva: business studies and higher education: the Swedish case.*

Dissertations

Alexandersson, Gunnar (2010). *The accidental deregulation: essays on reforms in the Swedish bus and railway industries 1979-2009.*

Bohman, Claes (2010). *Attraction: a new driver of learning and innovation.*

Buturak, Gökhan (2011). *Choice deferral, status quo bias, and matching.*

Ejenäs, Markus (2010). *Ledning av kunskapsintegration - förutsättningar och hinder: en studie av en fusion mellan IT- och managementkonsulter.*

Engvall, Anders (2010). *Poverty and conflict in Southeast Asia.*

Glassér, Charlotte (2010). *The fountainhead of innovation health: a conceptualization & investigation.*

Hemrit, Maetinee (2011). *Beyond the Bamboo network: the internationalization process of Thai family business groups.*
Juks, Reimo (2010). *Corporate governance and the firm's behaviour towards stakeholders.*
Lundvall, Henrik (2010). *Poverty and the dynamics of equilibrium unemployment: [essays on the economics of job search, skills, and savings].*
Lychnell, Lars-Olof (2010). *IT-relaterad verksamhetsförändring: processer som formar växelspelet mellan utveckling och användning.*
Magnusson Bernard, Kristin (2010). *Remittances, regions and risk sharing.*
Mohlin, Erik (2010). *Essays on belief formation and pro-sociality.*
Monsenego, Jérôme (2011). *Taxation of foreign business income within the European internal market: an analysis of the conflict between the objective of achievement of the European internal market and the principles of territoriality and worldwide taxation.*
Nakatani, Tomoaki (2010). *Four essays on building conditional correlation GARCH models.*
Nelson, Maria. *Utflyttning av aktiebolag: en analys i ljuset av den internationella skatterätten och EU-rätten.*
Siming, Linus (2010). *Private equity and advisors in mergers and acquisitions.*
Sjöquist Rafiqui, Pernilla (2010). *Evolving economic landscapes: institutions and localized economies in time and space.*
Stepanok, Ignat (2011). *Essays on international trade and foreign direct investment.*
Strid, Ingvar (2010). *Computational methods for Bayesian inference in macroeconomic models.*
Sunesson, T. Daniel (2010). *School networks and active investors.*
Tolstoy, Daniel (2010). *International entrepreneurship in networks: the impact of network knowledge combination on SMEs' business creation in foreign markets.*
Öhman, Niclas (2010). *Considering intentions.*