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Managing and Designing Dyadic R&D Collaboration

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Tuotekehitysyhteistyön johtaminen ja suunnittelu kahdenvälisissä yrityssuhteissa

Tiivistelmä

Yritysten keskittyminen yhä vahvemmin ydinliiketoimintoihinsa on lisännyt merkittävästi niiden riippuvuutta toisistaan. Kun yritykset hankkivat valmistusta ja palveluita oman organisaation ulkopuolelta, myös näihin liittyvän kehittämisen painopiste siirtyy omasta organisaatiosta kumppaniyrityksiin. Kehitystyötä ei kuitenkaan yleensä voida tehdä toimittajayrityksissä ilman asiakasyrityksessä olevaa tietoa tarpeeseen liittyen. Tämä asetelma on johtanut tilanteeseen, jossa tarve toimivalle tuote- ja palvelukehitysyhteistyölle on suuri. Toimimaton tuotekehitysyhteistyö heikentää yritysten tuotteiden suhteellista kilpailukykyä, kun taas ne yritykset, jotka pystyvät rakentamaan toimivia tuotekehitysyhteistyösuhteita, onnistuvat luomaan kilpailuetua nopeammalla, tehokkaammalla ja osuvammalla kehitystyöllä.

Tämä tutkimus käsittelee tuotekehitysyhteistyön johtamista ja suunnittelua kahdenvälisissä yrityssuhteissa. Tavoitteena on luoda ymmärrys siitä, miten yritykset voivat suunnitella ja johtaa kahdenvälistä tuotekehitysyhteistyötä. Tähän pyritään tarkastelemalla erillisissä tutkimusartikkeleissa kolmea tuotekehitysyhteistyön elementtiä; sen mahdollisia muotoja, prosessia ja sitä tukevia käytäntöjä.

Tutkimuksen teoreettinen viitekehys rakentuu resurssiperustaisen teorian, suhdenäkökulman ja dynaamisten kyvykkyyksien teorian perustalle. Tutkimuksen empiirinen osa nojaa laadulliseen aineistoon. Kolmesta osatutkimuksesta ensimmäinen on pitkittäinen tapaustutkimus, toinen konstruktiivinen design science -tutkimus ja kolmas monitapaustutkimus, jossa tutkittavat tapaukset on valittu määrällisestä kyselyaineistosta.

Yritykset voivat suunnitella ja valita tuotekehitysyhteistyön muodon tietoisesti ja toisaalta myös siirtyä yhteistyömuodosta toiseen tilanteen muuttuessa. Tuotekehitysyhteistyön prosessin toimivuuden kannalta on tärkeää huomioida samanaikaisesti sekä tehokkuus- että dialogisuusnäkökulmien toteutuminen vuorovaikutuksessa. Tuotekehityssuhteita tukevat käytännöt ruokkivat toisiaan ja siksi niiden tasapainoinen implementointi on tärkeää.

Kokonaisuudessaan tutkimus korostaa kahden yrityksen välisen tuotekehitysyhteistyön olevan parhaimmillaan molempien kumppanuuden osapuolten kilpailukykyä parantava toimintamalli, jonka suunnitteluun ja johtamiseen tutkimus avaa uusia näkökulmia.

Asiasanat
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Abstract
The increasing need in recent years to focus on core business has increased companies' dependence on each other. When companies acquire manufacturing and services from external companies, the result is that related R&D tasks also move from one company to its collaborator companies. However, typically the R&D tasks in question cannot be conducted without the customer company's knowledge related to the actual need. This setting has led to a situation where companies need efficient R&D collaboration. Nonfunctional R&D collaboration decreases the relative competitive edge of products whereas those companies that are able to build functional R&D partnerships can achieve a competitive advantage with faster, more efficient, and more accurate R&D.

This research addresses the management and design of dyadic R&D collaborations. It aims to create an understanding of how companies can design and manage such dyadic R&D relationships. To that end, this dissertation explores three essential elements of R&D collaboration through three research articles on the possible forms of collaboration, the collaboration process, and the practices supporting R&D relationships.

Theoretical framework of the dissertation builds on the resource based theory, the relational view, and on dynamic capabilities. The empirical part of the research leans on qualitative data. Of the three sub-research pieces, the first is a longitudinal case study, the second is a constructive design science study, and the third a multiple case study in which cases are selected based on a quantitative survey dataset.

Collaborating companies can design and choose the form of their collaboration purposefully, and can switch from one collaboration form to another as the situation demands. For an R&D collaboration process to be fully functional, it is important to simultaneously take into account both efficiency and dialogical perspectives in the relevant interaction. Practices that facilitate and support R&D collaboration strengthen each other and thus it is essential to ensure their balanced implementation.

Overall, this research emphasizes that dyadic R&D collaboration can at its best be an approach that creates collaborative advantage for both parties. This research also opens up new perspectives on designing and managing such collaborations.

Keywords
R&D collaboration, R&D management, business relationship management, case study.

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I jumped into this dissertation project as an entrepreneur who felt that a doctoral degree could offer brand value and a nice boost for the business. It was only few months after starting in the PhD program that I realized other, more intrinsic, motivations had started to influence my path. While writing my research plan, a genuine will to better understand the research topic and to contribute to research and practice with my own work became the guiding motivational factors that encouraged me to go the extra mile.

I feel that I am privileged as I have had the luxury to develop myself and my thinking in the form of this dissertation. This dissertation project has offered me a wealth of experience that would not otherwise have been possible. National scientific collaboration and international research visits to Australia and the USA, in addition to several conferences around the world have given me a good view of the international academic world and in particular the people within it.

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Contents

PART II: ARTICLES

This dissertation is based on three appended articles:

[1] Ylimäki, J. (2014). A dynamic model of supplier–customer product development collaboration strategies. *Industrial Marketing Management*, 43(6) 996-1004.[1]

[2] Ylimäki, J., & Vesalainen, J. (2015). Relational development of a service concept: Dialogue meets efficiency. *Journal of Business and Industrial Marketing,* 30(8), 939-950.[2]

[3] Huikkola, T., Ylimäki, J., & Kohtamäki, M. (2013). Joint learning in R&D collaborations and the facilitating relational practices. *Industrial Marketing Management*, *42*(7), 1167-1180.[3]

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1 INTRODUCTION

1.1 Background

The significance of supplier companies' role across industries has increased over the last several decades. Not only is the production of subassemblies outsourced, but suppliers' resources are increasingly used to develop products and services. Because suppliers have experience in production, their knowledge of the best possible design from the production viewpoint is far superior to that of a buyer company. The logical step forward for buyers is to gain an advantage not only from the flexibility of outsourced production but also from suppliers' capability to develop products and services. By integrating suppliers in development activities, companies aim to gain advantages in development time, quality and cost issues.

Research on supplier-customer collaboration in R&D can be traced back to studies on the Japanese car manufacturing industry (Imai, Nonaka, & Takeuchi, 1985; Johnsen, 2009). Supplier involvement is the integration of suppliers' capabilities into their customers' product development process, and it includes the development responsibilities of subassemblies, processes and services and all the actions that suppliers perform on behalf of their customers in terms of product development (van Echtelt, Wynstra, van Weele, & Duysters, 2008). Supplier involvement is important because suppliers maintain specialized product and process knowledge. The significance of this specialization is emphasized when products and services are developed to meet demanding needs requiring complex solutions. Researchers have indicated that supplier involvement has a positive influence on the quality of new designs (Takeishi, 2001) and on the overall quality, cost and time cycle of the development process (Ragatz, Handfield, & Petersen, 2002).

Another approach to understanding supplier-customer R&D collaboration comes from customer involvement. Whereas suppliers maintain valuable information on how to produce components and other goods, "need information" is maintained on the customer's side. Integrating customers with "need information" into the supplier's design process is defined as customer involvement (Kaulio, 1998). Customer involvement clarifies the early stages of the development process in particular because these stages, including idea generation, idea screening and concept development, include high uncertainty (Alam, 2006). Furthermore, customer involvement increases customers' satisfaction because customers are able to affect product specifications; thus, the gap between customers' requirements and realized product specifications is kept to a minimum (Risdiyono &

Koomsap, 2013). Customer involvement also enhances quality and reliability (Sun, Yau, & Suen, 2010).

Although the benefits of supplier-customer R&D collaboration have been identified, they are not certain; instead, they depend on different factors. Some identified critical factors of partnerships between suppliers and customers for the realization of these benefits are trust, joint training, shared risks and profits, suppliers' representation in development teams and, particularly in asymmetric relationships, the avoidance of the misuse of power (LaBahn & Krapfel, 2000). In addition, supplier-customer R&D collaboration research has highlighted, for example, the relevancy of asymmetric relationships, the criticality of purchased entities for end products and suppliers' technological capability. If R&D collaboration is poorly managed, it might be harmful to both parties in the collaboration. It can cause unwanted information leaks to competitors, and for the supplier, it might lead to efforts that consume resources without benefits. To avoid these risks, collaborative parties should have a clear picture and vision for their R&D collaboration efforts.

Supplier-customer R&D collaboration research has emphasized the buyer company's viewpoint, and related topics have been treated as a supply chain phenomenon. One reason for this might be that large buyer companies with more extensive resources are more likely than supplier companies, which are usually smaller, to invest in research. However, the same collaborations are also interesting from the supplier's viewpoint. Collaborations that address supply chain management questions of buyer companies can address business logic questions of supplier companies. This dissertation uses a dyadic viewpoint, as it approaches supplier-customer R&D collaborations from the perspectives of both suppliers and customers. To balance supplier and customer viewpoints, customer involvement research is used to complement supplier involvement research. This dyadic approach creates an opportunity to study how collaboration can create an advantage for both companies and how they can design their collaborations in a relational manner.

1.2 Research gaps

Research on collaborative R&D is extensive. This is understandable, as the effect of product and service development on economic profit is apparent and companies currently collaborate more than ever. Although collaborative product development has been the focus of multiple studies (Dyer & Singh, 1998; Johnsen, 2009; Takeuchi & Nonaka, 1986), the dyadic consideration of collaborative de-

velopment in a broad sense has been lacking. Articles in different fields of relational business practices call for more studies balancing customer and supplier viewpoints (Kamp, 2005; Terpend, Tyler, Krause, & Handfield, 2008, Johnsen, 2009). A dyadic approach could help close the gap between the traditional viewpoints of buyer companies (Dyer & Singh, 1998) and supplier companies (Stjernström & Bengtsson, 2004). A larger issue of relational business studies is the lack of practical studies and articles that focus on practice-level findings (Kale & Singh, 2007). Although earlier studies have focused on specific themes within collaborative R&D, the literature lacks a compilation that could draw an overall picture of the design and management of dyadic supplier-customer R&D relationships.

R&D collaboration studies that concentrate on strategic-level issues highlight the selection of optimal suppliers (Hartley, Zirger, & Kamath, 1997; Melander & Tell, 2014), risks in supplier involvement (Wasti & Liker, 1997), supplier training (Krause, Handfield, & Scannell, 1998), the timing of supplier involvement in product development (Bidault, Despres, & Butler, 1998), the types of supplier involvement (Petersen, Handfield, & Ragatz, 2005) and the types of customer involvement (Kaulio, 1998). These strategic-level studies lack a broad consideration of the types of collaboration in customer and supplier involvement. To be able to develop R&D relationships, companies should identify and be aware of what types of R&D relationships they possess. The literature also lacks investigations on how different collaboration types can change and develop over time while maintaining or changing the original collaborating companies in the relationship. Choices between customer and supplier involvement types are essential when companies manage their collaboration portfolios. The choices of these types are important, as are the transformations between different collaboration tactics. When prerequisites for R&D collaboration change, companies have to be prepared to reform their collaborations to match them with the new requirements. However, these transformations in the form of R&D collaboration have not been the focus of earlier studies.

There are several examples of the collaboration process point of view in the literature. Relational literature studies have shed light on how to involve suppliers in product development, how to establish supplier involvement networks and how to assess suppliers. Process literature has given examples of how to build an effective product and service development processes (Cooper, 1990, 1996; Shostack, 1984), placing minor or no emphasis on the inter-firm phases of the process. Furthermore, value co-creation literature that leans on relational business logic is criticized for being too abstract, and there is a lack of studies that express the practical potential of relational value creation in service-dominant

businesses (Ballantyne, Frow, Varey, & Payne, 2011; Kowalkowski, 2011; Lambert & Enz, 2012).

In addition, the literature does not provide sufficient information about practices in R&D collaborations. This is an important topic because concrete practices could describe the actual nature of relationships, unveiling how companies generate a collaborative advantage through R&D collaborations. Consequently, studies call for research on practices that companies deploy in business relationships (Kale & Singh, 2007). Furthermore, the vast majority of studies see alliance capability as a firm-level phenomenon (Kale, Dyer, & Singh, 2002; Walter, Auer, & Ritter, 2006) that hinders the dyadic analysis of value creation prerequisites.

To summarize, in the literature on collaborative development, there are two theoretical gaps and three practical gaps that are the focus of this dissertation. First, there is a lack of an overall picture of how to design and manage dyadic supplier-customer R&D collaborations. Second, studies tend to be conducted from the buyer firm's perspective, and more studies from the supplier perspective and dyadic studies are needed on all levels of collaborative development. In addition, three more practical gaps are identified: First, strategic-level studies do not shed enough light on the issue of choosing between different supplier and customer involvement types. Second, from the process point of view, more information is needed on the relational process of collaborative development. Third, studies call for new contributions to practices that support R&D collaborations. Although the latter three gaps are practically oriented, their theoretical meaning is remarkable. Solving these gaps would pave the way for theory development in terms of dynamic dyadic R&D collaborations.

This dissertation aims to respond to these gaps by studying the cornerstones of R&D collaborations, particularly topics that are relevant in terms of designing and managing these collaborations. It aims to build new knowledge and integrate previous research on the strategic, process and practice levels of collaborative R&D. The contribution of this dissertation is fivefold. First, it contributes to the strategic discussion of different types of collaborative R&D and their dynamic nature. Second, it contributes to process-level research by providing knowledge on actual relational development processes. The third contribution is an investigation of practices that facilitate development in R&D relationships. Fourth, as a summary of three above-mentioned contributions, the dissertation builds an overall picture of managing and designing dyadic supplier-customer R&D relationships. Fifth, derived from the research setting of all the articles, the dissertation contributes by providing a rare dyadic perspective for research on collaborative R&D. This knowledge constitutes consistent building blocks for companies

that are willing to create or modify supplier-customer R&D collaborations, and it provides researchers with a broad understanding of the phenomenon of designing and managing R&D collaborations.

1.3 Study objectives and research questions

As shown in Figure 1, this dissertation has three main objectives to advance both theory and practice. The first objective of this dissertation is to clarify the various types of dyadic R&D collaborations and their nature. The first article aims to investigate the possible types of supplier-customer dyads in R&D collaboration. Furthermore, to highlight the role of the collaboration type in terms of designing and managing R&D collaborations, another objective of this article is to build a model that takes into account the possibility of changing the type of R&D collaboration. The second objective of this dissertation is to shed light on dyadic process viewpoints of supplier-customer R&D collaboration. This is addressed in the second article, whose objective is to investigate dyadic R&D processes by developing an actual joint process for two collaborating case companies with a design science approach. The third objective of this dissertation is to extend the knowledge on the practices that companies apply in dyadic supplier-customer R&D collaborations. The third article aims to identify and describe practices that facilitate joint learning in R&D relationships, thus addressing the third objective of the dissertation. With these three main objectives, this dissertation provides a basis for understanding and managing business-to-business collaborations that include R&D actions. Furthermore, this dissertation aims to combine the findings of these three themes in an overall model for designing and managing dyadic supplier-customer R&D relationships. Finally, this dissertation aims to promote a dyadic research setting in which to investigate each abovementioned theme.

The main research question that this dissertation seeks to answer is as follows:

How can companies manage and design supplier-customer R&D collaboration?

To address this research question, this dissertation aims to combine three elements of dyadic supplier-customer R&D collaboration: types of R&D collaboration, joint development processes and practices in R&D collaboration. These elements are manifested in following research questions, respectively:

Q1. *What are the possible types of R&D collaboration? How do these types change over time? (Article 1)*

Q2. *How should firms design their collaborative development process to achieve results effectively? (Article 2)*

Q3. *What practices are used within R&D collaborations? (Article 3)*

By seeking answers to these questions, this dissertation aims to achieve the following: gather and create broad knowledge on how companies collaborate in the development of products and services; connect the somewhat fragmented knowledge on dyadic R&D collaborations by taking these three viewpoints on different levels; and assist both researchers and managers in solving issues concerning the design and management of R&D collaborations. Figure 1 illustrates how the different viewpoints represented by the three research questions in this dissertation intertwine around the issue of managing and designing R&D relationships.

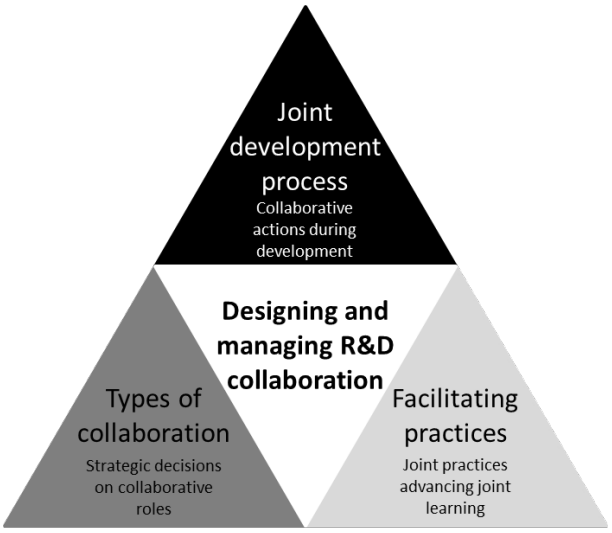

Figure 1. The overall framework for the dissertation.

1.4 Research context - Finnish mechanical engineering industry

The data for this dissertation come from the technologically oriented Finnish mechanical engineering industry, where long-term relationships between companies form a fruitful basis for collaboration development. The mechanical engineering industry in Finland has traditionally been a strong part of the economy. All companies in this dissertation represent the Finnish technology industry's largest sector, the mechanical engineering industry. In Finland in 2013, the turn-

over of mechanical engineering was 24 billion euros (The Federation of Finnish Technology Industries, 2014), the total turnover of technology industries was 65 billion euros (*Finnish Technology Industries – Statistical Yearbook*, 2014), and the national GDP was 202 billion euros (*Annual national accounts*, 2014).

Companies in this sector aim to apply new technologies rapidly to customer-driven products and production processes and cooperate to produce broad tailor-made solutions to meet customers' unique needs (The Federation of Finnish Technology Industries, 2014). Cooperation is needed to allow companies to concentrate on their core business. For Finnish suppliers, 2-3 of the largest customers typically constitute a major part of the total turnover (Niiniluoto, 2012). Suppliers' relationships with their main customers typically have a long history and strong ties, including cases in which the current suppliers are spinoffs of their main customers or there is some level of cross-ownership between companies. A long joint history and strong ties provide companies with the potential to benefit from R&D collaboration (Clark & Fujimoto, 1989). The relationships between firms in the Finnish mechanical engineering industry, with their need for accelerated development and long tradition of collaboration, create interesting settings to study how industrial R&D collaborations can be managed and designed. Although this research does not aim to achieve broad generalizability, the results can be applied to business environments similar to the Finnish mechanical engineering industry.

A major portion of the case companies are involved with publicly funded research projects that are managed by the University of Vaasa. This connection created a basis for exceptional openness and trust when the data were collected.

1.5 Structure of the dissertation

This dissertation consists of an introductory section and three published articles. The introductory section includes sections on research gaps, the theoretical background, the methodology, summaries of the articles, overall conclusions and a discussion. Each article aims to fulfill the research gaps and to provide academically proofed partial solutions for companies designing and managing their R&D collaborations. Article 1 is single authored, Article 2 is co-authored with professor Vesalainen, and Article 3 is co-authored with researcher Huikkola and professor Kohtamäki. Ylimäki is first author of the first two articles, and he had a major role in Article 3, of which he was the second author.

Table 1. Summary of characteristics of articles included in the dissertation

	Article 1	Article 2	Article 3
Focus	Different **types** of R&D collaboration	**Joint process** for service solution development	Facilitating **practices** of joint learning
Research strategy	Longitudinal dyadic case study, explorative	Design science study	Multiple case study, explorative
Research context	Dyadic R&D collaboration, mechanical engineering industry	Industrial buyer-seller dyad aiming to co-develop service concepts, mechanical engineering industry	R&D relationships with high levels of joint learning, mechanical engineering industry
Data collection methods	Structured interviews, discussions, secondary sources, customer survey	Participative interviews, evaluations, group interviews and workshops	Structured interviews, secondary sources, survey
Case firms	Supplier and its customer	Factory maintenance company and its industrial customer	Seven R&D relationships
Sample selection based on	Interesting developments in dyad	Access, case companies' need to solve problem	Cluster analysis, quantitative dataset

2 THEORETICAL BACKGROUND OF COLLABORATIVE DEVELOPMENT

The main theoretical background for this dissertation is resource-based theory (Barney, 1991), particularly its extension relational view (Dyer & Singh, 1998) and dynamic capabilities (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2003; Helfat, 1997; Teece, Pisano, & Shuen, 1997). Following the resource-based view (RBV), dyadic R&D collaboration can be source of competitive advantage for both companies separately by allowing them to access each other's resources (Gulati, 1999). Such competitive advantage can be sustainable, as using each other's resources is socially complex and includes high levels of ambiguity. Derived from relational view, dyadic R&D collaboration can be a source of relational rents, as it typically includes high levels of relation-specific investments and sophisticated knowledge-sharing routines. It also encourages companies to find and use their complementary resources and use efficient governance mechanisms in a relationship. From the dynamic capability viewpoint, collaborative product development is a source of competitive advantage, as it focuses on integrating, creating and reconfiguring internal and external competence. Figure 2 illustrates the reasoning for collaborative development from these three theoretical viewpoints.

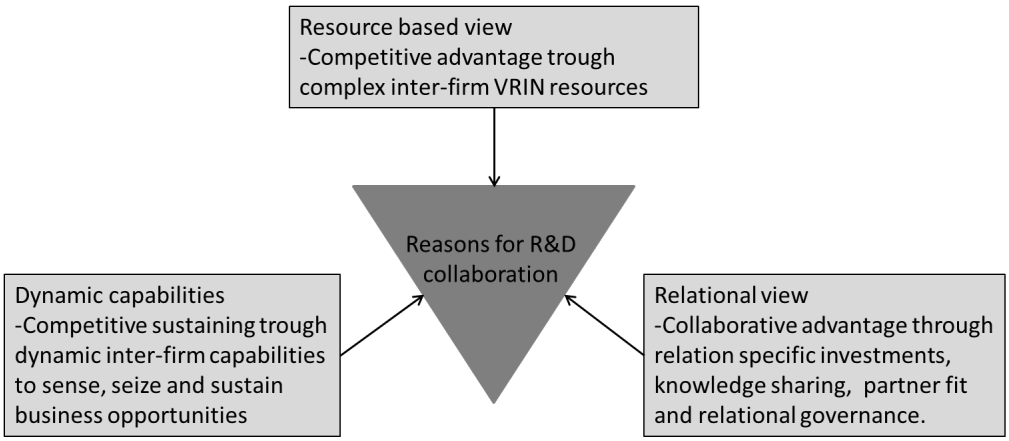

Figure 2. Theoretical reasoning for collaborative R&D and its development in different aspects.

This chapter further explains these different theoretical viewpoints and their relation to collaborative development. It begins with an overview of RBV and the relational view and then explains the role of R&D collaboration as a joint dynamic capability. Theoretical considerations form a foundation of how managing R&D collaborations can potentially add collaborative advantage and benefit both

supplier and customer separately. After discussing the theories, this chapter reviews the research on collaborative development.

2.1 Access to partners resources – RBV of the firm and collaborative R&D

One of the most influential theoretical frameworks in the past several decades, illuminating the competitive advantage of firms has been the RBV of the firm. RBV explains variation in companies' competitive advantage with differences in their resource bases and in their capabilities to use those resources (Barney, 1991; Rumelt, 1984). Capabilities are seen as a special type of resource that is used to deploy other resources (Amit & Schoemaker, 1993).

The principles of RBV include the assumption that a company's resources have to meet VRIN criteria to create competitive advantage. A resource has to be a) valuable, b) rare, c) inimitable and d) non-substitutable (Barney, 1991). All four criteria must be fulfilled simultaneously to make a resource relevant in terms of a company's sustainable competitive advantage.

Two notable assumptions of RBV are that companies are heterogeneous and that their resources and capabilities are immobile (Peteraf, 1993). If these criteria are not met, the reasoning of RBV does not hold. For example, if two companies maintain a similar mix of resources, they are equal, and the bundle of resources does not create competitive advantage even if they fulfill the VRIN criteria. Furthermore, if resources are perfectly mobile, companies can easily acquire the resources and capabilities they lack from the market to match their competitors.

The literature has identified the varying potential of different resources as a source of competitive advantage. Thus, researchers have listed possible resources and attempted to classify them. Barney's (1991) classification divided resources into three categories: 1) physical capital resources, 2) human capital resources and 3) organizational capital resources. In general, it has been widely accepted that intangible assets are more likely to create a sustainable competitive advantage than are tangible assets, which are typically more mobile and easier to imitate.

The sustainability of competitive advantage is dependent on how well competitors can imitate resources that are sources of competitive advantage. Thus, one key factor in the sustainability of competitive advantage is a firm's ability to create barriers to the imitation of resources. These barriers are also called *isolating*

mechanisms (Rumelt, 1984). Isolating mechanisms can have elements that result from inter-firm collaboration.

Causal ambiguity refers to resource characteristics related to how well managers understand the relationship between resources and the output that they provide (King, 2007; Lippman & Rumelt, 1982; Matthyssens & Vandenbempt, 1998; Peteraf, 1993). The logic is that if causal ambiguity is high and if the relationship between input and output is unclear, it is difficult for competitors to imitate those resources. Causal ambiguity is common when resources are knowledge based or socially complex (Mahoney & Pandian, 1992; Peteraf, 1993). Knowledge-based resources have even been described as the core of RBV (Conner & Prahalad, 1996). Furthermore, when causalities cross firm borders and engage many actors, their complexity typically increases, making it difficult to understand unity. King (2007) highlighted that this type of *inter-firm causal ambiguity* can act as a potential source of sustainable competitive advantage. Thus, from RBV, R&D collaborations between companies can be a resource that is difficult to imitate because it is characterized by high levels of interfirm causal ambiguity. If the collaboration fulfills other VRIN criteria, it can turn out to be a source of sustainable competitive advantage for both parties.

Despite the notion that a resource combination that creates competitive advantage can have an inter-firm dimension, the unit of analysis in RBV is the firm, and RBV has focused on searching for competitive advantage within a firm. However, companies are increasingly dependent on collaboration and networks. In competitive landscapes, a company cannot internally sustain a large variety of VRIN resources (because of the fast erosion of VRIN, for example). Particularly in large companies with broad and complex product offerings, investing in a large variety of technologies and manufacturing resources easily leads to a stiffness that hinders a company's ability to react, for example, to changing market needs (Sirén & Kohtamäki, 2014). For small companies, it is even more difficult to maintain a broad and thus expensive resource base that is relevant for R&D. Therefore, it is essential that a company have access to external resources that fulfill the VRIN criteria. Company can achieve this by investing in relationships with suppliers or partners who focus on firm-specific resources that are needed during R&D processes. Every supply relationship can thus be a source of competitive advantage for a buyer company. However, RBV does not guide practitioners or academicians to analyze resources and competitive advantage on a relationship level because it focuses on firm-level competitive advantage.

To extend and at some points, to contradict RBV, the relational view (Dyer & Singh, 1998; Gulati, 1999; Lavie, 2006) takes special interest in relationships as a

source of relational competitive advantage. In the relational view, the unit of analysis is dominantly a relationship that turns firm-centric research themes of RBV to relationship-driven subjects.

2.2 Inter-firm collaboration as a source of relational advantage

Collaboration between companies in general can simply create competitive advantage for both parties separately because it allows each party to access VRIN resources maintained by the other party in the dyad. The relational view suggests that benefits of collaboration can go beyond this resource acquisition (Dyer & Singh, 1998). It highlights the role of inter-firm collaboration in companies' competitive position. Deep inter-firm collaboration, such as joint product development, can create *joint* benefits that neither party in the collaboration can gain without the other party. These benefits are called *relational rents* or *collaborative advantage* (Dyer & Singh, 1998). To achieve joint benefits, companies should move away from the arms-length, market type of relationship to a relationship that includes attributes that support long-term collaboration and commitment. This chapter explains further the mechanisms how relationships can create collaborative advantage.

Whereas RBV highlights the VRIN characteristics of resources and firm's access to other firms' resources, the relational view concentrates on four categories of sources of collaborative advantage. These are categories for the elements that collaborating parties should implement in their relationship to gain joint benefits. These broad categories for relational rent-generating elements are 1) relation-specific assets, 2) knowledge-sharing routines 3) complementary resources/capabilities, and 4) relational governance.

First, relation-specific assets, which have roots in transaction-cost economics (Williamson, 1975, 1985), refer to investments that cannot be used within other relationships or whose value dramatically decreases if used in another context. These specialized assets are tied to the assets of the other party in the relationship. Many types of assets can be specialized for a relationship (Williamson, 1985).

Site specificity refers to an investment in facilities close to the other party's location. Locations that are close to each other facilitate coordination and decrease inventory and transportation costs. The business value of these facilities is strongly tied to the presence of the collaborating party. In terms of joint product

development, proximate sites ease communication on different levels (Schiele, 2006).

Specific *physical assets* refer to investments in physical goods that are allocated to a specific relationship. These can include, e.g., tailored production machinery and tools or integrated IT systems that enhance collaboration. Customized machinery, tools and IT systems all support R&D collaboration, as they enable the production of the specialized needs of customer and enhance communication. Physical asset specificity thus has the potential to enhance quality and increase possibilities for differentiation (Clark & Fujimoto, 1991).

Specific *human assets* (Williamson, 1983) are skills, knowledge and experience that are relevant to a certain relationship. The forms of specific human assets include shared language, experience working together, good knowledge of the other party's challenges, and knowledge of the other party's processes. In R&D collaborations, these human assets enhance communication, thereby enabling a faster speed to market and fewer defects. Specific human assets are strongly tied to certain relationships, and without modification, their value to other relationships is very limited.

Dedicated asset specificity (Williamson, 1983) refers to increased resources dedicated to a specific customer. These are not customized resources but rather the quantity of resources whose output is used in the collaboration in question and whose value without collaboration would be dramatically lower. For example, an increased manufacturing capacity to meet customer's customers' needs is an example of a dedicated asset. In R&D collaborations, increased R&D resources allocated to serve demand in collaboration are an example of a dedicated asset.

Malone et al. (1987) shed light on *time-specific assets,* referring to goods that are valuable in a certain time period. Time specificity is also relevant in the context of collaboration. For example, components that have to arrive at a customer's facilities in a specific timeframe to avoid interruptions to the customer's process are assets whose value is tied to a certain time. Furthermore, the value of investments in a specific technology applied within one relationship can perish fast when new technology evolves. In R&D collaborations, the risks associated with technological uncertainty can be managed using shared technology roadmaps (Wagner, 2011).

In their research in the service industry context, Zaheer and Venkatraman (1994) presented a new concept of broader *business process asset* specificity. The concept integrates two components of asset specificity: human asset specificity and procedural specificity. The latter refers to the tailoring of workflows and process-

es to meet unique criteria set by the collaborating partner. These are routines that vary remarkably between relationships and can be costly to modify. Thus, investments in business processes in which both parties have their roles are highly restricted to a specific relationship. In terms of R&D collaborations, business-process asset specificity includes important relational assets, particularly if the view of collaboration is restricted to the actual exchange of R&D services. However, for the benefits of vertical R&D collaboration, production capabilities are central. That being said, other forms of asset specificity cannot be ignored.

All in all, relation-specific assets enhance the commitment to the relationship and to greater transaction volumes. They reinforce bonds between companies and broaden collaboration, simultaneously resulting in less hierarchical relationship governance (Zaheer & Venkatraman, 1994). Longer agreements lead to lower value chain costs and more efficient product development processes (Dyer, 1996).

The second potential source of collaborative advantage is inter-firm knowledge sharing routines. Depending on the industry, the majority of innovations can be traced back to external parties' such as suppliers' or customers' ideas and suggestions (Von Hippel, 1988). This being the case, companies can gain great benefits by facilitating inter-firm knowledge sharing with functional routines. A typical need for knowledge sharing in R&D collaboration arises from the fact that the customer's company has the knowledge about market needs and the supplier's manufacturing knowledge is needed to create cost-efficient designs. When this knowledge is shared through efficient routines, R&D collaboration can generate relational rents.

Knowledge sharing can be separated into three processes: transferring, translating and transforming knowledge (Carlile, 2004). These processes are applied to share domain-specific knowledge with the other party through different types of boundaries. The needed process depends on the novelty of the knowledge that needs to be shared. A pure technical *transfer* of knowledge is possible when the domain-specific knowledge in question is not novel and when the differences and dependencies between the parties are known. At a low level of knowledge novelty, a common lexicon between parties is sufficient to share knowledge and cross-syntactic boundaries. Storage and retrieval technologies support knowledge sharing at syntactic boundaries. Knowledge *translation* is needed when the increased novelty in the knowledge to be shared blurs the dependencies and differences between parties. The key is to develop common meanings that provide an adequate means to share knowledge. Inter-firm interaction and teams and boundary spanners are needed to overcome semantic boundaries. A pragmatic boundary,

which is associated with sharing the most novel knowledge, can be crossed using the transformation of knowledge. The need to *transform* knowledge arises when parties' interests are in conflict, and beneficial knowledge created in one domain has negative consequences for another domain. To overcome pragmatic boundaries and enable knowledge transformation, parties must negotiate and develop a common interest (Carlile, 2002). This can be facilitated with boundary objects, such as prototyping or joint development processes.

Le Dain and Merminod (2014) operationalize Carlile's framework for dyadic R&D collaborations. They study the nature of knowledge sharing in three forms of supplier-customer R&D collaborations: white box, grey box and black box collaborations. As expected, the results of white box collaboration, where the supplier role is limited to commenting on design primarily from the manufacturability perspective, include not only knowledge transfer but also, to some extent, interpretive knowledge translation. Grey box collaborations, characterized by intensive interaction and joint decision making, include the full cycle of different knowledge-sharing processes. Knowledge transfer serves as a basis for translation, which, in turn, is a necessity for knowledge transformation. The knowledge transformation cycle progresses to technical knowledge transfer with an aligned common interest, meanings and lexicon. In black box collaboration, where the supplier is extensively responsible for the design and decisions during the development process, knowledge transfer requires knowledge translation, which ensures the shared understanding of both the architecture (known by the customer) and the component (known by the supplier) requirements that guide the development process.

Dyer and Singh (1998) highlight two elements in particular that are essential for collaborative, advantage-creating knowledge sharing: relationship-specific absorptive capacity and incentives that encourage transparency and equal contribution to knowledge sharing. Absorptive capacity is "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal 1990), and applied to the dyadic relationship, it provides an important basis for R&D collaboration. With a high relational absorptive capacity, companies are able to recognize and use valuable knowledge spread to both organizations in the collaboration. Typically, absorptive capacity evolves informally as collaboration develops and as a company's awareness and understanding of the other party's capabilities increases. To add collaborative advantage through knowledge sharing, firms need incentives that support transparency and equal contribution to share knowledge (Dyer & Singh, 1998). Particularly in R&D collaborations, shared information is typically confidential. The vulnerability of inter-firm knowledge sharing has been highlighted, e.g., by Ritala et al. (2015), who

found that while external knowledge sharing has a positive effect on innovation performance, accidental and intentional information leaks have a negative effect on that relationship. The possibility for unwanted information leaks in R&D collaborations is apparent; thus, collaborating companies need to have incentives to promote fair knowledge sharing. Some functional approaches to successfully aligning incentives are equity arrangements (Mowery, Oxley, & Silverman, 1996) and leaning on relational governance rather than on contractual governance (Helper & Levine, 1992). Furthermore, relational capital can potentially ensure trustworthiness in R&D collaborations (Kohtamäki, Partanen, & Möller, 2013), thereby enhancing fair knowledge sharing. Furthermore, symmetry in relation-specific assets between parties in a dyad enhances the stability of knowledge sharing in different market situations (Shou, Yang, Zhang, & Su, 2013). Mohr and Sengupta (2002) note that governance mechanisms should be aligned with the intended type of knowledge sharing, and the length of the relationship is enriched in some cases by formal guidelines for sharing confidential information.

The third source of collaborative advantage is a partner fit that allows companies to build a combination of resources and capabilities that would not be possible in isolation. To add collaborative advantage, a partner fit requires two elements: complementary capabilities and organizational compatibility. Due to their complexity, inter-firm capability combinations can provide value that is unique and difficult to imitate (Harrison & Hitt, 2001). Complementary capabilities are distinctive resources "that collectively generate greater rents that the sum of those obtained from the individual endowments of each partner" (Dyer & Singh, 1998).

Organizational compatibility is an essential prerequisite for complementary capabilities to generate collaborative rents (Thorgren, Wincent, & Ortqvist, 2012). If fit between companies in terms of organizational culture, processes and systems is not satisfactory, companies face severe difficulties in benefitting from their complementary capabilities.

In the context of R&D collaboration, partner fit is evident, for example, in situations where capabilities connected to manufacturing reside in the supplier company and capabilities connected to the overall design of the end product are maintained by the buyer company. To identify and develop an integration of these capabilities, network capabilities are required. Furthermore, to actually use these capabilities in collaboration, companies need to have organizational compatibility, meaning that their cultures, organizational systems and processes have to match one another.

Fourth, *relational governance* is a potential source of collaborative advantage. Relational governance refers to a "specific form of interorganizational strategy

that is distinct from the traditional modes of markets and hierarchies" (Zaheer & Venkatamaran 1995). The defining characteristics of relational governance are significant relation-specific assets and high levels of mutual trust between companies (Ring & Van de Ven, 1992). The literature on the relational form of governance originates largely from Macneil's work (1978, 1980). He sees that relational exchange always represents both economic and social exchange and that the social component of exchange is characterized by mutual trust and solidarity. Furthermore, he argues that business relations, similar to interpersonal relationships, require faith in others to work successfully. It is natural that economic exchange as a social action includes socially embedded personal relationships and that these relationships include non-economic motives, including expectations of trust and the absence of opportunism (Granovetter 1985).

Zaheer and Venkatamaran (1995) highlight two dimensions of business relationships that determine the degree of relational governance in collaboration. First, the high significance of business conducted in the relationship compared to all operations of the firm signals that the type of collaboration is reminiscent of vertical integration without a legal form. Another dimension suggested in their study was the degree of joint action. Joint action refers to carrying out focal activities in a cooperative and coordinated way (Heide & John, 1990). Collaborations with a high level of joint action include a great deal of mutual decisions and other cooperative efforts that promote future exchange and thus indicate relational governance.

Blois and Ivens (2006) highlight the meaning of the atmosphere of a relationship when analyzing the nature of exchange in it. They argue that the atmosphere is a result of the existence of norms in a relationship (Macneil, 1980, 1983) and that the most important contractual norms in terms of relationality are those that promote trust and a commitment to develop (Blois & Ivens, 2006). Other researchers state that long-term interaction and episodes of exchange build the atmosphere in a relationship (Turnbull & Valla, 1986).

Relational governance creates abnormal profits for collaborating companies by decreasing transaction costs. When governance relies on self-enforcing agreements and mutual understanding, the relationship saves contractual costs. Relationality also increases collaborating parties' will to invest in relation-specific assets, to combine complementary capabilities and to share knowledge.

Relying on informal governance rather than on formal contracts demonstrates a trust-based collaboration that is difficult to imitate, creating a basis for long-term sustainable collaborative advantage. Furthermore, collaborating companies that rely on relational governance and self-enforcing agreements are more likely to

invest in those value-creating actions in the collaboration whose value is difficult to measure because they can trust that they will obtain a fair reward for their efforts (Dyer & Singh, 1998). On the contrary, leaning on trust as an informal safeguard can sometimes expose the relationship to opportunism (Granovetter, 1985). In practice, relationships commonly begin by using formal contracts and move towards informal mechanisms as parties gain experience with each other (Gulati, 1995).

The elements that generate collaborative advantage are interconnected and strengthen each other. For example, companies with a high level of relational assets are likely to share more information (Shou et al., 2013). To support the use of relational governance, firms can control risks of opportunism by having specific reciprocal assets with their collaborating partners (Williamson, 1985).

Despite offering a solid base for assumptions on R&D collaboration, the relational view falls short in terms of the dynamism of resources and capabilities. Similarly to RBV, it focuses on the sustainability of collaborative (or competitive, in the case of RBV) advantage and thus does not highlight the needs that arise from the current dynamism of all fields of the economy. By definition, the dynamic capability view described in next chapter instead emphasizes the need for the dynamism of capabilities.

2.3 R&D collaboration as a joint dynamic capability

One admitted criticism of RBV is that its static VRIN principle does not fit well with dynamic contexts (Barney, 2001; Priem & Butler, 2001). Whereas RBV focuses on the achievement of sustainable competitive advantage, the focus of the dynamic capability view is competitive survival. The dynamic capability view (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2003; Helfat, 1997; Teece et al., 1997) thus complements RBV, as it highlights needed dynamism in managing resources. Teece et al (1997) define dynamic capability as “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.” Dynamic capabilities are distinguished from operational capabilities; the former includes “the capacity of an organization to purposefully create, extend, or modify its resource base” (Helfat et al., 2007), and the latter indicates the capacity that is needed to successfully operate in a current way. The authors also highlight that dynamic capabilities are typically path dependent and rooted in the company’s history, making them difficult to imitate.

Current theoretical understanding treats firms capabilities as a multi-level phenomenon with four levels (Sanchez, 2004; Wang & Ahmed, 2007; Vesalainen &

Hakala, 2014). First, assets represent the lowest-level elements of a hierarchy. They are the basic elements of competitive advantage, but as passive elements, they need coordination that enables the creation of business benefits. Furthermore, in dynamic environments, their ability to serve as a source of sustainable competitive advantage is limited due to the fast erosion of VRIN (Wang & Ahmed, 2007). The second level consists of capabilities, which are activities that use assets to achieve a desired goal. The third level of elements includes core capabilities, which are strategically important bundles of resources and capabilities coordinated by certain processes that generate competitive advantage (Wang & Ahmed, 2007). A core capability could be, for example, a product development process that coordinates the usage of resource and capability bundles (Vesalainen & Hakala 2014). The highest level of the hierarchy is dynamic capabilities, which represent the ability to modify core capabilities (Wang & Ahmed, 2007). A firm's capability to identify market needs and to modify its capabilities to capture its respective market opportunity is an example of a dynamic capability. Some scholars see dynamic capabilities as firm characteristics that are embedded in a firm's activities and processes, promoting sensing and seizing opportunities within different parts of the organization (Sanchez & Heene, 1997). Dynamic capabilities can also be seen as capabilities to both modify current capabilities and to build completely new ones to capture market opportunities (Vesalainen & Hakala, 2014).

Capabilities at different levels can be connected to various business activities such as manufacturing, marketing or product development. In terms of collaboration, prior research has identified network capability as a concept that refers to a firm's ability to create, manage and develop relationships (Håkansson, 1987; Ritter & Gemünden, 2003). In terms of the collaborative advantage gained through partner fit, network capability is essential because it enables companies to identify and evaluate potential complementarities in collaborations. Vesalainen and Hakala (2014) highlight the role of network capability in a firm's capability architecture. They define network capability as core capability and compare it with other generic capabilities, such as effective processes and superior technological expertise. They also see that network capability intertwine with other capabilities, enhancing their possibility to generate competitive and collaborative advantages.

This dissertation takes a special interest in *joint capabilities* because they are highly relevant in terms of R&D collaboration. Joint capabilities are defined here as capabilities which cross firm boundaries and include joint actions. In other words joint capabilities are capabilities that reside in relationships rather than in

individual company. This differentiates them from network capability that is firm's internal capability to collaborate.

It can be derived from RBV and the relational view that actions that companies jointly conduct to manage the use of their resources (e.g., product development resources) are joint core capabilities. In other words, the collaborative product development process is a joint core capability that uses both suppliers' and customers' resources and requires management actions from both parties. Joint core capabilities are socially complex capabilities that are unable to be found on markets without remarkable effort. They lean extensively on trust and are constructed over a long period of time.

The characteristics of designing and managing dyadic R&D collaboration fit into Teece's (2007) three-item description of different features that dynamic capabilities include: "the capacity (1) to sense and shape opportunities and threats, (2) to seize opportunities, and (3) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets." By providing more links and broadening companies' connection to the environment, dyadic R&D collaboration enhances both parties' ability to sense what is happening in the market and in technology. It also helps them capitalize on the opportunities that neither party could seize in isolation because together, they can create designs and solutions that are only possible in collaboration. Collaborating companies can also intentionally (Ambrosini & Bowman, 2009) modify the ways they use relevant resources residing in both companies. The design and management of R&D collaboration strategies (described in article 1) is thus defined here as a dynamic capability because it attempts to integrate and reconfigure internal and external competence when companies responding to changing needs (that they separately or jointly sense) adjust the form of collaboration.

When these managerial actions are taken in collaboration, this dynamic capability requires both parties' seamless efforts. Thus, the management and design of dyadic R&D collaboration is defined here as a joint dynamic capability. The term used here highlights the fact that managing R&D collaboration is a special type of dynamic capability that requires two (or more) parties. This is different from relational dynamic capability, which typically refers to a company's own "willingness and ability to partner" (Dyer and Singh 1998). The reasoning for this difference is similar to that of the collaborative advantage of the relational view in relation to the firm-based competitive advantage of RBV. This dissertation focuses on determining and explaining how to enhance this joint dynamic capability on three different levels: strategy, process and practices.

2.4 Research on supplier-customer R&D collaboration

2.4.1 Definition and collaboration types

From customers' (buyers') perspective, the collaboration between suppliers and customers in development is typically understood as supplier involvement, which has been defined as "the tasks suppliers carry out on behalf of the customer, and the responsibility they assume for the development of a part, process or service" (van Echtelt et al., 2008). Another definition of supplier-customer collaboration from suppliers' (sellers') perspective is Kaulio's (1998) definition, i.e., "integration between customers and the design process." Risdiyono and Koomsap (2013) further state that in customer involvement, customers "are guided to define the fittest alternative that meets the cost, schedule and the product requirements through the capabilities of a company."

Along with these definitions, which interpret collaboration in a relatively broad manner, the literature has acknowledged the target of R&D collaboration. Blomgren (1997) states that in supplier-customer relationships, "developmental capability does not need to be restricted to pure product development, rather it may be about manufacturing, for example producing prototypes." This is a relevant observation because concentrating purely on collaboration in new product development would leave considerable development potential unused. R&D collaboration research also extends to service development, which has been the focus of several studies (Alam & Perry, 2002; Alam, 2006; Matthing, Sandén, & Edvardsson, 2004). Service development collaboration is also paralleled to product development, and these concepts are approached in a similar vein (Carbonell, Rodríguez-Escudero, & Pujari, 2009; Cooper, 2001).

In addition to the various targets of development, research has also distinguished various collaboration strategies. In the supplier involvement literature, Petersen et al (2005) distinguish collaboration into four types according to the level of the supplier's responsibilities in development. The same type of separation is introduced within customer involvement research, where Kaulio (1998) presents three different strategies to collaborate with customers. These classifications of collaboration types have gained little attention with regard to customer involvement types (used e.g. by Risdiyono & Koomsap, 2013) and supplier involvement classification (used e.g. by Johnsen, 2009; Koufteros, Cheng, & Lai, 2007). Despite their multiple faces in terms of development targets and types, all R&D collaboration efforts share a similar theoretical basis, highlighting an efficient reconfiguration and the usage of a shared resource base.

2.4.2 Selection of R&D collaboration partners

Partner selection influences the results of R&D collaboration (Kamath & Liker, 1994; Monczka, Petersen, Handfield, & Ragatz, 1998; Petersen, Handfield, & Ragatz, 2003; Schiele, 2006; van Echtelt et al., 2008). Because this dissertation emphasizes the development of current relationships (typically long-term, culturally and physically close partners with high levels of trust), the topic of partner selection has not been studied here. However, findings from studies on partner selection can be applied when considering the optimal collaboration types presented later in chapters 4.1 and 5.2.

Partner selection in terms of beginning a collaborative development has been addressed in earlier research. Petersen et al. (2003) highlights the criticality of careful supplier selection and assessment for successful collaborative new product development. The same research group previously emphasized the meaning of the formal partner selection process for successful customer-supplier collaboration in general (Monczka et al., 1998). In an early study by Kamath and Liker (1994), the authors argue that resource-consuming development partnerships should sometimes be reserved for collaborative parties that have outstanding technology and sophisticated management. In a recent study, Melander and Tell (2014) highlight the role of flexibility in terms of supplier and technology selection. They argue that in uncertain environments, the benefits of flexibility can be greater than the benefits of long-term relationships. On the contrary, Schiele (2006) proposes in his study that specialized, technically competent companies in close proximity to trusted and intensive relationships have a higher potential of being core innovative partners and that these criteria should be applied when choosing partners with whom to collaborate. Bonaccorsi and Lipparini (1994) highlight the careful evaluation of supplier sites when selecting new product development partners. To distinguish different assessment criteria, Emden et al (2006) suggest a broad model that includes three alignment areas to be solved before collaboration. These areas are technological alignment, strategic alignment and relational alignment, the latter of which highlights the role of long-term orientation, cultural fit and flexibility when the requirements for collaboration change. Van Echtelt et al (2008) note that the uncertainty of the other party's capabilities and suitability for collaboration can reduce collaboration and even cause a firm to change its development partner. Having the correct partner is important, but when an available partner is given, companies should be aware of the different possibilities for collaboration.

2.4.3 Enhancing factors and benefits of R&D collaboration

Characteristics that advance joint development are also addressed in several studies. In addition to the abovementioned characteristics suggested by Schiele (2006), McCutcheon et al. (1997) emphasize the role of relational thinking by suggesting that cooperativeness can be more important than suppliers' technical competence for successful R&D collaboration. Handfield et al. (1999) pay attention to partners' technological capability, particularly when technology is critical for the developed product. Tyler's (2001) article suggests that the co-operative competencies of partners are important because they complement technological competencies. Wynstra et al (2010) note the importance of partners' strategic focus on innovation as a factor that enhances product development activity in collaboration. Top management support from both collaborative companies, a joint agreement on performance measures, confidence in the other party's capability, formalized risk/reward sharing and the development of trust are highlighted as important prerequisites for successful R&D collaboration in a study by Ragatz, Handfield and Scannell (1997). The authors of another study highlight the central role of bilateral communication and building trust (Monczka et al., 1998). Furthermore, Walter (2003) presents with similar findings, noting that the trust and commitment of the supplier are keys for successful R&D collaboration; these can, in turn, be enhanced by managers functioning as relationship promoters within the customer firm. Johnston et al. (2004) explain that the supplier's trust facilitates joint responsibility, flexibility in arrangements and shared planning.

Bessant et al. (2003) study learning in supply chains. They find that the buyer company, as a R&D collaboration coordinator, enhances learning beyond first-tier suppliers. When the buyer company has a culture that is open to learning from external parties, this culture spreads along the supply chain. Furthermore, several scholars (Dyer, 2000; Petersen et al., 2003, 2005; Takeishi, 2001) emphasize the role of functional inter-firm communication for beneficial collaborative development. Petersen et al. (2003) suggest three themes to ensure efficient R&D collaboration: first, understanding the capabilities and design expertise of the partner and the technical risks related to them; second, exchanging efficient and continuous technology and cost information; and third, ensuring that the partner has an active role in the design team. Wagner et al. (2006) note that in addition to specific technical competence, partners' ability to provide external viewpoints is of remarkable value.

Studies that demonstrate the benefits of collaborative development are many. In their case study, Bonaccorsi et al. (1994) conclude that close development rela-

tionships with suppliers is a key element in achieving a shorter product cycle, better products and increased ability to compete in markets. Johnsen et al. (2006) suggest that the role of customers and suppliers in development depends on the phase of the innovation life cycle. They argue that in fluid and emerging contexts, customer and supplier involvement is less important and less beneficial than they are in mature and specific contexts. On the contrary, in their study of 173 radical innovation projects between new ventures and their suppliers, Song et al. (2008) find a direct positive effect of supplier involvement on new product performance. They also address the role of contingency factors, stating that suppliers' specific investments strengthen their involvement in customers' new product development.

Sun et al (2010) conduct simultaneous research of customers' and suppliers' involvement effects on new product performance using a sample of 600 manufacturing companies worldwide in the metal products, machinery and equipment industry. They find that supplier involvement results in better quality and reliability, better innovativeness and a faster time to market. Customer involvement leads to a better quality and reliability of a new product but does not enhance the time to market or innovativeness. Their explanation is that customers were not able to help in terms of manufacturability (affecting the time to market) or technological innovation because the focus of customers is elsewhere. Somewhat contradictorily, Von Hippel (1988) highlights the role of customers as an important source of innovation.

Whereas customer benefits have been the main focus in the literature, some studies have addressed the supplier perspective. Kalwani and Narayandas, (1995) conclude that long-term collaboration in general creates higher profitability through lower discretionary expenses to suppliers compared to transactional selling. Walter et al (2001) also take the supplier perspective in their study of different functions that are present in long-term relationships and that create value for the customer. They construct a model that identifies seven value-creating functions, three of which represent direct, operations-related value functions—a profit function, a volume function, and a safeguard function—and four indirect, change-related functions—an innovation function, a market function, a scout function, and an access function (also Ritter & Walter, 2012).

2.4.4 Factors hindering R&D collaboration

The factors hindering R&D collaboration have also been the focus of research. In their case article, Stjernström and Bengtsson (2004) conclude that in many relationships, suppliers feel that they could participate more in product development. However, according to their results, collaboration is hindered by continuous demands for price reductions, an unequal relationship with an unfair division of benefits, set restrictions on collaboration with other companies, and unclear and sometimes conflicting expectations and targets for collaboration outputs. Karlsson et al (1998) discuss the difficulties in the specification process, particularly in black box collaborations. Several studies have also discussed the hindering factor of the "not invented here" (NIH) syndrome (Katz & Allen, 1982; Ragatz et al., 2002, 1997). The NIH syndrome refers to a culture that makes personnel reluctant toward ideas from another party in the collaboration. Thus, McIvor et al (2006) highlight the meaning of culture that supports collaboration for the benefits of collaboration. Dyer et al (2000) suggest creating supplier associations and inter-firm job rotation practices to stimulate tacit and explicit learning between suppliers and customers. Johnsen (2011) emphasize the meaning of delegating decisions to the other party for a successful collaboration. Delegation enhances trust and, thus, the willingness to collaborate. In their collaborative study between Japanese and US traditions in collaboration, Wasti et al (1999) find three important differences between these traditions. According to their study, more extensive delegated decision making, more retained control over the design and more frequent design-related communication lead to more successful R&D collaboration.

3 METHODOLOGY

The following chapter discusses the philosophical assumptions of this dissertation and the research methodology used. The chapter begins by describing the dissertation's philosophical paradigms and overall research strategy. Then, it explains the design and methods used in each article.

3.1 Scientific premises

Scientific work in social sciences always represents researchers' understanding of the social world (ontology) and how research can gain knowledge of this world (epistemology). These philosophical assumptions and choices are always influenced more or less by researchers' mindset, which forms a lens through which researchers see the phenomenon under investigation.

The ontological debate focuses on the discussion of the nature of the social world. Following Burrell and Morgan's (1979) assumptions on the nature of the social world, this dissertation represents nominalism; it considers the social world to be constructed by actions of humans who participate in it. The opposite viewpoint in Burrell and Morgan's continuum is realism, which considers the social world, with its structures and labels, to exist even before one is born and lives in it. From the realism viewpoint, the social world is not something that individuals create or modify; the social world "has an existence which is as hard and concrete as the natural world" (Burrell & Morgan, 1979).

Epistemology refers to the discussion of the nature of knowledge. Based on Burrell and Morgan's (1979) epistemological selections, the epistemological view of this dissertation is anti-positivism (also known as interpretivism). Emphasizing the role of interpretation, it perceives that the social world can only be understood by being directly involved in studied activities (Burrell & Morgan, 1979, p 5.). This means that a phenomenon must be understood from the inside, not the outside. This perspective opposes the positivist view, which represents the objective role of the researcher and highlights the usage of traditional approaches similar to those of natural sciences. The problem with positivism in business-to-business research is the complexity and context dependency of phenomena. Perfect quantitative data should include countless measures to control all factors affecting the dependent variable. Thus, it has been suggested that the data and analytical techniques available are not sufficient to study such a complex phenomenon with underpinning causalities and relationships with the positivist approach (Easton, 1995 p.449).

The methodological viewpoint of this dissertation is the ideographic approach, which is based on the view that researchers must gain information by getting close to the subject and that one has to view the investigated object "from the inside." The ideographic approach is opposite to the nomothetic approach, which emphasizes objectivity, systematic protocol and technique (Burrell & Morgan, 1979 p.6).

Based on Burrell and Morgan's widely applied 2x2 matrix for research paradigms in the social sciences, this dissertation is best fitted to the paradigm that they term "interpretive." It considers the nature of social science subjective rather than objective and sees society as driven by regulation rather than by radical change. Burrell and Morgan's dichotomist framework has been criticized for an overly strict division of different paradigms. Kakkuri-Knuuttila et al. (2008) argue that interpretive studies in business can have both subjective and objective elements. This finding is also present in this dissertation, which uses methods aimed to increase objectivity, such as triangulation. As noted by Vaivio and Sirén (2010), identifying and selecting a paradigm serves to support the researcher in his or her professional development. The paradigm the researcher selects allows the researcher to concentrate on the development of specific methodological skills and the particular knowledge of his or her topic instead of continuously consuming resources to compare the philosophical assumptions underpinning different paradigms.

The abovementioned viewpoints are in line with pragmatism, which is the philosophical theory that this dissertation follows. Pragmatism emphasizes the role of the practical value of knowledge. Truth is not an absolute concept. Instead, it is defined "as a knowledge that is beneficial for its user." Thus, truth can change or differ according to the context and depending on the user. Pragmatists claim that forming beliefs and information is not a process that starts from scratch (Peirce, 2001). Instead, assumptions and pre-understanding are always present when researchers or humans in general begin to cumulate information or form beliefs. Additionally, in this dissertation, I had a pre-understanding of collaborative development as a result of my experience with the topic as a consultant. When the habit of action leads to surprise, it ignites doubt. This doubt, in turn, leads to research that modifies the habit of action. Dewey, another pragmatist, adopts the view that research is always an attempt to solve a problematic situation that emerges from action. Thus, scientific knowledge is achieved by learning challenging skills and "learning by doing." Following Dewey's (1999) view, research is a way to survive in an environment, and thus, the boundary between skills and knowledge is blurry. I see that the findings of this dissertation can be viewed as organizational or relational skills that benefit companies when they collaborate in

development actions. At the general level, pragmatism research is not limited to scientific research but instead extends, for example, to common life. Pragmatism considers that research cumulates knowledge with circles or spirals beginning from belief and followed by habits of action, specific actions in line with habits of action, surprises or problems, doubt, research, modified beliefs and, again, new habits of action. This continuous process approaches truth by bringing belief closer to the truth every time research is conducted. Based on the practical need for knowledge, truth is satisfactory or beneficial to its users and is not refuted by future experience (Haack, 1976). This type of definition of truth emphasizes the human nature of knowledge and the presence of human error. All beliefs gained through research can face problems and thus require new research and modifications. From the pragmatist point of view, science "aims to achieve the best available explanation" (Van Aken, Ketokivi, & Holmström, 2009; Peirce, 2001).

There are three possible approaches within scientific reasoning. Induction refers to logic, where the researcher starts from empirical phenomenon and builds a theory on her findings. Deduction, on the contrary, builds strictly on former theory and uses it to build a testable hypothesis. Although induction and deduction logics have the strongest tradition in science, both have their problems, at least in their purest form. Induction in its purest form prevents researchers from benefiting from earlier research, and deduction in its purest form hinders researchers from extending former theory based on empirical findings (Perry, 1998; Salmi & Järvenpää, 2000). Abduction is a form of reasoning that promotes continuous interplay between theory and empirical findings. Abduction was first introduced by the philosopher and founder of pragmatism Charles Peirce (1939-1914). In abduction, the research process continuously moves from theory to the empirical world and back, and its aim is to achieve the best available explanation with a balance between science and creativity. A similar type of reasoning was subsequently introduced as "systematic combining" (Dubois & Gadde, 2002). In its reasoning, this dissertation builds on abduction. The sequential interplay between theory and empirical findings is evident in all three articles. The reasoning in article 1 is closest to pure abduction; the prerequisites for research included a tentative theory of collaboration types, but the overall typology was developed based on empirical research. In a similar manner, in article 2, a preunderstanding provided a tentative structure for the developed process, but the reasoning developed step by step, changing back and forth from practical development involving companies to theoretical considerations of supporting frameworks. In article 3, the search for joint practices was based on the former theoretical framework, bringing reasoning closer to induction. However, the interplay between theory and empirical findings was not straightforward; new theoretical viewpoints were formed as interpretation proceeded.

Hermeneutics, a theory of interpretation, is also present in this dissertation. This theory promotes the idea that all understanding is based on pre-understanding (Niskanen, 1994). The hermeneutic method aims to interpret and understand phenomena in the social world (e.g. Kusch, 1986; Palmer, 1969). The key concept of hermeneutics is hermeneutic circle, which describes the aim of approaching the truth stage by stage. The hermeneutic circle has three meanings. First, it describes the interplay between pre-understanding and research that modifies pre-understanding, which always maintains its connection to the past. Second, it describes the interplay between an entity and its parts. The understanding of the parts affects the interpretation of the whole, and the understanding of the whole affects how the interpretation of the parts. The third meaning refers to the interplay between research and concepts, which also advances stage by stage. When analyzing this dissertation as a whole, the hermeneutic circle is present in many ways. Researchers' pre-understanding affects the interpretation of the results, which in turn modifies the understanding during the research process. The overall phenomenon of collaborative development is essential to understanding lower-level phenomena, which in turn advance the overall knowledge of the topic. This meaning of the hermeneutic circle is exemplified in Figure 3, which demonstrates the development of understanding with the interplay between an entity and its parts. The research defines concepts related to collaboration, such as frameworks for different collaboration types, which in turn open venues for further research. Both hermeneutics and pragmatism have advanced the functional value of the achieved knowledge and have thus guided the choices of methods and research strategies used in the articles. Article 2 in particular focuses on the real-life value of its findings by using a design science methodology. The case studies in articles 1 and 3 are also practically oriented, and their conclusions focus on understanding the "habit of action."

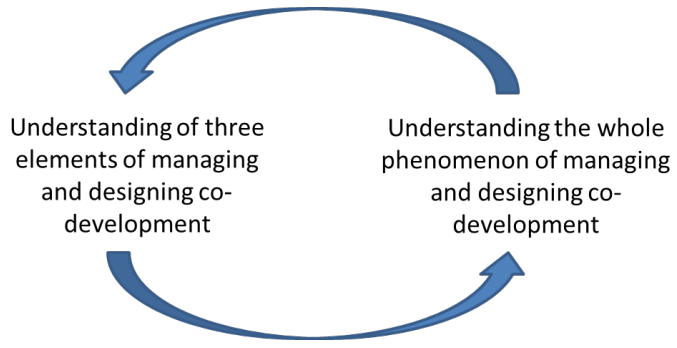

Figure 3. The hermeneutic circle as an interplay between the whole and the elements of managing and designing co-development

3.2 Applied research strategies

A research strategy is a set of decisions that guide method selection and usage throughout the research process. These decisions have to be in line with the underpinning philosophical assumptions that the researcher has and with the target of research.

This dissertation studies *how companies can arrange supplier-customer collaboration in product and service development*. This broad and practical theme is addressed with three different qualitative research strategies in three articles that concentrate on different sub-themes. Article 1, which addresses a sub-question of what different types of dyadic R&D collaboration exist and how to change these collaboration types, is based on a longitudinal case study. Article 2, which set out to build a process for R&D collaboration, is based on a participative design science approach. Article 3, by exploring practices that facilitate joint learning in R&D relationships, builds on multiple cases. Furthermore, the last article also applies quantitative methods; cases were selected from a survey dataset using cluster analysis.

These qualitative strategies fit the broad and qualitative research questions of this dissertation well because they provide the possibility to gain rich and well-grounded descriptions (Miles & Huberman, 1994), aim to understand the whole (Janesick, 1994) and are flexible, allowing researchers to benefit from special opportunities that appear during the research process (Eisenhardt, 1989). Naturally occurring events on which qualitative research is based fit the aim of this dissertation well, creating practically beneficial knowledge. Because I have experience as a consultant in the area of business-to-business collaborations, the view of qualitative research strategies that the researcher always has a certain ideology arising from his or her history (Janesick, 1994) makes the selection of qualitative research strategies logical for this dissertation.

3.2.1 Case studies

A case study is a research strategy that is particularly suitable for studying complex phenomena. It concentrates on one or several cases that are investigated from several directions, typically by using various data sources. Instead of aiming to generalize or study causalities, a case study is a research strategy that aims to describe phenomena and to draw fresh and innovative findings. Case studies aim to gain a deep understanding of phenomena within a single setting (Eisenhardt, 1989), typically focusing on questions such as how, why and what (Merriam, 1988). Case studies can use both quantitative and qualitative evidence

(Eisenhardt, 1989). In-depth case studies are the best way to understand the interaction between context and research phenomena; when the environment changes, the results of a case study still hold in their specific context (Dubois & Gadde, 2002). A qualitative case study is typically associated with research topics that aim to gain a deep and rich understanding of a research subject, which is difficult to achieve with quantitative research strategies. Successful case studies often modify former frameworks. Using abduction logic, they create new combinations with a mixture of established theoretical models and findings based on the investigated cases (Dubois & Gadde, 2002). Case studies develop and build theories and bring former theoretical models alive with their holistic understanding and rich descriptions of actual cases.

The object of this case study is a restricted system, such as an individual, group, program, phenomenon or process that takes place in certain time frame (Pettigrew, 1997). The unit of analysis in business studies is typically an organization, but it can also be a dyad or a network of relationships that includes several companies. Case selection is a critical phase of case studies. Whereas statistical research aims to select a representative sample to allow for generalization to the population, in case studies, selected cases should primarily include interesting findings. This is particularly the case in single case studies, which focus on deep and rich data for a single setting. This information-oriented sampling argues for the selection of specific cases with reasons such as the researcher's access to an interesting case, the selection of opposite cases or the selection of multiple cases in a similar context. To serve the last mentioned option, case selection from a quantitative dataset with cluster analysis is suggested as an innovative sampling method (Piekkari, Plakoyiannaki, & Welch, 2010). All in all, case selection should maximize researchers' learning potential (Merriam 1988).

As a research strategy, case studies include various sub-strategies. This dissertation uses both a longitudinal single case study (article 1) and a multiple case study (article 3). Longitudinal settings are particularly fitting to research topics where phenomena change over time, making time a critical factor of research (Pettigrew, 1990). A single case approach is often used for longitudinal settings (Voss, Tsikriktsis, & Frohlich, 2002). This approach allows researchers to maintain control of the context because the context does not vary between cases. This consistency is suggested to lead to better communication of contextual insights (Dyer & Wilkins, 1991). A multiple case study is variant of a case study that includes two or more observations of the same phenomenon. Suggestions for the optimal quantity of cases vary from 4-10 (Eisenhardt, 1989) to 2-14 (Perry, 1998). The chosen number of cases should ensure data saturation and richness, taking into account the available resources for data collection (Perry, 1998). As the

number of studied cases decreases, the opportunity for in-depth observation with the same resources increases (Voss et al., 2002). A multiple case study strategy with more cases is used when the depth of knowledge is not in focus and when research calls for numerous examples. This strategy is particularly useful when the aim is to explore the habits of actions in a certain context and to select a sufficient number of cases so that researchers can achieve data saturation (Huikkola, Ylimäki, & Kohtamäki, 2013, Article 3). All in all, using multiple cases does not aim to guide a case study towards a positivist tradition with statistical reasoning and generalization; instead, it aims to increase the quantity of interesting research objects to achieve rich data in terms of width and depth and to strengthen its analytical inference (Dubois & Gadde, 2002; Easton, 1995).

Whereas nomothetic research aims to generalize its findings with statistical inference from the sample to the population, case studies aim to achieve generalization from specific observations through the context (Salmi & Järvenpää, 2000). Validity in case studies typically refers to internal validity, which can be enhanced by using triangulation techniques. Triangulation refers to a method in which the same phenomenon is investigated from different viewpoints. Triangulation can involve data triangulation, where several types of data are used (e.g. Beverland & Lindgreen, 2010; Miles & Huberman, 1994), or method triangulation, where different methods are used to ensure and broaden findings (Vaivio & Sirén, 2010). Both case-based articles in this dissertation employed triangulation techniques to enhance the studies' validity (Huikkola et al., 2013, Article 3; Ylimäki, 2014, Article 1).

In Article 1, the case refers to the dyadic history of R&D collaboration in which collaboration types changed over time. The aim of the article was to study different collaboration types and the possibility to change them. A longitudinal setting was considered suitable because the time element was crucial to the development of a collaboration type (Pettigrew, 1990). Furthermore, single in-depth case studies have been suggested for longitudinal settings (Voss et al., 2002). This particular case was selected because the researcher had exceptional access to it, and according to pre-understanding, it represented interesting developments in the form of collaboration.

Article 3, another case study-based article in this dissertation, adopts a multiple case study strategy. In this article, the case refers to dyadic R&D relationships, which include joint learning. The article's aim was to draw a holistic picture of practices that facilitate joint learning in R&D relationships. A multiple case study was selected as a research strategy because both the number of examples and the richness of the descriptions had to be ensured (Beverland & Lindgreen 2010, Du-

bois & Araujo 2007). Seven relational cases were selected based the cluster analysis of the quantitative dataset. Using a K-means cluster analysis creates a cluster solution that maximizes the variance between clusters and minimizes the variance within them (Punj & Stewart, 1983). Cases were selected from a cluster that had the highest values of the breadth of R&D services and joint learning in relationships. Data collection included interviewees from both sides of relationships to validate the findings (Brennan & Turnbull, 1999).

3.2.2 Design science study

Article 2 builds its findings on a design science approach (Simon, 1996). Whereas traditional description-driven research aims to describe, explain and sometimes predict certain factor, the aim of prescription-driven design science in management is to develop actual solutions to real-life challenges and then build research products at an abstract level where these solutions can be applied to other similar types of management problems and challenges (van Aken, 2004). For decades, business studies have been criticized for producing information that lacks practical relevance and applications, which hinders its usage in business world (Abrahamson, 1996; Beyer & Trice, 1982; Hambrick, 1994). This problem is a consequence of over relying on description-driven scientific methods (van Aken, 2004). Other fields of research, such as medical and engineering science, have been more successful in combining theoretical and application knowledge. In those examples, academicians have been able to integrate description-driven and prescription-driven research programs that advance the practical usage of scientific research (van Aken, 2004).

Strengthening the tradition of design science in business studies is suggested as a solution to the lack of practical relevance and to the lack of usage of business research outcomes (Romme, 2003; Simon, 1996; van Aken, 2004, 2005). Design science involves more than applying scientific knowledge in practice (which is seen as a duty of practitioners). Instead, it provides industries with solutions that are developed in a scientific manner, field tested and reported ready to be applied to other cases (van Aken, 2004). Reporting is performed at an abstract level to enhance the transferability of solutions (or artifacts) to differing contexts (van Aken, 2005).

The general output of a design study is a solution to a specific problem, guiding practitioners to find the most appropriate way to act in this situation in real-life work settings. A solution shows a context-specific way of acting to achieve anticipated results: In a situation x, do y to achieve z. X is the known situation from which the need for a new solution arises, and z is the target that needs to be achieved. Procedure Y thus represents a solution that has to be developed. To be justified, ‘procedure Y’ has to be (1) justified

in practice, (2) grounded in theoretical principles (Romme, 2003) and (3) transferable to contexts other than the context in which it was created (van Aken, 2005).

Article 2 aimed to develop a procedure for the joint development of a service solution. The context was a relational development process for a full-service solution for factory maintenance. Participating companies agreed that the process of development had to be both efficient and dialogical. These somewhat contradictory viewpoints were fitted together with a process model that included principles from both fields. Service blueprinting and stage gate models represented the efficiency side, and principles of dialogical ideals ensured the relationality of the process. The development process included interviews, evaluations and several group meetings where all three parties—the buyer company, the customer company and researchers—were present. Researchers' role in solution development was participative, including conducting interviews, facilitating development discussions and an evaluation process, and bringing in theory-based principles and reporting.

3.3 Summary of methodological choices

Through its ontological viewpoint, this dissertation represents nominalism; it considers humans to have an active role in constructing the social world. More specifically, this dissertation takes the viewpoint that actions taken by companies create and modify the part of the social world that is investigated in terms of designing and managing R&D collaborations. From an epistemological perspective, this dissertation represents interpretivism, in practice; i.e., to fully understand R&D collaborations, the researcher has to gain an understanding from the inside rather than from external observations, and the researcher's interpretation is valuable in terms of analyzing findings. Emphasizing the role of the practical value of its findings, this research follows pragmatism as its research theory. Findings, built models and gained knowledge in terms of R&D collaborations are meaningful if they are beneficial to the researchers and companies that use them.

In line with these assumptions, research follows abduction logic in its reasoning. In all articles, the reasoning vacillates between theory and findings, resulting in theory extensions and new models. To accomplish these principles, this dissertation builds on qualitative research strategies. The research strategies used in the articles include a longitudinal case study, a multiple case study and a design science study. The data for the dissertation were collected using surveys, individual interviews, group interviews, development workshops and data from secondary sources. Table 2 summarizes the methodological choices that guide the research in this dissertation.

Table 2. Methodological choices in the dissertation

Area of research philosophy	**Methodological choice**
Ontology	Nominalism
Epistemology	Interpretivism
Research theory	Pragmatism
Reasoning	Abduction
Research strategies	Longitudinal case study, multiple case study, design science study
Data collection	Survey, individual interviews, group interviews, development workshops, data from secondary sources

4 REVIEW OF THE RESULTS

The dissertation includes three articles that concentrate on R&D collaboration between suppliers and their customers in the Finnish engineering industry. All three articles were published in refereed international journals. This section summarizes the results of those articles, explains their contribution to the whole dissertation and highlights the viewpoint of each article. The complete articles are included in the final part of the dissertation.

4.1 A dynamic model of supplier-customer product development collaboration strategies

Article 1, "A dynamic model of supplier-customer product development collaboration strategies," investigates the dynamic nature of collaboration in supplier-customer product development relationships. Despite their similar characteristics, supplier and customer involvement have seldom been considered alternative collaboration strategies within a dyadic relationship. This article examines the phenomenon from suppliers' perspective and considers suppliers' possibilities to enhance their position by utilizing their product development capabilities in a relationship. Building on the typologies introduced in the supplier involvement literature (Petersen et al., 2003) and in the customer involvement literature (Kaulio, 1998), the article creates a comprehensive model of different R&D collaboration strategies. The model increases the understanding of the dynamic nature of R&D collaboration strategies by proposing that companies can intentionally change their roles in these dynamic relationships, thus defining collaboration type as a strategic decision that can be managed jointly or in a single-sided fashion. The model, which consists of six possible collaborating strategies, is illustrated in figure 4.

In addition to theoretical considerations, the article illustrates transfers between different collaboration types from the viewpoint of the industrial supplier. The longitudinal case study includes data from four transfers that occurred in the same dyad, showing that the type of collaboration can change in the same dyad over time. This dynamic nature of collaboration types enables collaborative partners to maintain the benefits of long-term relationships, even in situations when the expectations of and needs for collaboration change. The framework introduced in the article illustrates different collaboration strategies for product development relationships between suppliers and customers. These strategies constitute the answer to the first research question of this dissertation: *What are the possible types of R&D collaboration? How do these types change over time?* The

well-managed transitions described in the article can help suppliers to gain relief from continuous price pressures and competition. Choosing the optimal collaboration type can also benefit customers because resources within dyads can be applied effectively. Suppliers with a higher development capability can be granted more responsibility in terms of product development, and suppliers concentrating purely on manufacturing can be steered to a role in which participating and investing in product development is not expected.

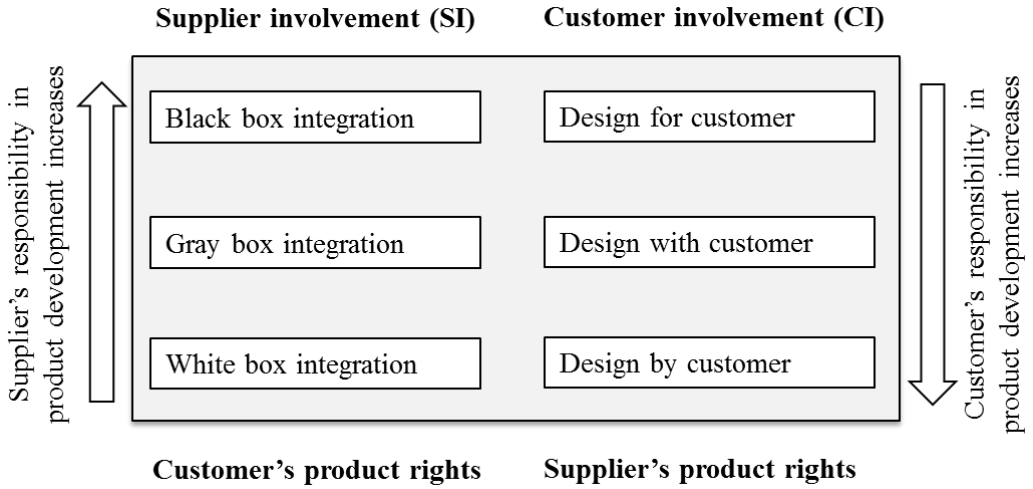

Figure 4. Types of supplier and customer involvement

Collaboration type selection and changes in collaborative R&D relationships are essential phases that create grounds for shaping these relationships in other terms. The desired collaboration type should define what type of joint development process collaborative companies apply and what type of relational practices they should use.

4.2 Relational development of a service concept: Dialogue meets efficiency

Article 2, "Relational development of a service concept: Dialogue meets efficiency," reports a relational solution development process that was developed by us researchers with two companies: providers and buyers of an industrial maintenance service. The relationally oriented service-dominant logic literature has been criticized for being too abstract and for a lack of practical work (Kowalkowski, 2011; Nordin & Kowalkowski, 2010). This design science-based article does its part to fill this gap and to enhance practical knowledge at a pro-

cess level. Using design science methodology, the article's business relevance is proofed in collaboration with both participating companies.

The article answers the second research question of: *"How should firms design their collaborative development process to achieve results effectively?"* by providing an example of how companies collaborate in service development. The solution developed in the article highlights the need to balance two important perspectives: relational business logic, with its value co-creation possibilities, and the firm-centric efficiency management perspective, with its efficiency claims. The developed process uses the stage-gate model's logic and aims to enhance interaction by adding principles of dialogical interaction to the co-development process of maintenance service solutions.

In addition to the context-specific development process (figure 5), the article proposes a general artifact for the joint development process (article 2, figure 3). The developed process consists of five phases: 1) checking the orientations; 2) analyzing the present state; 3) analyzing customer value; 4) designing the service process and 5) planning the relational governance. After each phase, companies should be able to form a shared understanding and joint decisions before moving to the next phase. Guided and analytical discussions in each phase improve the development of shared understanding and build room for objective interaction, concentrating on the solution development between parties that are typically locked in the roles of buyer and seller. This second article in the dissertation provides a process viewpoint for designing and managing R&D collaborations. It shows an example of how relational development work can be managed with a jointly accepted framework to ensure simultaneous efficiency and relationality. For researchers, the article provides unique insight into a joint process. The article can also encourage researchers to use more practically oriented methods, such as the design science approach, to enhance the practical value of their work.

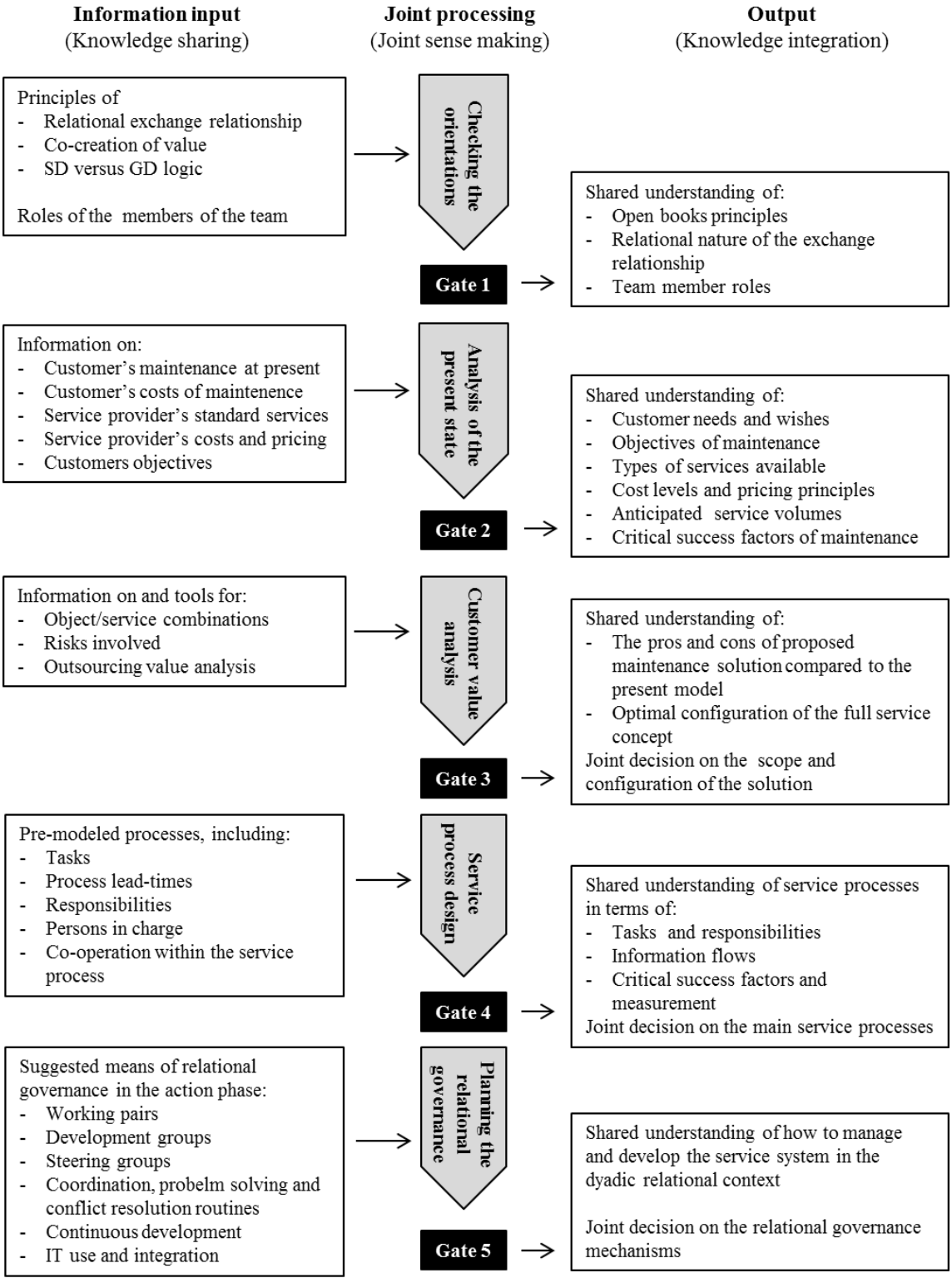

Figure 5. Context-specific relational process for the development of a service solution

4.3 Joint learning in R&D collaborations and facilitating relational practices

The third article, "Joint learning in R&D collaborations and the facilitating relational practices," examines the role of relational practices as enablers of joint learning in R&D collaboration between suppliers and their customers. It fulfills the strategic and process perspectives of two earlier articles by focusing on collaboration practices. Despite the high number of articles focusing on R&D collaborations and their management, the literature has lacked the analysis of relational practices in R&D collaborations. The article aims to fill that gap by analyzing relational practices in the mechanical engineering industry. The data examined in the article were based on eight dyadic cases. The cases were selected from survey data, and they represented dyads in which the exchange of R&D services and joint learning were both at a high level, according to survey responses.

Knowledge sharing, joint sense making and integration into relationship-specific memory are dimensions of learning identified in earlier studies (Selnes & Sallis, 2003). The dimensions are also in line with the logic of article 2, which suggests a cycle that includes elements representing the same dimensions in each phase of the joint development process. Our research illustrates the joint learning practices of relational investments, relational structures and relational capital at all three learning dimensions.

Our research suggests that an interplay between facilitating practices is necessary to support learning. The research also finds that relational capital is embedded in other elements that facilitate joint learning. Furthermore, as illustrated in figure 6, the cycle of joint learning forms a dynamic relational capability that takes place in a context in which facilitating practices interplay.

For research, a holistic framework for joint learning and facilitating practices also creates a venue for further research that could focus on the interplay between different relational practices and joint learning. Through results at the practice level, the third article answers the third research question, "*What practices are used within R&D collaborations?"* Taken together, these three articles provide an overall suggestion of how to manage and design R&D collaborations at the strategic, process and practice levels, thus answering the dissertation's main research question, "*How can companies manage and design supplier-customer R&D collaboration?"*

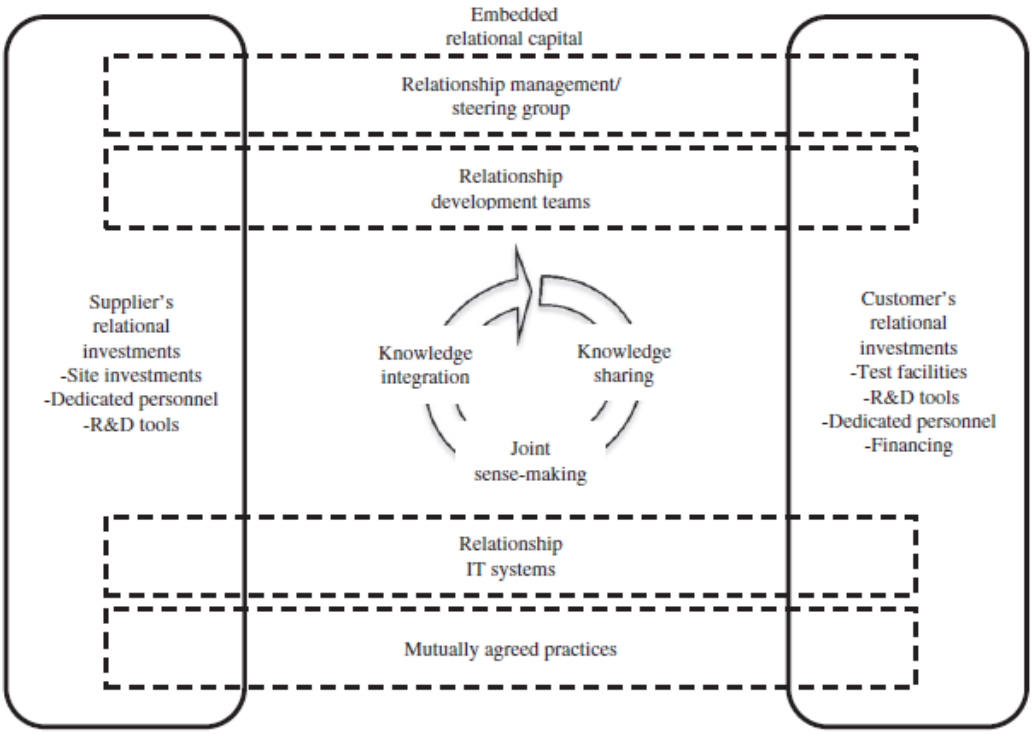

Figure 6. Holistic framework of joint learning and relational practices in R&D collaboration

5 DISCUSSION AND CONCLUSIONS

This dissertation concentrates on studying how companies collaborate in terms of product and service development and how these collaborations can be managed. The dissertation addresses gaps in the R&D collaboration literature by building a broad overall understanding of how supplier and customer companies collaborate in R&D and particularly how they can develop existing relationships in terms of R&D collaboration types, processes and practices (Kale & Singh, 2007) to seize evolving opportunities. This dissertation also addresses the issue of one-sided studies in the collaboration literature (Kamp, 2005; Terpend, Tyler, Krause, & Handfield, 2008, Johnsen, 2009) by building its findings throughout the study on the dyadic viewpoint; it is understood that neither one of the parties in dyadic collaboration alone can provide sufficient information for research to draw balanced conclusions on relationship-related topics. This section discusses how companies can analyze and plan future collaboration by taking into account all three core elements: what type of collaboration it should be, what type of process to use in actual collaboration and what practices should be implemented to develop the relationship.

5.1 Model for managing dyadic R&D collaborations

This dissertation contributes to inter-organizational research on collaborative development, and through its dyadic perspective, it has emphasized the somewhat neglected supplier's perspective in industrial collaborative development. Furthermore, it has approached the theme of collaborative development with pragmatic research philosophy. The published articles in the dissertation have focused on three core elements of R&D collaboration, providing partial solutions to the three sub-issues of (1) the strategic decisions of the collaboration type, (2) the effective collaboration process and (3) the practices that support R&D collaboration. In the articles, it was not possible to present holistic answers to the overall research question, *"How can companies manage and design supplier-customer R&D collaboration?"* However, together, the three core elements of R&D collaboration—strategically choosing the collaboration type, building the joint development process, and planning the practices that facilitate joint learning in relationship and the interplay between elements—constitute a model for designing and managing R&D collaborations. The model is relevant to contexts in which companies have already established a long-term R&D collaboration relationship that they aim to develop further. The model aims to assist in situations where parties feel that the full collaborative product or service development potential is not reached or roles are blurred. The elements of the presented model

could also be applied to other situations, for example, when a new potential customer proposes R&D collaboration.

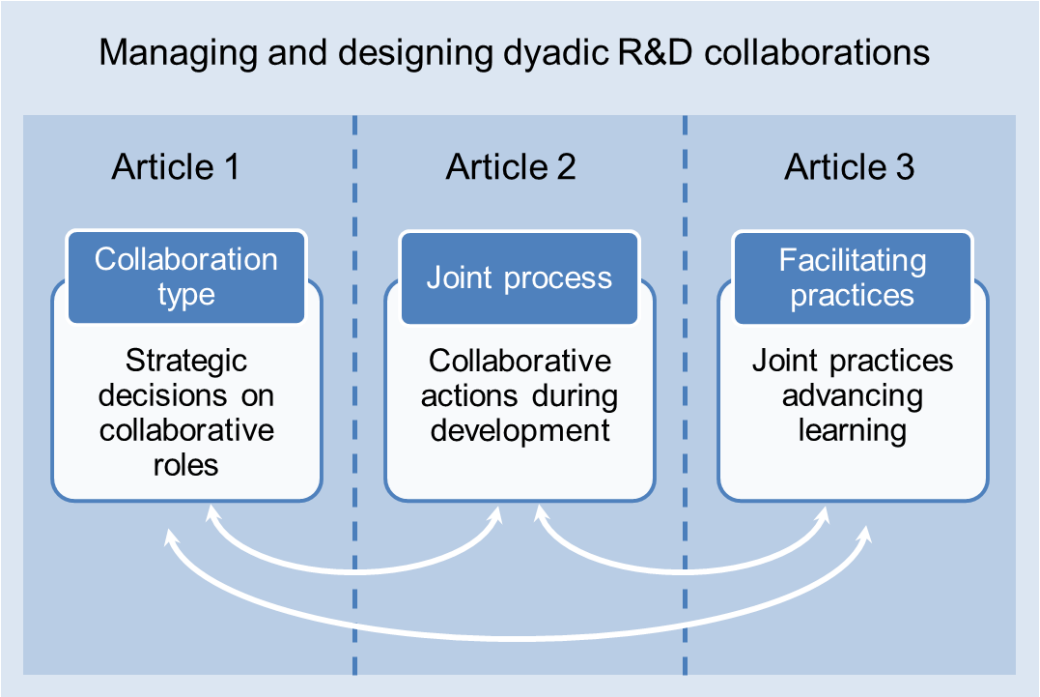

Figure 7. Model of three core elements in managing and designing R&D collaborations

Using these three elements to develop collaboration is not straightforward process with a beginning and an end; during collaboration, companies learn and prerequisites for collaboration can change. Thus, companies should occasionally reconsider their choices to ensure that the habit of collaborating is optimal in a broad sense. To ensure beneficial R&D collaboration, companies should take into account decisions concerning all elements when designing their relationship. The arrows in figure 7 highlight this interplay between the core elements of managing and designing R&D collaborations.

In relationships where both parties view collaboration as a source of relational advantage and are willing to develop supplier-customer relations in a relational manner, open discussions about the plan to apply a broad framework for developing R&D collaboration could be beneficial. A key to making the right decisions about how to communicate relationship development plans for a collaborating party is to know and identify each party's preferences for the relationship in question. When another party tends to emphasize relationality, openness seems to be the logical option, and when the other party emphasizes transactional relationships, acting without unveiling the whole picture could work better. In some

cases, attempts to promote the supplier's role in development could promote the reputation of the supplier in relation to suppliers that pursue passive development.

Analyzing and considering the potential changes in the current relationships by using these three core elements can occasionally unveil knowledge or experience that challenge the advantages of the current relationship or the other party's willingness to collaborate in way that advances the other. Furthermore, in some cases, a broad plan for collaborative development could contradict the customer's supply policy; it can strengthen the relationship, thus hindering the possibilities to use a market mechanism in negotiations. In these cases, revealing a broad relationship development plan for transactionally oriented purchasers from the customer company can cause suspicion and thus hinder supplier-driven collaborative development. Thus, in some cases, companies cannot collaborate in designing and managing their relationship, but one party can apply the core elements proposed in the model on its own, depending on the side, as a customer relation management tool or as a supply chain management tool. Phases that require participation from both parties must be made together, but nonetheless, the overall picture can be concealed from another party. In situations where the relationship has severe problems but clear potential, one could consider starting applying the broad development model first as an internal tool and afterwards expand over firm boundaries.

5.1.1 Selecting the type of collaboration

R&D collaboration studies from the buyer company's perspective have emphasized how to select the right partner when needs for R&D collaboration evolve. However, taking a dyadic perspective, partners with a high dependency on their collaborating partners are more eager to learn how current relationships with their customers or suppliers can be facilitated and modified in terms of R&D collaboration. Based on case study findings, this dissertation suggests that strategies to collaborate in development work are dynamic in nature. The proposed possibility to change the type of R&D collaboration successfully within existing relationships creates opportunities to develop them radically.

This dissertation contributes to the discussion on different forms of collaboration by combining typologies from the supplier involvement and customer involvement literature. Different strategies in dyadic R&D collaboration have not received enough attention. Instead, the traditional approach to handling variation in R&D collaboration has concentrated on the intensity of cooperation. However, less cooperation can actually indicate either very high supplier responsibility or

very low supplier responsibility depending on the collaboration type. For example, in black-box collaboration, the supplier assumes remarkable responsibility for development but primarily works independently during the development process. Similarly, a low level of actual supplier-customer cooperative tasks is found in white-box collaborations, where suppliers assume minor responsibility for development. Thus, the intensity of cooperation is not an optimal indicator when evaluating the nature of R&D collaboration; instead, types of R&D collaboration should be recognized. This should be taken into account in future research.

Both collaborative and single-sided decisions of the targeted R&D collaboration type include considerations for preconditions of different collaboration types. Companies should consider both internal and external preconditions to ensure that the resource combination gained through a specific collaboration type is optimal. Internally, the overall business strategy, capabilities and resources define the most lucrative collaboration types. External factors to be considered include past experience within the relationship in question, the dynamism of the industry, the other party's resources and capabilities and the willingness to invest in development.

The framework of article 1 includes six different forms of collaboration, three of which are supplier involvement types with product rights on the customer side and three of which are customer involvement types where the supplier owns immaterial property rights. Customer involvement collaboration strategies are more suitable when scale advantages are in focus. When the supplier is allowed to sell to various customers, it is likely to gain cost benefits and knowledge from other customers. When the supplier's deliveries constitute subassemblies that are a source of remarkable competitive advantage for the customer, supplier involvement strategies could work better. In these cases, the supplier's business is limited to the relationship in question, and the benefits of the advancements in development should be capitalized in a single relationship. However, if the benefits of development are clear and extensive, the customer should be willing to compensate for the supplier's participation in development.

In addition to varying the ownership of product rights, collaboration types differ in terms of the customer's and the supplier's responsibility in development work. When the supplier maintains sophisticated development capabilities, it is logical that the type in which the supplier's responsibility is high is aimed for. On the contrary, suppliers that have decided to focus on manufacturing, leaving design capabilities of minor importance, should aim for collaboration types with fewer development responsibilities. To ensure a seamless design, regardless of the development responsibilities, collaborative parties should emphasize collaboration

types with the most integration (gray-box and design with customer) when the integration of the subassembly with other parts of the end product is extremely complex or otherwise challenging.

According to the findings in article 1, the collaboration type is dynamic in nature. Companies can steer their relationship together or independently to the optimal collaboration type. The decision about the collaboration type is a strategic choice that corresponds to the overall strategy of companies when designing their dyadic R&D collaboration. Because the nature of these types is dynamic, decisions are not definitive; instead, the type of collaboration can be modified again as situations change. Thus, the dynamic view on the collaboration type also enables maintaining the achieved benefits of long-term relationships when the need for development efforts changes. Managing and designing R&D collaboration together can be seen as joint dynamic capability because it assists companies to sense opportunities and threats, seize business opportunities and sustain their collaborative advantage together.

The wrong collaboration type could hinder development efforts. For example, the supplier can have remarkable ideas but may not see enough economic value in developing them for a single customer. The solution could be to adopt a collaboration type with customer involvement. The collaboration type could also include a conflict of interest. Differing assumptions, targets, understandings of the relationship and party capabilities could easily lead to conflicting views of the optimal type of collaboration. An open discussion between suppliers and customers about collaboration roles can be challenging and can benefit from mutual respect and a shared vision.

Furthermore, collaborating in development work is not suitable for all relationships. It should be remembered that joint development is not itself a value. The dynamic nature of the collaboration type also means that companies can move to a direction in which the supplier's responsibility is lowered. If conditions are such that joint development does not have the potential to increase the advantage for collaborative parties, then it should not be forced into the relationship.

5.1.2 Process of actual collaboration

Business-to-business marketing scholars have called for frameworks that can optimize the value creation potential of industrial collaborations (Lambert & Enz, 2012) and advance the two-way communication of buyers and sellers during the development process (Edvardsson, Kristensson, Magnusson, & Sundström, 2012). This dissertation strengthens the service-dominant logic by designing a

joint process by which co-creating value in terms of collaborative development has managerial relevance. Bringing efficiency-seeking principles of service blueprinting and the stage-gate model to the relational development process with dialogical interaction, this dissertation proposes that R&D collaboration should be both effective and relational.

Actual R&D collaboration is a task in which collaborating parties should step aside from their typical roles of seller and buyer. Collaborative parties have to understand the importance of dialogical interaction when aiming for joint development. Collaborative development can be time consuming. To simultaneously control efficient and dialogical modes of action, this dissertation proposes a general framework for the joint development process. It has been abstracted from a process that was developed for joint solution development between industrial companies (figure 5).

Managers could control both relationality and efficiency by setting up "arenas" for different aspects of joint development. These arenas provide a basis for target-oriented interaction within the collaborative development process. When companies enter a collaborative process, each arena emphasizes jointly agreed-upon principles of dialogical interaction, which, combined with defined outcomes for each arena, bring structure and target orientation to relational development, ensuring that companies achieve collaboration that creates relational rents for both parties.

5.1.3 Practices supporting collaborative development

This dissertation advances the literature on relation-specific assets by showing that in addition to cost advantages and relational rents (Dyer & Hatch, 2006), relational investments can facilitate the development of relational dynamic capabilities (particularly joint learning). It also sheds light on mechanisms by which those advantages are reached. For example, investments in proximate service sites and joint information systems affect joint learning by enhancing knowledge sharing and implementation. Time investments in joint interaction in turn potentially enhance joint sense making, as they assist companies in finding a shared language. It has also been suggested that mechanisms and practices of relational interaction forums (relational structures), such as IT systems and meetings in different levels, have a similar effect by advancing knowledge sharing. Furthermore, development teams are important platforms for dialogical interaction that create a basis for joint sense making with a shared language developed in interaction. Relational steering groups assist in improving participation, commitment and loyalty for joint development. Furthermore, the relational form of social

capital advances joint learning. Familiarity enhances mutual trust, which, in line with previous research, controls the threat of opportunism, assists in knowledge sharing and reduces the cost of collaboration (Zaheer, McEvily, & Perrone, 1998). Relational capital also enables open dialogue and healthy criticism, thus advancing joint sense making.

This dissertation provides a model that describes the interplay between different elements of joint learning, relational investments, relational structures and embedded relational capital (Fig 2, Article 3.). The model clarifies the interconnection of theoretical elements formerly applied to the sources of relational rents and finds practices that facilitate joint learning, thus advancing research on relational advantage.

Companies can strengthen their R&D collaboration by creating circumstances favorable to joint learning, which can be enhanced with relational practices in areas of relational investments, relational structures and relational capital. For example, relational investments, such as joint IT systems, facilitate knowledge sharing, joint sense making and knowledge implementation. The summary of practices identified is described in table 3, article 3. Implementing these practices facilitates joint learning in relationships, thus enhancing the prerequisites for R&D collaboration. Because different elements of joint learning strengthen each other, facilitating them should generate a positive circular effect on collaboration (figure 2, article 3).

In addition to the relational form of implementing practices, it is noteworthy that these facilitating practices can also be planned and implemented by one party. Although both companies are needed for collaboration, wider targets for implementing these practices can remain veiled to the other party. This is same logic of how buyer companies sometimes act with their supplier development programs, particularly when the benefits of the program for suppliers are not clear.

5.2 Limitations and suggestions for future research and for managerial actions

This dissertation focuses on three elements of managing and designing dyadic R&D collaborations in long-term industrial relationships between suppliers and their customers by applying a qualitative approach. It leaves the quantitative investigation of the achieved benefits and experienced functionality of R&D collaboration for other studies and concentrates purely on actions, approaches and practices in collaborative R&D relationships. Although it contributes to theory development by offering new models and suggesting relational practices, it does

not test theories quantitatively. The dissertation also focuses on a single industry and on a limited quantity of cases: it does not aim to generalize its findings to a population of companies. Instead, the findings are relevant to their respective contexts, and the theory extensions that they stimulate should be tested elsewhere. Despite extensive research on collaboration and business school fads of networking, real-world inter-company collaboration in development is often conducted in a less lucrative atmosphere than that presented in speeches and supplier guides. Ultimately, the managerial value of the findings of this dissertation is defined by their usefulness in practice.

This dissertation uncovers several interesting research themes. The first theme is collaboration types. The influence of collaboration types could be studied using the framework presented in article 1. The different phases of R&D collaboration could explain the somewhat conflicting results of past studies on collaboration benefits. Studies could also further validate the findings on the dynamic nature of collaboration types by identifying cases where collaboration types were changed. Further, more specific descriptions of the requirements for different changes between types could have both theoretical and managerial significance. The second theme applies a design science approach to various joint development topics. Researchers could, for example, attempt to develop, field test and report the managerial process for evaluating the optimal collaboration type for a specific relationship. Third, the model suggested in the discussion chapter assumes that companies have already established a relationship, but it does not take into account the partner selection process, which also has be seen as essential phase of creating successful R&D collaboration. Thus, it would be interesting to broaden the model to the partner selection phase and field test and refine the broadened version of the model.

The development and building of collaborative product and service development relationships is inarguably beneficial to various companies across industries. To advance the implementation of development actions studied in this dissertation and others that support development relationships, joint projects with companies and research institutes are needed. By applying design science principles to relationship development, these projects could remarkably advance the participation of companies in implementing research-based knowledge and academia by offering real-world contexts in which to challenge sometimes overly theoretical concepts. To spread acquired knowledge, it is also essential that researchers fulfill their responsibility as professionals and help companies use knowledge gained in various ways, including private consulting, lectures and managerial handbooks.

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A dynamic model of supplier–customer product development collaboration strategies

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ABSTRACT

This study examines transitions between different types of product development collaboration in supplier–customer settings, the events that trigger such transitions, and the emerging requirements for suppliers. The current study contributes to the literature regarding supplier and customer involvement by combining previously discovered types of collaboration into a dynamic model that describes these different types as alternative modes of collaboration that can be implemented in a relationship. Transitions between different types of collaboration are identified in a longitudinal case study. Three of the four transitions identified took place in the same dyad, which demonstrates that it is possible to change the type of collaboration without losing the advantages of a long-term relationship with a customer. The most radical change in collaboration—the change from supplier involvement to customer involvement—involved temporarily discontinuing the original relationship, which indicates that this transition incorporates the highest risk of relationship termination. By offering a dynamic model for product development collaboration, this study is the first to analyze changes between different types of customer–supplier product development collaboration from a supplier's perspective. The dynamic view is important for companies seeking to take advantage of their long-term relationships instead of starting new ones when new requirements for product development collaboration emerge.

1. Introduction

Companies across industries are seeking relational advantages through product development collaboration. To develop complex products, companies need to safeguard a level of collaboration within supplier networks because suppliers retain specific knowledge of the subassemblies that they offer. Furthermore, suppliers serve as an access point for the technologies and capabilities needed for development (Johnsen, Phillips, Caldwell, & Lewis, 2006). In the last three decades, scholars have extensively examined product development collaboration among industrial companies (Dyer & Singh, 1998; Johnsen, 2009; Takeuchi & Nonaka, 1986). The collaboration between suppliers and customers regarding product development can be divided into two main streams in the literature: supplier involvement and customer involvement. The supplier involvement literature focuses on the role of suppliers in the customer firm's product development (Johnsen, 2009; Takeuchi & Nonaka, 1986) whereas the customer involvement literature investigates customer participation in a supplier's product development (Kaulio, 1998).

However, these literature streams fall short of discussing the potential to adjust or change the type of product development collaboration to correspond to changing needs. The form of collaboration is typically studied as a static phenomenon, with costs and benefits associated with various types of collaboration (e.g., Gruner & Homburg, 2000; Ragatz, Handfield, & Petersen, 2002). The rationale for the static approach is that the customer simply switches to another supplier when what it needs the supplier to contribute changes during product development (thereby initiating a new (but static) collaboration). This study considers dynamic alterations in the form of collaboration in a given customer–supplier dyad instead. The potential for the important development of the supplier's role in collaborations and the changes to the types of collaboration make it possible for suppliers to leverage product development collaboration and to exploit the benefits of a long-term relationship between suppliers and customers (Holmlund, 2004).

The current study aims to advance both supplier and customer involvement research, and in so doing to assist companies to identify the most valuable collaboration type among their current product development collaboration relationships. To attain those goals, this study analyzes the possibility of switching between different types of product development collaboration; the reasons that might prompt such changes; and the adjustments suppliers would have to make to switch from one collaboration type to another. To make this examination possible in a long-term relationship, and in contrast to the majority of prior research on customer and supplier involvement, this study relies on a longitudinal case study. As the transitions revealed in this study were completed while the original dyad continued to function, this study proves both that the type of product development collaboration is not

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an unchangeable characteristic of a relationship, and is not something that can be developed only at the cost of supplier substitution. Analyses of such changes result in a model that combines different types of product development collaborations and illustrates the directions in which companies can develop their dyadic collaborations.

The article is organized as follows. After the introduction an overview of the literature on supplier–customer collaboration is provided and a conceptual framework for collaboration developed. The third section outlines the methodology and data used. The fourth section presents the findings derived from the study of transitions, and finally, the paper concludes with a discussion of the results and their implications for the management of supplier–customer development collaboration and theory.

2. Supplier–customer collaboration in product development

Håkansson's (1987) view of long-term relationships between buyers and solution providers as a source of innovation serves as the basis for both supplier involvement and customer involvement in product development. The logical reason for collaboration on product development is provided by the complementary knowledge (Makri, Hitt, & Lane, 2010) and complementary resources that collaborating companies bring to the process (Barney, 1991; Dyer & Singh, 1998; Miotti & Sachwald, 2003). By combining their diverse capabilities, companies can generate new technologies and create products that would not have been possible using only homogenous knowledge and resources. Complementarity in capabilities also leads firms to prioritize knowledge sharing over cost issues (Sakakibara, 1997), which is in the interest of suppliers. To capitalize on complementary knowledge, firms require an extensive information exchange between key customers and suppliers. This information exchange has been seen as a fundamental factor necessary for successful product development (Katz & Tushman, 1981; Von Hippel, 1986, 1988) and the ultimate need for such an exchange arises from the asymmetric nature of business relationships in which the "need" information is on the customer side and the "solution" information is retained by the supplier (Thomke & Von Hippel, 2002). Direct communication with customers offers suppliers rich knowledge by facilitating the transfer of complex information (Salomo, Steinhoff, & Trommsdorff, 2003). Broad and deep information that is gained through intensive communication within the customer relationship is important because it increases the quality of the development process and facilitates joint learning (Brown & Eisenhardt, 1995; Huikkola, Ylimäki, & Kohtamäki, 2013).

To satisfy the need for extensive information exchange and to use complementary resources efficiently, companies therefore adopt supplier and customer involvement strategies in their product development relationships. Supplier involvement, which is defined as "the tasks suppliers carry out on behalf of the customer, and the responsibilities they assume for the development of a part, process or service" (Van Echtelt, Wynstra, van Weele, & Duysters, 2008, p. 182), has been proven to result in lower development and product costs, fewer engineering changes, higher quality with fewer defects, greater reliability, shorter time to market, highly standardized components, detailed process data and innovativeness (Bonaccorsi & Lipparini, 1994; Feng, Sun, & Zhang, 2010; Monczka, Handfield, & Scannell, 2000; Ragatz et al., 2002; Sun, Yau, & Suen, 2010). Following Kaulio's (1998) definition, customer involvement is seen as the "interaction between customers and the design process". It is suggested that customer involvement leads to better innovation performance by helping companies recognize market and technology opportunities, generate new ideas and prevent them from developing poor designs (Lin, Chen, & Chiu, 2010; Tsai, 2009; Von Hippel, 1988). It has also been proven to enhance product quality, delivery reliability, process flexibility and customer service (Feng et al., 2010; Sun et al., 2010).

In contrast to studies that have identified benefits from both supplier and customer involvement, some studies have argued that collaboration can lengthen the development cycle (Zirger & Hartley, 1994), increase costs (Ittner & Larcker, 1997) or lead to limited opportunities (Callahan & Lasry, 2004) and to ideas that are overly exploitative (Frishammar & Horte, 2005). To avoid such potential drawbacks, firms should align product development collaboration with contextual factors that affect the results from the supplier and customer collaboration, such as product modularity, product innovativeness, internal coordination, product complexity, information processing capability and motivation (Lau, 2011; Zirger & Hartley, 1994).

2.1. Types of customer and supplier collaboration

Highlighting the varying nature of supplier involvement relationships, Petersen, Handfield, and Ragatz (2005) applied a typology that distinguished supplier involvement collaboration into three different types. The type where the supplier's role is the most comprehensive is referred to as *black-box* development. In this type, the supplier takes primary responsibility for providing a solution to the customer according to a list of requirements that the customer has established. In black-box development, the supplier is responsible for developing the component or subassembly. A second type of supplier involvement is *gray-box* development where cooperation plays the most important role. Design is undertaken together, and collaborative companies often share an office to facilitate information exchange during product development. Gray-box development allows firms to effectively integrate a supplier's processes in the design (Koufteros, Cheng, & Lai, 2007). The third form of supplier involvement is the *white-box* development where design is customer driven and the supplier's role is limited to commenting on the customer's design. In a white-box development, the supplier's contribution typically relates to input on whether the new component can be manufactured.

In the field of customer involvement, a similar type of classification system has been provided by Kaulio (1998), who divided customer involvement in product development into three categories. In the first type, *design for customer*, development is supplier driven; the supplier's engineers carry out the design work and are the main actors. Data related to customer needs are gathered by using market research methods and are then turned into performance measures. The design process is guided by these data, but the customer's role is limited to passing on customer-specific data via interviews or survey replies. The second type in Kaulio's (1998) typology, *design with customer*, features more collaboration, as the product concept and solutions are developed through collaboration between customer and supplier. The design with customer type, is marked by on-going dialog between customer and supplier during the product development process. Collaborative companies discuss and compare various potential concepts and prototypes. The third type, *design by customer*, is a customer-driven product development type where the customer actively designs the product. The distinction between the work of the supplier's designer and the customer becomes blurred, with the customer taking a significant role in the process of developing and selecting a design solution. A supplier's role is to help the customer find realizable solutions to their problems. Furthermore, Koomsap (2011) states: "*[in DBC, customers] are guided to define the fittest alternative that meets the cost, schedule and the product requirements through the capabilities of a company*".

The two classification systems mentioned above share many characteristics. Both focus on product development collaboration between suppliers and customers. Both divide collaboration types into three categories, and in both classification systems the defining factor is the extent of the contribution that the collaborators set up the product development. As Fig. 1 demonstrates, the supplier-involvement type gray-box integration is comparable to that of *design with customer* in the customer involvement typology. Black-box and white-box integrations are similar to *design for customer* and *design by customer*, respectively.

Because many of the characteristics of supplier involvement and customer involvement are both similar and opposite to one another

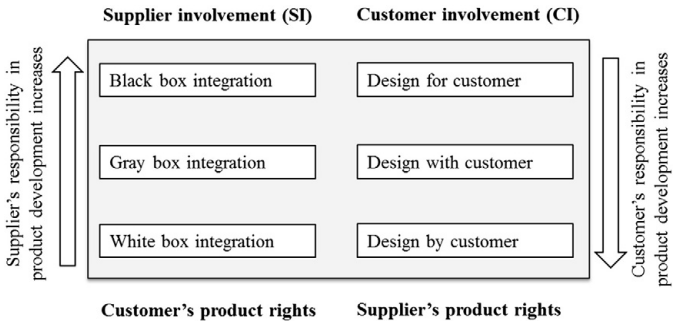

Fig. 1. Types of supplier and customer involvement and their relative positions.

(Flynn, Schroederb, & Sakakibara, 1994), these two collaboration strategies in product development could potentially be mixed depending on the viewpoint. This is the case particularly if the relationship is the unit of analysis and product development collaboration assumes different forms in different business lines. In this article, the distinguishing factor between customer and supplier involvement is the type of sales of the developed product or subassembly. If the supplier is allowed to market and sell the product in question to other customers, any collaboration is necessarily of the customer involvement type. If the supplier is delivering and marketing products only for its collaborator, the collaboration is seen as of the supplier involvement type. In collaborative relationships where the parties have made written agreements on product rights, ownership of those rights defines whether collaboration is of the customer or supplier involvement type. For instance, if a customer owns the product rights, the collaboration type is that of supplier involvement, and if the supplying company owns the product rights of the target of development, the case is one of customer involvement. This determination clarifies the sometimes-blurred distinction between supplier and customer involvement. An example that supports the determination above is a situation where product rights are sold or transferred from the customer to the supplier. In such a case, the same collaboration switches from being a supplier involvement to a customer involvement type.

The importance of developing the dynamic model of product development collaboration arises from the view that both the supplier (Kalwani & Narayandas, 1995; Walter, Ritter, & Gemünden, 2001) and the customer (Monczka, Petersen, Handfield, & Ragatz, 1998) firms benefit from long-term relationships and thus the relationship as a whole. Firms benefit from long-term relationships according to multiple theoretical viewpoints, such as IMP (Håkansson, 1987), transaction cost economics (Heide & Stump, 1995) and the relational view (Dyer & Singh, 1998). Should the need for collaboration in product development emerge, research has shed light on how a firm should select its partner (Schiele, 2006). Less research has concentrated on development within on-going relationships to satisfy a changed collaboration requirement in product development. Developing current relationships can also be seen as a natural way to switch between different collaboration types because companies tend to prefer stability in relationships due to high switching costs, risk-reducing strategies, and market concentration (Turnbull, Ford, & Cunningham, 1996).

3. Methodology and data

This research leans on a longitudinal qualitative case study of product development collaboration on one of the supplier's business lines that was in place between 1992 and 2013. The longitudinal approach was chosen because the study focuses on a product development collaboration where the time element was crucial (Pettigrew, 1990). Single in-depth case studies have been considered particularly fitting for longitudinal settings (Voss, Tsikriktsis, & Frohlich, 2002). The rationale for selecting a single line of business for investigation comes from the consistency, versatility, and coverage of the case data that cover four temporally divergent transitions within a single line of the supplier's business.

3.1. Data collection

Primary data for the study include 11 interviews with key informants. Interviews covered collaboration at a general level and then moved on to more specific discussion of what constituted collaboration, what were the defining factors and events relevant at different times, and how the interviewees viewed the collaboration at different times. Interviews were primarily structured to review events chronologically, but structure did permit the interviewer to move back and forth in time when necessary. Preliminary notes were made immediately after the interviews to enable the interviewer to ask follow-up questions (by e-mail and phone) promptly and to devise the most apt questions for the next interview. This process encouraged a focus on emergent themes and constructs, as data collection proceeded as suggested by Huberman and Miles (1994, p. 431). To protect respondent confidentiality, company names used throughout the article are pseudonyms.

Data collected from the supplier side include memos from meetings starting in 2007, transcribed records from group discussions, semi-structured face-to-face and phone interviews from 2010 to 2013, purchase orders from 1992 to 2013, company history, income statements, balance sheets and validation of findings. Key informants were chosen by the CEO as the person with the longest tenure at the company. Key informants included the quality manager, sales manager, chief engineer and financial manager.

Given the recent challenges in collaboration, the opportunity for direct data collection from the customer side was limited. The length of the collaboration and the publicity requirements of the publicly-listed customer company provided secondary data. Table 1 lists the data sources used, and shows that supplier interviews are complemented by rich secondary data from the customer side; thus, data distribution in this study accords with Kamp's (2005) request to expose the change issues in dyads that emphasize the supplier perspective.

A part of each interview covered relationship development several years prior to the interviews. To increase this study's reliability in general and to address this possible source of error through memory loss and retrospective rationalization, findings from the interviews were triangulated (e.g., Beverland & Lindgreen, 2010; Huberman & Miles, 1994) whenever possible with other interviews, purchase orders, companies' press releases and financial information from the Orbis database, as well as with meeting memoranda from 2007 to 2012. In addition, a retrospective approach in interviews also assisted the interviewees to be more open compared to interviews about current issues, as suggested by Danneels (2010).

Table 1
List of data used from both collaborative parties.

Supplier	Customer
Semi-structured face to face and phone interviews from 2010 to 2013	Customer research answers to open-ended questions on product development collaboration
Transcribed records from group discussions	Customer research quantitative raw data
Validation meeting of findings	Relationship level customer research report
Memos from meetings	Purchase orders
Purchase orders from 1992 to 2013	Supplier manuals
Company history	Press releases
Income statements	Stock and order book information
Balance sheets	Annual reports

3.2. Case selection and description

A major role in the business line selected for this study was played by typical asymmetric dyadic collaboration, including product development with two culturally and physically close western hemisphere companies with a long common history from a country with high labor costs. The privately owned Ventlor, a medium-sized supplier of sheet metal products, has a long history with Poweko, a publicly listed international industrial company. As early as 1992, Ventlor started deliveries of the first version of the product that is the focus of this study. Prior to that, Ventlor had delivered special to type solutions to cover the same need. During their collaboration, both companies have been successful. Ventlor more than doubled its turnover in the period 2005–2012 and its average EBIT margin for the same period was over 11%. The period 1994 to 2012 saw an almost a tenfold increase in Poweko's market capitalization, and its sales volume grew by over 500%. Both companies are located close to one another and thus have similar cultural backgrounds. However, Poweko's global presence has required Ventlor to adapt to international communication when doing business with Poweko's organization abroad. The companies' roles in their product development collaboration underwent a significant transformation from a relationship where Ventlor simply took care of installing individual subsystems designed by Poweko, to a relationship where Ventlor delivers modular products for several customers and collaborates on product development with all of them.

3.3. Analysis

The analysis stage proceeded from a more concrete to a more abstract interpretation (Huberman & Miles, 1994). Initially, brief analytical notes were produced. These notes were in the form of memoranda that included the researcher's insights from empirical materials (Strauss, 1987) and were continuously compared with earlier typologies of product development collaboration and change theory in business relations (Eisenhardt, 1989). To make sense of the longitudinal data, the researcher sought out "critical events". The relationship evolution literature defines such "critical events" as occurrences that initiate change and that are crucial to relationship development (Halinen, Salmi, & Havila, 1999).

Based on the interviews, critical events associated with changes between types of collaboration were identified. The memoranda were then classified according to the different eras and critical events that were identified. These classified findings, the researcher's insights and comparisons with earlier literature led to theoretical interpretations that fit the case data and that were thus continuously examined. The preliminary results were written down and shaped; these results were then further refined and clarified chronologically to form a model. Data were then investigated further to find additional evidence and to enrich the preliminary model.

For the purposes of data auditing and investigator triangulation (Huberman & Miles, 1994), the findings were compared to the case data by two academic professionals who were not otherwise involved in the study. Finally, the resulting model of changes in types of product development collaboration was presented to and discussed with the CEO and the marketing manager of the supplier company to validate the findings.

4. Findings

4.1. Transitions between different collaboration types

The case studied in this paper describes four changes in the type of product development collaboration. This section explains the changes between different collaboration types and considers the reasons for such changes, and also the consequences of such changes for suppliers. The changes analyzed in this section clarify Ventlor's path from a supplier of customer-designed, custom-made constructions to an OEM company selling its product to three major players in Poweko's industry. The path is illustrated in Fig. 2.

4.1.1. Change from white-box development collaboration to gray-box development

Prior to 1992, Ventlor supplied individual custom-made systems for Poweko. These systems were designed by Poweko, and Ventlor's role before the installation of the components was limited to commenting on the feasibility of the designed system. In this white-box supplier involvement collaboration, Ventlor's competitive edge came from its flexible production and installation resources. The need for gray-box collaboration came about in 1992 when Poweko wanted to reduce costs by replacing individual custom-made systems with modular design systems. The aim with the new product architecture was to shorten the delivery time and most importantly cut costs. The anticipated cost benefits were to be realized in multiple ways. The new modular architecture would decrease high planning costs in special to type constructions, and would also reduce installation time at the end user's site, increase manufacturability, and enhance quality. Because Ventlor had supplied components for a prior system and had experience in the installation of that system, Ventlor's knowledge was needed to create modular products that would be efficient to manufacture with the available machinery. Furthermore, Ventlor's experiences from other industries using the same technology helped it to achieve performance and physical measurement targets.

> *We had prior experience from technology used in various environments. Poweko wanted to use that knowledge that we had and thus participated with us in the product development. We had already delivered related products to Poweko and knew what they wanted, so we were the logical choice for collaboration.*
>
> [CEO, Ventlor]

This finding is consistent with prior studies that highlight the influence of joint sense making in partnering (Henneberg, Naudé, & Mouzas, 2010) and with studies that highlight the supplier involvement benefit of bringing solutions from other industries (Wagner & Hoegl, 2006). Compared to the parties' earlier collaboration, Ventlor had to allocate more resources to product development as it moved from simply commenting on the feasibility of Poweko's design retrospectively to co-developing the product. The change from white-box collaboration

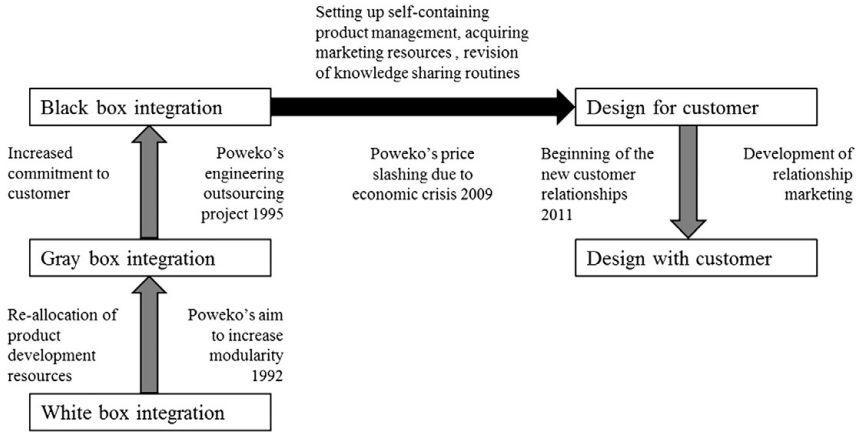

Fig. 2. An illustration of the development of the collaboration, the critical events leading to the change in the type of collaboration and the necessities for change that the supplier faced.

on individual custom-made products to gray-box collaboration on the modular design of products meant that Ventlor was able to plan production on a longer-term basis.

4.1.2. The change from gray-box development collaboration to black-box development

Deliveries continued steadily until Poweko adopted large scale outsourcing of its engineering functions in 1995. Whereas engineering of many of the other subsystems was outsourced to a third-party engineering company, engineering of the product that Ventlor produced was outsourced directly to Ventlor. Poweko felt that Ventlor's employing own engineers would be the most efficient way to continue with development work, and so decided to give more responsibility to the supplier. As Ventlor was willing to invest more in the relationship, it was given full responsibility to develop and produce this subsystem. At the same time, the collaboration type in development changed to one of black-box supplier involvement because the customer's development efforts were limited to communicating end customer needs and setting requirements for performance and measures. In a black-box type collaboration, Poweko needed to divert fewer resources to product development, and Ventlor felt that it could gain a better position as Poweko's supplier by investing more in the relationship.

> *We were willing to take all responsibility for product design when Poweko outsourced the majority of its product development functions to a third-party engineering company in 1995. During that change Poweko saw that we had enough internal product development capabilities and that there was no need for a third-party engineering company in terms of the products that we delivered.*
>
> [CEO, Ventlor]

> *[After Poweko's decision to outsource engineering functions] their role in development was limited to communicating their needs in terms of using the product's environment and performance measures.*
>
> [Chief Engineer, Ventlor]

For Ventlor, the transition from gray-box collaboration to black-box collaboration meant that it was practically on its own in development work terms. Its existing resources in product development eased the transition and the gray-box collaboration with Poweko created a solid basis for broader responsibility in product development. In a black-box collaboration, the supplier has to operate virtually the same process that is required in the independent product development of a company's own product. This process includes idea generation, business and technical assessment, concept development, product engineering and design, prototype build and testing, as well as pilot production and operational ramp-up (Cooper, 1990; Petersen et al., 2005).

The intentional and jointly agreed change to a black-box collaboration was a success. The companies collaborated using this type of supplier involvement for over a decade, and during that time Ventlor's sales to Poweko multiplied. Between 1995 and 2009, Ventlor made dozens of revisions to the product, including significant modifications to the product's manufacturability to develop its competitiveness. Ventlor also developed extended solutions to be used in special environments, such as arctic areas and deserts. Apart from economic profit, growth meant that Ventlor had to invest in its production plant and equipment. Ventlor's physical and intangible relation-specific investments tied the supplier to the customer (Dyer & Singh, 1998), but the customer's investment developed at a slower pace. This imbalance led to great asymmetry in the relationship, which culminated in its next transition period.

4.1.3. The change from black-box supplier involvement in development collaboration to design-for-customer development

In 2008, the economic crisis hit industries all around the world. As Poweko sells industrial investment products, the effect on its order book was tremendous. Its share price dropped by more than 50%. In these circumstances, Poweko tried to push its suppliers hard. In 2009, Poweko announced to Ventlor that the latter had to reduce the price of its supplied product by 30%. Ventlor observed that it was not possible to continue collaboration as it had previously, and after serious internal discussions, it decided to stop deliveries to the customer. Because Ventlor had been responsible for product development for over a decade and had made significant investments in tangible and intangible resources concerning products, it felt as though it had to try somehow to make the product lucrative.

> *Their new purchaser came to our site to negotiate a new deal. First thing that he did was show us our previous year's income statement and state that we are making too much profit. He also required us to cut our price by 30%…We felt that this was unfair, given that only some 20% of our sales and even smaller portion of our profit came from Poweko that year.*
>
> [CEO, Ventlor]

Ventlor believed in the product and made a risky decision to continue development work without Poweko's formal support. It started an internal product development project that aimed to reduce the

product's cost by 30%. The new version was designed for Poweko but Ventlor's plan was clearly to safeguard its IPR to the product to avoid Poweko's misuse of Ventlor's product development effort. Ventlor invited Poweko's purchasers to its site and was ready to demonstrate the new prototype that would bring down the cost by approximately 30%. However, first Poweko's representatives were asked to sign an agreement that would confirm that product rights for the developed solution belonged to Ventlor and that Poweko agreed not to pass on details of Ventlor's redeveloped product to competing suppliers. Although Ventlor estimated that it had met the requirement for a 30% decrease in cost, Poweko's representatives refused to sign a nondisclosure agreement. This refusal increased Ventlor's mistrust in Poweko, and Ventlor decided to quit the development project before finishing it. It was clear that Ventlor would either have to discontinue the product line or start marketing the product to other customers.

We started to develop an alternative design for the product internally, and we believed that with the new design we could cut the cost by approximately 30%. We were willing to discuss our new solution with the customer, but we wanted them to sign an agreement that would confirm that product rights for the developed solution belong to us. They refused to sign and we decided to shelve our plan for the development project.

[CEO, Ventlor]

At the same time as the collaboration with Ventlor was under severe threat, Poweko asked for more active product development from Ventlor, which Ventlor saw as a confusing action.

They [Ventlor] should be more proactive and keen in product development.

[R&D Engineer, Poweko in Ventlor's customer study 2010]

Trust between the companies declined after Poweko's attempt to misuse its power. After collaboration with Ventlor ended, Poweko began using another supplier to make a substitute product. Poweko admitted later to Ventlor that they experienced many problems with the substitute product, especially with delivery times. In 2009, Ventlor found out that Poweko was openly using Ventlor's confidential product pictures to broaden its supplier base.

Because collaboration with Poweko seemed to be impossible, Ventlor decided to search for alternative markets to cover its product investments. During that time, Ventlor had to rely on its knowledge of customer needs in product development. When Ventlor moved to market its own product to a broader market, it decided to revise its policy on information exchange.

Every now and then, we have gotten spare part inquiries including our confidential product pictures from Poweko's end customer. When we decided to continue development on our own, we had to change our policies in communication so that we no longer share detailed product pictures. Since customers still need to have pictures of our products that are integrated in the end product we now send them product pictures without technical details.

[Chief Engineer, Ventlor]

As stated above, the transition from black-box collaboration to a design-for-customer type of development required increased risk taking, revision of knowledge sharing routines and the development of an independent product management practice.

[After starting to market the product to other customers] we started our independent product management. It was practically necessary to move forward from the earlier approach that was set up for Poweko since there are variations in our product depending on the customer.

[Quality Manager, Ventlor]

The transition from a black-box supplier involvement collaboration to a design-for-customer format was the most risky change in collaboration type. Cutting the cord leaves a supplier alone with the product and increases the uncertainties related to competitive markets. Without a customer's commitment to the product, the suppliers' trust in the product becomes the key determinant when it considers investment in development. It also creates a new type of demand on a supplier's marketing activities. On the other hand, safeguarding sales to the original customer has a limited effect on customer attractiveness if volume and profitability are not satisfactory (Lindgreen & Wynstra, 2005). The transition to customer involvement also means that the supplier has to establish a self-sufficient product management system and secure its product rights by revising knowledge sharing routines. The supplier also has to actively investigate customer needs when the collaboration type changes from a supplier involvement to a customer involvement form. Network change theory would label such a change radical, because it involves the emergence of new relationships with new customers and the temporary dissolution of the original relationship (Halinen et al., 1999).

4.1.4. The change from design-for-customer development to design-with-customer collaboration

Ventlor's marketing efforts eventually secured orders from a second customer in 2011, and in 2012, Ventlor received its first order from a third customer and thus continued to grow a business that three years earlier had seemed to be at its end. Furthermore, Poweko started to order Ventlor's product again, bringing hope that the original development collaboration could be restored to health. Before the first delivery for a new customer, Ventlor modified the product according to the second customer's needs. While the primary construction remained unchanged, modifications were made in industrial design to match the new customer's brand. Changes were also made to areas integrated into the customer's main product. Satisfying the second customer's needs required Ventlor to develop its communication capabilities because the second customer had a different culture and was located further away from Ventlor than Poweko was. This design-with-customer type of product development collaboration was now applicable to all three customer relationships.

We have made some changes to the product according to the new customers' needs. Most of the changes have been related to industrial design.

[CEO Ventlor]

Ventlor also developed its resources and practices to facilitate collaboration with new customers.

We have to approach overseas customers [all customers other than Poweko] differently compared to Poweko. We have marketed our product in trade fairs, invited new customers to our site and even hired persons with versatile language skills to make collaboration easier with new customers.

[CEO Ventlor]

In addition to product changes, Ventlor changed to its operations to meet the needs of its new customers.

Ever since we started to market our product to other companies [besides Poweko] we had to adapt to other customers' quality systems. This process included a revision of our own quality system to satisfy their requirements.

[Quality Manager, Ventlor]

The transition from one type of customer involvement to another is less dramatic than the transition from supplier involvement to customer involvement. However, suppliers changing from design-for-customer to design-with-customer have to develop their communication with customers to create a foundation for deeper collaboration. In the studied case, this transition meant that the supplier had to invest in new

communication resources, develop its relationship marketing and adjust its quality management system.

5. Discussion

The purpose of the present study was to extend the existing view of supplier and customer involvement by offering a dynamic model for supplier–customer collaboration. The development of collaboration was explored in a longitudinal dyadic case study. First, in comparison to earlier literature on supplier–customer collaboration types in product development concentrating on either customer-driven collaboration (Petersen et al., 2005) or the supplier-driven form (Kaulio, 1998), the model developed in this study combines both supplier and customer involvement categories of possible collaboration types. Second, although prior research has addressed the evolution of business-to-business relationships in general (Beverland & Lindgreen, 2004), the literature on product development collaboration has predominantly emphasized the supplier selection process (Schiele, 2006) and has not highlighted the possible changes in product development type within the customer–supplier dyad. To address these shortcomings, this study considers the issue of collaboration type in customer–supplier dyads as a relationship strategy that can be adjusted either unilaterally or jointly. Building on the definition by Koufteros et al. (2007) of a supplier involvement type between gray-box and black-box collaboration as a "decision variable that can be manipulated by management action", this study sees collaboration type as a dynamic decision in a wider sense. That is, collaboration type in product development can be assigned to six differing collaboration types derived from prior literature, including both customer and supplier involvement types. The findings of this study have illustrated the changes that prompted the shift between different product development types in the case, confirming that development in terms of changes in product development collaboration type are possible. Having the possibility to change the collaboration type within an established dyad is essential for companies aiming to gain an advantage from a long-term relationship (Holmlund, 2004) instead of building collaboration from scratch when the need for collaboration changes. Fig. 2 provides a summary of collaboration development in the studied dyad, critical events leading to the change between different types of collaboration and the necessities for change supplier faced.

Following Halinen et al.'s (1999) framework, a change in the form of product development collaboration can be incremental or radical. Change is incremental if changes occur in a single relationship, and is radical if the change in question creates new relationships or dissolves old ones. Particularly when the change is radical, the supplier needs to develop new capabilities to facilitate that change. In such cases, strategic level learning and knowledge transfer plays an important role (Sirén, Kohtamäki, & Kuckertz, 2012; Sirén, 2012). In the studied case, changes between different forms of supplier involvement and change between different customer involvement types were incremental, whereas the only radical change between different product development collaboration types was a change from black-box supplier involvement to a design-for-customer involvement. This transition required the supplier to introduce self-containing practices, including applying its marketing resources to support a product line that had previously been sold to a single customer and setting up its own product management, all of which represents strategic level learning.

Critical events drive change in networks (Halinen et al., 1999). The critical event does not change the type of collaboration itself; instead, the collaboration type changes as a result of managerial actions corresponding to the critical events. In our case, changes to supplier involvement tactics were driven by a customer's strategic decisions. The first decision came about owing to the customer's aim to increase modularity and thus involve its customer in the development of the new design, and the second change started with the customer's decision to outsource engineering functions. The trigger for the change from supplier involvement to customer involvement was the customer's strict requirement for an extensive price cut, following which the companies were unable to negotiate a sustainable price level. Interestingly, that change took place after a long period of black-box development in which the supplier worked relatively independently on product development. That relative independence means the black-box product development form could weaken activity links between companies over time, leading to weakened actor bonds. A supplier with an independent and broad product management capability that is suited for black-box collaboration and a weakened connection at a deep structural level, might be more disposed to discontinue deliveries and the customer might be more keen to search for a substitute product. Consequently, the long black-box product development period might cause lead suppliers to look for additional customers for the product if its business goals are not being achieved. In the model developed in this study, this is described as a horizontal transition from supplier involvement to collaboration characterized by customer involvement. In the case of the types of change investigated in this study, the design-for-customer to design-with-customer collaboration type took place after the need for detailed tailoring emerged in a new customer relationship. From the supplier's perspective, all the critical events emerged as a result of external factors.

5.1. Managerial implications

Many small industrial suppliers face dilemmas regarding the best form of collaboration to adopt in the business context of endless price competition. They must assess whether it is better to contribute their specialized manufacturing knowledge to support their lead customer's product development unreservedly, or to release their ideas piecemeal to retain the customer's interest in the longer term. The risk to a supplier of releasing its intellectual property is that its customer can continue to look for the next ideas from competing suppliers, or even worse, apply those ideas with other suppliers without incurring product development costs. Small suppliers typically deliver products or subassemblies that are not a uniquely remarkable source of competitive advantage. When supplier economies of scale are essential, a lead customer might be willing to permit a supplier to sell the product to other customers. In that case, supplier involvement becomes customer involvement. On the other hand, a supplier might be willing to transfer product rights to the customer if the supplier's product offers a remarkable source of competitive advantage for the customer and, for instance, resource issues hinder the supplier from selling the product to other customers. In the situations described above, each party's motivation to collaborate changes, but the process and the collaboration might remain unchanged.

From the supplier point of view, these transitions can be seen as a business model change. By controlling its role in product development collaboration, a supplier can avoid customer opportunism and maintain a sustainable profit margin. From the customer perspective, intentional transitions between types can be seen as strategic choices in supply chain management. Even the transition from supplier involvement to customer involvement can serve a customer because the customer can absorb knowledge from the supplier's other customers or at least gain advantage from developments to which other customers have contributed. A customer can also benefit from such a development because the supplier is more willing to invest in product development when it can benefit more if the product succeeds.

5.2. Limitations and future research

Some limitations in this study's findings must be considered. Concerning the case study, there is a trade-off between the insights gained from the case study's particular circumstances and the generalizability of the results. Ventlor had a strong economic position and deliveries of the product in question represented only approximately 20% of Ventlor's turnover. Taking these preconditions into account, the

findings from this study cannot be directly applied to collaborations in which suppliers are strongly dependent economically on partner customers. In the future, it would be interesting to study quantitatively how common the changes in product development collaboration described in this study are in practice. Furthermore, a multiple case study setting could provide interesting detailed knowledge on the most remarkable change in collaboration, namely the change from supplier involvement to customer involvement. Future research could also shed light on changes in the other direction, those decreasing the supplier's responsibility and moving from customer involvement to supplier involvement by limiting a supplier's sales outside of the dyad. A fourth interesting research topic arising from this study would be a profitability comparison between different collaboration types for both parties and for the relationship. On this subject, there are questions to be addressed about the fit of different collaboration types with a dyad's internal and external environmental factors, such as product complexity, technological uncertainty, cultural and physical distance between companies, or economic atmosphere in an industry.

6. Conclusions

In conclusion, this study has developed a new theoretical framework for understanding product development collaboration between organizations within supply chains that accounts both for levels of involvement and the legal structure of the relationship. This framework illustrates the changes between dyadic product development collaboration types, and as a result suggests that the type of collaboration is dynamic at the level of the dyad and can be adjusted to fit to the changing needs of the participating companies. By showing that it is possible to have changes in the type of collaboration with a given supplier that maintain the cost and other advantages of long-term relationships, the framework developed in this study challenges the presumption implicit in earlier research that changes in circumstances lead to the switching of suppliers. Furthermore, this framework can help organizations operating within supply chains better understand the scope of potential changes in the types of collaboration and some of the costs and benefits involved in such changes.

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Relational development of a service concept: dialogue meets efficiency

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Abstract
Purpose – The purpose of this study is to build a generic model for relational development of a value proposition for a service concept. The study seeks to answer two questions: First, what kind of process is practical for joint development of a service concept in customer–service provider collaboration? Second, what are the functional principles for such collaboration?
Design/methodology/approach – A participative, design science approach was used to develop the model for a joint-development process. Researchers developed and analyzed joint activities between a provider of industrial maintenance service solutions and its customer during the process of co-developing a service concept for factory maintenance.
Findings – The study suggests that a co-development process has to integrate service blueprinting, a stage-gate philosophy, dialogical interaction principles and elements of joint learning to meet the requirement for both efficiency and relationality.
Research limitations/implications – The study develops a generic model for collaborative development of value propositions that integrates the aforementioned elements of separate streams of research. Applying the developed model to different contexts would further verify and enhance it.
Practical implications – The model can be applied to the development of a value proposition in different collaborative development situations to enhance interplay between efficiency and relationality.
Originality/value – The study illustrates a generic model for joint service concept development and proposes a solution balancing contradictory requirements in such a collaboration.

Keywords Value proposition, Design science, Dialogical interaction, Solution co-development

Paper type Research paper

1. Introduction

In the solution business where the customer co-produces value, seamless collaboration and knowledge-based interaction between solution provider and customer is vital. Despite its promising theoretical ideas, approaches driven by service-dominant (S-D) logic (Vargo and Lusch, 2004) face some practical challenges. It is, for example, unclear whether service providers really understand the problems of their customer, and some researchers have even questioned whether customers are capable of adequately expressing their needs (Nordin and Kowalkowski, 2010).

Perhaps, the greatest challenge is posed by the mismatch between sellers' marketing and buyers' purchasing orientations (Hedaa and Ritter, 2005). The major boundary between buyers and sellers thus stems from the two opposing business orientations (transactional vs relational). In addition to the varying practical orientations, there is also a gap between disciplinary approaches to service and solutions development. Specifically, the efficiency management approach originating in industrial management stresses strict differentiation between service providers' and customers' activities in a solution development process (Fließ and Kleinaltenkamp, 2004), whereas the relationship marketing-oriented literature, particularly the new S-D logic, stresses the importance of value co-creation through a relational development process with dialogical interaction.

This article focuses on that contradiction and develops a combined approach that encourages dialogical interaction in a relational solution development process by taking into account the efficiency claims for such a process. With respect to the value proposition as a relational process, we lean on the extant literature (Ballantyne *et al.*, 2011b; Lambert and Enz, 2012; Nordin and Kowalkowski, 2010; Tuli *et al.*, 2007) while adding the efficiency claim (Enz and Lambert, 2012) to the discussion. We aimed to build a framework close to reality on which to develop practices of, and theoretically contribute to, relational dyadic processes within solution sales and purchasing. Our empirical development case illustrates the co-creation of value propositions (Ballantyne *et al.*, 2011a; Lambert and Enz, 2012) in the pre-activity (negotiation and

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development) phase of a full-service maintenance concept. The case illustrates the importance of an open and analytical business negotiation procedure that is intended to share relevant information; ensure there is a common understanding of premises, goals, means and outcomes; and achieve balance between the parties' interests in a dyadic exchange context where uncertainty increases due to the increasing complexity of exchange. The paper ultimately proposes a general model for the generation of a joint value proposition. As an interactive development model, it responds to recent calls to develop models that apply two-way communication between buyers and sellers during the development process (Edvardsson *et al.*, 2012) and, subsequently, make theoretical ideas of S-D logic viable in practice (Ballantyne *et al.*, 2011a; Kowalkowski, 2011; Lambert and Enz, 2012).

The study begins by defining a framework that illustrates how the somewhat opposing principles of efficiency management and relationality have to meet to create a basis for the development of an efficient joint solution. It continues by setting the scene for the focal negotiation process, where the parties sought to strike a deal for a full-service maintenance solution. We then illustrate the model developed for co-development and report the joint discussions between the parties and the decisions made during the negotiation process. The paper concludes by proposing a general model of an effective relational process for co-creating a value proposition.

2. Co-creating value propositions: relationality versus efficiency

To build a framework for solution development as an effective relational process, we fuse certain relevant principles from two distinct research streams: *Efficiency management*, particularly in the form of service blueprinting and "stage-gating" of processes, and *relationship marketing*, particularly the relational behavior embedded in the S-D logic. In so doing, we aim to add the efficiency claim to the relational processes in general, and to the solution co-development processes in particular.

2.1 Relational business behavior and co-creation of value propositions

Macneil's (1983) approach to relational norms as the basis for "relationality" in business relationships has been widely adopted among marketing scholars. Norms are role expectations that fall on the other party and refer to such behavioral dimensions as long-term orientation, role integrity, relational planning, mutuality, solidarity, flexibility, information exchange, conflict resolution, restraint in the use of power and monitoring behavior (Blois, 2002; Ivens, 2004). Literature also refers to various cooperative behaviors (Johnston *et al.*, 2004) or action patterns (Lui and Ngo, 2005) that refer to joint inter-organizational activities, such as joint action (Heide and John, 1990), interactive learning (Ballantyne *et al.*, 2011a), co-creation of value (Grönroos, 2011), joint decision-making (Piercy, 2009), joint problem-solving (Stanko *et al.*, 2007), supplier involvement (Freytag and Ritter, 2005), customer involvement (Nicolajsen and Scupola, 2011) and co-creation of value propositions (Ballantyne *et al.*, 2011a; Enz and Lambert, 2012; Truong *et al.*, 2012). In general, the relational view of strategy seeks collaborative advantage instead of firm-centered competitive advantage (Dyer and Singh, 1998).

The outcome of a service-development process is a value proposition (Edvardsson *et al.*, 2012), and in a relational business context, value propositions are reciprocal promises about future potential value that are jointly crafted and established prior to the creation of value-in-use (Ballantyne *et al.*, 2011a; Grönroos, 2011; Lambert and Enz, 2012). The joint generation of a value proposition has to be interactive, dialogical and process-oriented, and it must be marked by a leaning toward and a readiness to use interactive learning. As a result, reciprocal value propositions may lead to a negotiated, co-created and equitable agreement with longer-term relational consequences (Ballantyne *et al.*, 2011a).

Dialogue and dialogical interaction relate to such value-laden principles as reciprocity, mutuality, involvement and openness (Buber, 1970) or genuine empathetic understanding, unconditional positive regard, presentness, spirit of mutual equality and a supportive psychological climate (Johannesen, 1990). More conventionally, Koschmann *et al.* (2012) define dialogue as "ends-oriented talk that advocates a simplistic openness, urges personal sharing, and gives precedence to consensus and common ground over conflict and argument". Defined this way, dialogue is different from general conversation. To be productive, a dialogue has to have relational properties or as Tsoukas (2009) put it: "a dialogue is more likely to be productive when the modality of relational engagement is adopted by those involved". Thus, dialogue has a dual meaning as it builds the relational atmosphere and it deals with issues from within the generative process. A dialogue typically enables generative mechanisms for intersubjective meaning-making in the interplay of opposing voices (Baxter, 2006; Koschmann *et al.*, 2012). Communication studies have also recognized that endless conversation and premature termination of discussions can actually reduce the productivity of dialogue. The *right* duration of dialogue is, thus, an important principle of dialogical communication. Furthermore, private meanings can be expressed productively if the situation is well structured, thus forming a basis for compromises and for other kinds of observable outcomes (Koschmann *et al.*, 2012).

2.2 Efficiency claims in service co-development

Whereas "relationality", and particularly its dialogical principles, represent an extremely "soft" and people-centric approach in business-to-business marketing and the service business, the principles of efficiency management embedded in many business and organization models clearly represent a more mechanistic stance on cross-company interaction. Scholars emphasize that systematic and structured new service development (NSD) processes are a prerequisite for the development of successful new services (Smith *et al.*, 2007). Here, we refer to two well-known managerial approaches, *the service blueprinting model* and *the "stage-gating" of development processes*, which both are well-established in the literature (for stage-gating see Cooper, 1996, 2008, and for service blueprinting see Shostack, 1984; Fließ and Kleinaltenkamp, 2004). Stage gating was used as an overall framework to control creativity, whereas service blueprinting was used to

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manage customer involvement. The service blueprinting approach, which originates from operations management research, emphasizes the efficiency of service processes. From this point of view, a customer can be enmeshed in the process either too much or too little, and the level of a customer's involvement may be of high or low quality. There is, therefore, a reason to manage the service-development process effectively by defining when, where and how customer participation should occur in the process. Consequently, the service blueprinting approach typically tasks participants to define certain customer contact points in the service-development process. Such points usually relate to defining the customer requirements, presenting and discussing the solution offered and negotiating the price and the contract (Fließ and Kleinaltenkamp, 2004).

Another efficiency-seeking approach to the NSD process is the stage-gate model. While the service blueprint model aims to control customer involvement (among other things), the stage-gate model in its original form aims to control creativity. Originating in the new product development process context (Cooper, 1996), stage-gate models are used to speed the innovation process and reduce costs through tight control. Stage-gate models also aim to encourage the teams involved to identify a common focus. With a common focus and a relatively simple process platform, the parties can develop a shared understanding of the prerequisites of a successful NSD process. The "gates" serve as decision points, structuring the otherwise fuzzy innovation process. Despite their participative nature, stage-gate models do not usually involve customers. Typically, the voice of the customer is heard through the market research and test marketing conducted during the process (Smith *et al.*, 2007).

2.3 Dialogue meets efficiency

For the purposes of our study, the obvious tension between relational (highlighting dialogue) and firm-centric (highlighting efficiency) schools of thought serves as a driving force in both theoretical and practical senses. Despite their different origins, the firm-centric, efficiency-seeking principles and relationality with dialogical ideals come together in the way they seek common understanding through visualization of the relevant issues. In the literature on dialogical communication, visualization refers to the artifacts making it possible to acquire common knowledge and shared understanding. In Figure 1, the relational process for a joint value proposition is framed by two somewhat contradictory principles: one highlighting efficiency and the firm-centric perspective, and the other stressing the importance of relationality and dialogue between the parties. Taking a pragmatic view, we see both views as important to successful networking. The question is how to balance these seemingly contradictory principles. The proposed solution is to use an agreed process to deliver effective joint development. We particularly highlight the importance of timely and thematically bounded conversations that blend the knowledge of the parties involved. In such a role, these co-development arenas hold the features required to fulfill the efficiency claim and the need for productive dialogue.

3. Methodology and data

3.1 Design science for improved theoretical relevance

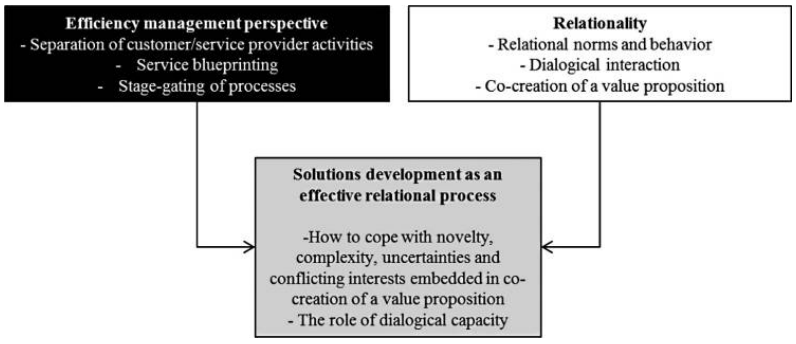
This study follows the principles of *design science* (Simon, 1996). In mainstream descriptive sciences highlighting the *validity* of research, quality is judged by other researchers, whereas in design studies highlighting the *relevance* of research, quality is evaluated against practice (Holmström *et al.*, 2009; Romme, 2003; van Aken, 2005).

Design science must meet certain criteria:

- the results have to be justified in practice;
- the solution has to be grounded in certain theoretical principles; and
- the solution has to be generalizable or transferable into other contexts, not just the context in which it was created (van Aken, 2005).

The justification is usually realized through a participatory research design, where researchers and practitioners develop the solution together. Justification thus links the created artifacts with practitioner needs in real situations. *The theoretical grounding* of solutions connects a design study to the relevant existing knowledge. Theoretical grounding reveals the underlying generative mechanisms anticipated to deliver a certain effect (Romme, 2003). Grounded practical solutions are not merely documented best practices, but theoretically linked constructions entailing a deeper understanding of the premises and mechanisms related to the focal problem. In

Figure 1 Theoretical framework for co-creation of a value proposition as an effective relational process



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design science, a local solution is a design exemplar offering general guidelines on a specific problem, but the solution has to be varied to meet the needs of other contexts, if it were transferred to address other issues (van Aken, 2005).

The outcome of a design study is a solution to a specific problem that offers practitioners a context-specific way to achieve their desired results: in situation *x*, do *y* to achieve *z* (Argyris, 1993; Romme, 2003; Van Aken, 2005). The context and the anticipated outcome are known but the procedure that will most effectively lead to the goal is unknown and must be developed. We viewed the task of developing a new procedure as similar to an ill-defined problem (Banathy, 1996). Neither the representatives of the two firms involved nor the researchers had a clear understanding of the ideal solution to the problem. The researchers did, however, have a preliminary understanding of the premises of relational business behavior, which can be seen as a basis for the *ideal target solution* (Romme, 2003). It is necessary to frame the ill-defined problem to generate useful propositions to advance the problem-solving process, but the ideal target solution was not well defined when discussions began. This is generally the case in design scientific studies, as Banathy (1996, p. 20; italics added) says:

> If solutions could be offered within the existing system, there would be no need to design. Thus designers have to transcend the existing system. Their task is to create a different system or devise a new one. *That is why designers say they can truly define the problem only in light of the solution. The solution informs them as to what the real problem is.*

Actually, "the general model for generating a joint value proposition" (Figure 3) can be considered an ideal target solution applicable to various local situations involving similar problems, and the original stage-gate model developed in the focal case (Figure 2) as a local, context-bound solution to the problem. The latter thus represents the "Procedure Y" and the generalized model is proposed by us to function as an ideal target solution for similar cases.

"Procedure Y" was justified, as it was developed incrementally with the managers involved. This corresponds to alpha testing in design approaches (Romme, 2003; Van Aken, 2005). The collaborative design process involved some trial and error, where researchers developed certain tools that the managers did not consider appropriate. "Procedure Y" was *grounded* on principles from the two theoretical perspectives presented earlier in this paper. These principles should explain why "Procedure Y" is an appropriate practical course of action to achieve the outcomes targeted above.

3.2 Setting the scene: the parties and the task of negotiating a full-service maintenance deal

A research project targeting the practical development of network governance in a variety of networks and business relationships involved the authors in negotiations between a global manufacturer of energy systems (here called MANU) and a service provider of maintenance solutions (here called SERV). The negotiations involved the conditions under which the manufacturer could outsource a major part of its plant maintenance to the service provider. The situation prompted an empirical research project aiming to resolve the practical issues besetting the negotiations while contributing to the existing knowledge on the relational processes of solution co-development.

Maintenance at the manufacturing plant was originally fulfilled by a combination of MANU's own maintenance department and transactional services purchased from up to 40 service providers, including SERV. The practice of buying services from multiple suppliers created relatively high transaction costs for MANU. SERV's business is based on factory automation systems and maintenance services for machinery and equipment, but SERV was interested in developing offerings, bundling system deliveries and maintenance services into a comprehensive customer solution, and had begun to search for ways to establish solution-centered partnerships (Table I).

MANU's representative had explicit and tacit knowledge of the plant's maintenance requirements and of existing practices. Similarly, SERV's representatives possessed explicit and tacit knowledge of various types of maintenance services and the applicability of various specialized manufacturing and maintenance technologies. The roles thus resemble the "reflective practitioner" role defined by Edvardsson *et al.* (2012), as the members of the group positioned their roles as in-context but *ex-situ*.

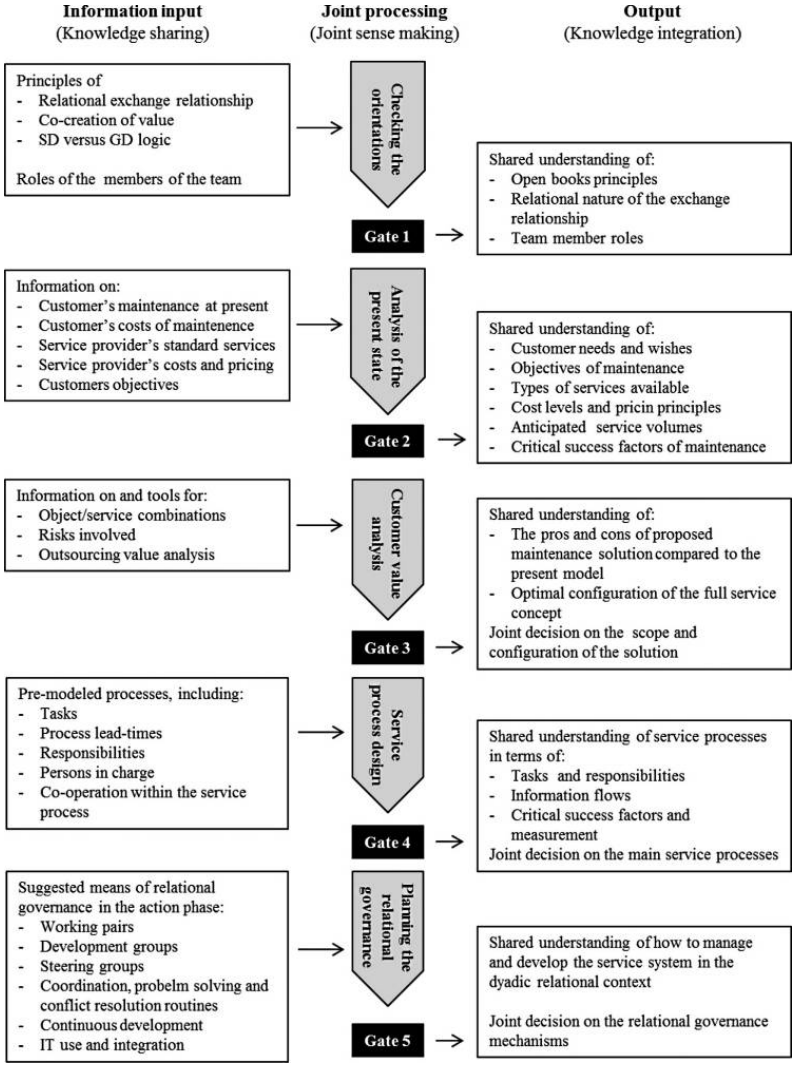
4. Service concept co-development as an effective relational process

It was evident that there was a lack of efficiency-seeking, relational process modeling underpinning the negotiations, so we suggested the parties base the co-development process on a stage-gate model. The recommendation served to underline the principle that a highly interactive, open and dialogical co-creation process need not be inefficient, but could instead promote efficiency in terms of objectives, speed and overall clarity of the process. The logic of the stage-gate model as a relational process (Figure 2) is built on three main elements corresponding to the elements of joint learning (Selnes and Sallis, 2003; Huikkola *et al.*, 2013): information input; joint processing; and output of a shared understanding and/or joint decisions of important issues. Each stage begins with the presentation of relevant information or the presentation of analysis frameworks or other tools to foster analytical discussion. Having the parties engage in analytical discussion should improve their shared understanding of important issues, thus facilitating the relational process. The main idea of the model is to support dialogue while ensuring the collaborative process advances efficiently. The phases of joint processing in the model represent the temporal and thematic arenas where relevant information fuels discussion. A further aim was to control the dialogue by defining a clear set of goals (output) for each arena. Within an arena, there can be one or more sessions (meetings) and several preparatory tasks. The "gating" of the co-development process gives the collaborative activity a form and, therefore, steers the process.

The model consists of five phases:

1. checking the orientations;
2. the present state;
3. analyzing customer value;
4. designing service processes; and
5. planning the relational governance.

Figure 2 Relational process for co-creation of a value proposition (Procedure Y)



The *checking the orientations* discussions, with relevant information input and outcomes, are an important starting point for any relational process and reveal differences in terms of marketing (sales) and sourcing (purchasing) orientations (Hedaa and Ritter, 2005). The process of *analyzing the present state* is also a part of any development process. Here, the relational aspect is highlighted by analyzing the present state of affairs in both firms, and not only in terms of the customer's current practice. The most important discussion in the development process is around *analyzing customer value*, as it contrasts value-in-use with cost of services and the previous activity with the proposed activity. As a result, the parties can reach a shared understanding of the value-generating dynamics of maintenance service in the context of activities and goals set by the customer. The phase labeled *designing service processes* consists of common planning and illustration of service processes using activity flows and examining the resources allocated to the activities. The last phase, *planning the relational* governance, refers to the governance model in the activity phase. Its importance stems from the need to strengthen the relational exchange relationship as a key to continuous development and adaptability of the maintenance service solution package. In the following section, we detail how the phases of the relational stage-gate model were realized in the focal case.

Table I Setting the scene for the negotiation process

	MANU Ltd (the customer)	SERV Ltd (the service provider)
Company information	A subsidiary (a manufacturing plant) of a global actor in the energy industry using approximately 20,000 employees worldwide	A provider of manufacturing systems and maintenance services with 400 direct employees worldwide, mainly in Europe
Prior status of the relationship	The firms had done business with each other for over 15 years, and had developed a high level of trust, but the business between companies had mainly been transactional, including machinery deliveries and various on-demand maintenance services	
Customer's strategic initiative	To outsource and reorganize the plant's maintenance so two-thirds of the maintenance volume would be outsourced (including all the related transactional purchases). The service provider would possibly be the other main maintenance partner in the future	
Service provider's strategic initiative	Following its strategy to bundle machinery and maintenance services to form comprehensive solutions, it agreed to an open-book maintenance deal with a profit target of 8%	
Individuals involved in the negotiation process	The maintenance manager of the plant (the main participant) and his superior, the plant director (informed participant)	Vice-president of solution sales and local unit director (main participants), maintenance manager and a maintenance specialist (informed participants)
Domain-specific knowledge	Principles and goals of the lean manufacturing processes of the plant, explicit and tacit knowledge of the maintenance needs of the machinery and other equipment (target-specific knowledge)	Conceptual and practical knowledge of various modes of maintenance (fault diagnosis and quick correction, repairs, preventive maintenance, retrofit, spare parts, design and reporting services); specialized knowledge of various manufacturing technologies

Phase 1: checking the orientations

When we became involved with the focal case, the parties had already agreed on the main goal (to negotiate an outsourcing deal) and to apply the open-books principle during negotiations to deliver a win-win solution. By applying open-books principles, companies share cost information and are jointly able to identify critical areas to eliminate waste (Romano and Formentini, 2012). Open-books principles have lead to an increase in trust, cooperation and commitment between buyer and supplier (Kulmala, 2004; Agndal and Nilsson, 2008). Upon joining the negotiation process, we first drew on the principles of relational business to emphasize its relational nature. We depicted a relational buyer–seller relationship in the service business. First, we distinguished between the negotiation and activity phases of cooperation and suggested that if the main task deals with the negotiation phase, we should also take the relational nature of the activity phase into account when negotiating the deal. We also suggested a separation of three bundles of issues typically present in business negotiations: commercial issues (e.g. prices, pricing policies, investments and profit-sharing principles); issues of governance (e.g. contracts, including the scope of the deal, responsibilities, penalties and other consequences) and issues dealing with the actual operative service provision aimed at customer value creation. We also suggested that the commercial and governance issues were logically dependent on these customer value and service provision issues, placing them at the heart of the negotiation process. Conversely, in the subsequent activity phase, issues concerning operational activity and its continuous development were dependent on commercial principles and governance structures. In other words, commercial principles had to motivate the parties to continuously develop the services and relationship, and the relational governance structure had to facilitate such cooperative behavior.

The *checking the orientations* discussions led to a more mutual and comprehensive understanding of the issue at hand. In addition, we conveyed the relational nature of business and introduced the parties to the idea of a *learning relationship*. Moreover, it was important to help the parties understand that their common task was to address the value proposition issue, including the maintenance services as such, while accepting its position in the broader context of issues affecting a relational exchange relationship.

Phase 2: analyzing the present state

To prepare the relevant information for use in the second stage of the process, researchers visited both firms to conduct individual discussions with their key managers. The firms' agreement to follow open-books principles meant that we were able to obtain relatively sensitive information, including:

- strategic plans and goals of MANU for outsourcing maintenance;
- organization and management of plant maintenance;
- real costs of maintenance (internal and external costs);
- SERV's cost structure and profitability of maintenance services; and
- SERV's strategic plans for service business development.

This information was then utilized in the second phase of the process to facilitate fact-based negotiation (Lambert, 2008). Previously, MANU had not only assigned maintenance to its own dedicated function, but also bought various maintenance-related services from up to 40 different firms on a transactional basis. MANU had divided its maintenance tasks into three task combinations. The aim was to keep one-third of all maintenance in-house and outsource the remainder to one or two service providers. MANU offered to outsource the maintenance of certain types of objects (clamps and brackets, certain CNC machinery, automation devices, auxiliary devices) and miscellaneous service tasks to SERV. For its part, SERV offered various service solutions, mostly consisting of fault diagnosis and quick correction, repairs, preventive maintenance, retrofit, spare parts, design and

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reporting services. The information provided by both parties led us to design a two-dimensional (2D) table connecting the five objects and eight types of maintenance services that were available. Using this framework, the parties were able to discuss and define the scope of the full-service concept in terms of the relevant object–service-type combinations (e.g. "preventive maintenance for auxiliary devices"). As a result, the parties were able to define the most relevant and critical maintenance objects and types of maintenance that were potentially most valuable for the customer. The firms were soon ready to proceed to the next stage of the proposed stage-gate model in which the value of the new maintenance services was assessed against the maintenance routines then in place.

Phase 3: analyzing customer value

To compare the proposed service package to existing maintenance practices, we developed an analysis tool. The discussions at the previous stage identified two main dimensions important to the comparison. First, regarding the service types, it was evidently necessary to look at their inherent value. Second, as the maintenance objects varied significantly, it was important to look at the risks involved in different types of objects. Combining these two important aspects made it possible to outline a 2D setting with *outsourcing value* and *risk level* as the main dimensions with which to analyze the various maintenance-object–service-type combinations. The outsourcing value dimension was further divided into two sub-dimensions: cost-effectiveness and value-in-use. Cost-effectiveness, again, was expected to be an outcome of the cost level of services and efficiency of the resource usage. Similarly, the risk level dimension was broken down into two sub-dimensions: defect probability and object criticality, which were further sub-divided into the number of objects–malfunction probability and asset value–process criticality. The analysis tool served as a common platform for joint analysis and discussion. It was designed to reveal the underlying value creation mechanisms by contrasting the existing and proposed new way of conducting maintenance activities in terms of costs, efficiency, expertise available, speed, lead times and risks involved. As Gate 3 in the gate model required a shared understanding of the realization of customer value-in-use, the analytical discussion also attempted to ensure that the parties had a common understanding of the relationship between service level and service costs. Thus, the task was to optimize rather than maximize the value generation. Analytical collaborative discussions produced the following findings:

- the direct costs of the work force did not differ significantly for MANU and SERV;
- direct costs of miscellaneous services previously bought on a transactional basis might increase, if SERV became the provider due to repeated profit margins;
- efficiency in the use of the work force would improve in the new model, as it became more flexible;
- availability of expert knowledge would improve in the new model;
- supervision and coordination of the maintenance work force (including external personnel) might be more effective in the new model;
- awareness and management of total maintenance costs would improve; and
- SERV would have to make relationship-specific investments to increase the service level to bring about better customer value-in-use, which would decrease cost flexibility.

The findings above shed light on the real advantages and disadvantages of the proposed arrangement. The open-books principle and the analytical negotiation practice allowed the parties to avoid typical selling and buying roles, leaving them free to address the main problem. As the analytical discussions progressed, it became obvious that the productized services of the service provider had only limited value as such, and the actual basis for service co-development appeared to be the service-object–service-type combinations that were important to the customer. However, the interactive analytical conversations led to a shared understanding of the main value-in-use principles concerning different object–service-type combinations. The parties were also able to decide on the particular services that would comprise the future service configuration in terms of object–service-type combinations.

Phase 4: designing service processes

The negotiation outcomes mentioned above enabled the process to continue to the next stage. To prepare relevant information for the collaborative meeting, we modeled all the important service processes (e.g. "the service process for the CNC machines' preventive maintenance") following the general ideas of service blueprinting (Fließ and Kleinaltenkamp, 2004; Smith *et al.*, 2007). This was done in collaboration with the service provider's key operations personnel. The process descriptions consisted of general process flows, including information flows, actual execution of services, responsibilities of both the customer and the service provider, the definition of the key personnel and important lead times when relevant. This information was then used as a joint platform for discussions to further develop the service processes as needed. The new information gave rise to the following discussions:

- Who has the authority to make important decisions with respect to timing, technical solutions, costs and other important aspects in the course of service actions?
- What are the critical response and lead times for various types of services?
- How might rising fixed costs best be controlled while trying to improve the service level?

The discussions referred to above helped MANU and SERV agree on how different services for different maintenance objects could best be delivered. The resulting solution was detailed enough for the parties to understand how the proposed services would work. By that point, the analytical negotiation process following the stage-gate model had generated a joint understanding and decisions on the whole service package and on how to serve the customer needs through the service processes. The discussions also generated cost information, which made it possible to set preliminary prices for the services. Pricing is, however, different in a relational relationship using the open-books principle than in more transactional negotiations. The point is not to negotiate

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prices as such, but costs resulting from the services tuned up to a certain value-in-use level. The actual commercial wrangling deals with the service provider's profit level being sufficient to motivate it while it continuously develops the services in the particular relationship.

Phase 5: planning the relational governance

The shared understanding reached at the point above would have been enough to conclude a deal. However, as pointed out earlier, the strengths of relational exchanges lie in the collaborative capability to continuously develop the exchange, to enhance collaborative practices, to use effective conflict resolution practices and to learn from mistakes. The service solution should to a certain degree be open to developments that increase the efficiency and effectiveness of the maintenance services. This kind of in-built development mechanism is crucial for all relational-type relationships, because the market mechanism is not as effective in relational contexts as in transactional relationships. For this reason, a collaborative discussion on the relational governance mechanisms would be required to create a context that facilitated relational exchange. In the focal case, we provided the participants with information on various options for governing the relationship. The literature provides precedent for grouping those into legal contracts, relationship structures, inter-organizational IT and process coordination. The collaborative processing of this information produced the following joint observations and preliminary decisions:

1. A legal contract should not prevent the firms implementing relational cooperation if cooperative norms (e.g. win-win thinking, trust, commitment, mutuality, loyalty) are strong enough.
2. However, cooperative norms prevailing in a dyad are usually person-specific and local and are thus never fully reliable, because strategic decision-making often occurs at the upper levels of organizations.
3. It appeared important to establish certain relationship structures:
   - first, at the operative level, it was agreed that the customer's maintenance manager and the service provider's customer account manager would form a working pair that would own the main service processes; and
   - second, it was decided to establish a steering group to manage coordination; the continuous development of services and cooperation; to continuously develop the customer's plant efficiency and effectiveness; and to offer a forum for conflict resolution.

The insights listed above were expected to support the formation of a relational governance structure (an enabling structure) (Kohtamäki *et al.*, 2012). This kind of governance structure was required because of the high risks and uncertainty involved in the outsourcing of maintenance services.

5. Discussion

Our design scientific research process in collaboration with the two firms resulted in a procedure that enabled the parties to analytically negotiate on future cooperation. The focal case was about outsourcing plant maintenance to a service provider as a full-service concept. The practical task was to facilitate the open-books negotiation process of the two firms. From the theoretical point of view, we were interested in how an effective relational process approach of solution co-development would appear in practice. To demonstrate the theoretical and practical value of this paper, we discuss the implications of this study through the three lenses of *justification*, *grounding* and *generalizability*.

5.1 Justifying joint value proposition

The recent theoretical development of S-D logic and its main principles have been challenged on the grounds of its lack of practical relevance (Kowalkowski, 2011; Nordin and Kowalkowski, 2010). Following the broader principles of norm- and behavior-based relationality, including the core idea of dialogical interaction, we attempted to use these principles in a field study and, thus, tried to *justify* them. During the negotiation, it soon became apparent that openness and dialogical conversations do not delay the co-development process. We tried to improve process efficiency by using theoretical principles from the efficiency management perspective. We found ideas emerging from the stage-gating of processes and service process blueprinting to be relevant to the progress of the negotiation. Using these theoretical principles together with elements of joint learning, we could suggest options to the parties that more closely reflected their expectations. This experience-based finding led us to highlight the fact that the relevance of relationality, and particularly that of dialogical interaction, is not unconditional. Dialogue in business and network contexts needs to be framed if it is to be efficient and goal-oriented. In this study, the frames were built using the theoretical principles mentioned above, which we considered would make it possible for the parties to enter into dialogical discussions targeting the joint development of a value proposition.

5.2 Grounding the context-bound solution for joint value proposition

The question of why this particular procedure of collaboration then leads to an efficient relational process is essentially a *grounding* problem. Below, we examine the procedure developed and explain the main theoretical generative mechanisms that should enable the procedure to function as an effective process for generating a joint value proposition.

First, the general structure of the model following the stage-gating idea creates a simple platform for a common process (Smith *et al.*, 2007). As such, it serves as an effective guide clarifying the various phases of the process and the phased objectives for sharing and creating knowledge. Thus, the model as a whole is "plastic enough to adapt to local needs and constraints of the several parties [. . .], yet robust enough to maintain a common identity across sites" (Star, 1989, p. 393). As the stage-gating idea is fairly well known among business managers, it is possible to see it as a general platform capable of forging consensus even from disparate views.

Second, the *checking the orientations* phase of the procedure is needed because of the possible differences of orientations and expectation of the parties in the focal situation (Hedaa and Ritter, 2005). Buyers and sellers might differ in terms of

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business mindset and behavior concerning transactional and relational behavior. To avoid the orientation trap, it is important to deal with the expected relational way of working in the upcoming process. The orientations discussion is also important for building the relational atmosphere and bypassing the traditional buyer/seller roles typically present in inter-firm situations. This principle also manifests itself in the dual meaning of a dialogue: it builds the relational mode for the participants and the resulting benign atmosphere makes it possible to treat the issues at hand dialogically (Tsoukas, 2009).

Third, the *analysis of the present state* is important as it facilitates fact-based negotiations (Enz and Lambert, 2012). This stage is highly significant when firms share classified information. When facts are on the table, there is no need for the parties to play the "selling/purchasing" game with hidden agendas: instead, they can enter into a dialogical discussion embracing the needs of both parties and targeting a win-win situation and collaborative advantage. For example, unrealistic customer wishes are exposed by cost information. In that way, open, fact-based information fuels dialogue, which becomes effective because the content of the conversation is meaningful (Koschmann *et al.*, 2012).

A key task in a relational business-to-business relationship is the *joint definition of customer value*. In practice, the co-development of a value proposition consists of contradictory aims, because the service provider naturally has its own business goals, too. Dialogue is essential to counter firm-specific needs and wishes and helps present the forthcoming value proposition as an optimal negotiated outcome, making this aspect of the generation of the value proposition the most crucial. We constructed an analysis tool that helped the parties immerse themselves in a joint analysis. It contrasted the customer's previous factory maintenance practice and the new way proposed by the service provider through a framework that prompted analytical discussion. The tool helped shape conversations so they became meaningful, thus, enhancing dialogical communication (Koschmann *et al.*, 2012). The analysis framework also enabled effective use of the open factual information the parties had shared.

The next phase (*designing the service concept*) followed the main principles of service blueprinting as the identified object–service-type combinations were mapped and visualized as service processes (Smith *et al.*, 2007). Visualized process maps enable the parties to focus on a joint issue effectively and discuss the issue analytically.

The relational business logic differs from transactional logic in the way it improves value generation. Where transactional logic relies on market mechanisms, relational logic highlights continuous improvement and learning within enduring business relationships. For that reason, the model was amended by the addition of *planning the relational governance* as the last phase. That phase should highlight the continuity and relational value-generating logic of the business the parties aim to enter into. The discussions in this arena were intended to define the cooperative behaviors and relational structures most important to establishing a learning business relationship.

5.3 From a local solution to a general model

This study showcases a local, context-bound solution for a negotiation process to facilitate the generation of a joint value proposition between an industrial customer and its service provider. Following the guidelines to evaluate design scientific studies, the developed model should be seen as *a design exemplar* (van Aken, 2005). As shown above, the model justifies and strengthens the relevance of the theoretical ideas on relational business behavior in general and joint value propositions in particular. We also illustrated the theoretical grounding of the local solution.

The sections that follow are intended to develop a theoretical model representing an *ideal target solution* for problem situations similar to the focal case. To begin with, we had to look at the local solution developed, so as to evaluate which of its elements were purely context-bound and which were more general. For the purposes of analysis, we approached the procedure developed from three separate angles: the procedure as a whole (e.g. the stage-gating idea of splitting-up the process into dialogical arenas each with a role in a goal-oriented negotiation process); the phases as such; and the analytical tools developed to facilitate dialogue within each arena. We argue that the most context-bound parts of the solution are the tools as such, as they were developed to cope with the emergent situational needs. However, the tool-level solutions also demonstrate more general principles of creating effective collaborative practices. Considering the phases defined in the solution, we argue that they are not context-bound at all. The phases can be seen to reflect an overall decision-making process with problem definition, data gathering, analysis, generation of possible solutions and choice. Each phase is also grounded in existing theoretical principles drawn from efficiency management and relational business behavior. With regard to the generalizability of the procedure as a whole, we see it as completely generalizable. The application of the stage-gating model gives the negotiation process a form, which both vertically (through the phases) and horizontally (phase-wise) forms a goal-oriented cooperative decision-making process. Each of the arenas are considered decision-making points, involving data gathering, analysis, generation of alternative solutions and finally, decision-making. Building on the above assessment of the generalizability of the local solution developed in this study, we propose the following model for the generation of a joint value proposition.

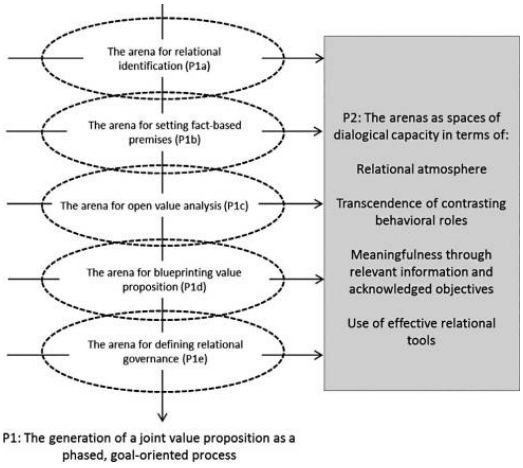
The proposed model (Figure 3) is explicated through the following propositions:

P1. To generate a joint value proposition, partners should follow a goal-oriented, phased negotiation procedure with certain successive and related arenas for discussions.

This principle follows the main idea of stage-gating processes to achieve efficiency, particularly in "fuzzy" situations. Here, the fuzziness is essentially due to the unclear practical content of the concept "joint value proposition" and the attempt to achieve dialogue in the negotiations between the parties.

P1a. *The arena for relational identification* is necessary to ensure similar business orientations between the

Figure 3 General model for generating joint value propositions



parties; to dissipate the constraining firm-centered roles of the participants; and to formulate premises supporting a relational atmosphere and dialogical interaction.

P1b. *The arena for setting the fact-based premises* is necessary to dispel the secretive atmosphere involving concealing information for the purpose of reinforcing firm-specific positions. Open information sharing also fosters meaningful discussion.

P1c. *The arena for open value analysis* is necessary as it openly contrasts the customer's wishes and the realities of the potential for value generation.

P1d. *The arena for blueprinting the value proposition* is needed to visualize and concretize the value proposition in the form of a service blueprint, including the service processes, the responsibilities of the parties and the key performance indicators of the service solution.

P1e. *The arena for defining the relational governance* is needed because the nature of relational business relationships requires inter-organizational learning and continuous improvement at the dyadic and network levels of action.

We expect all these phases to be prerequisites of a comprehensive process for generating a joint value proposition. If any of the phases is omitted, the process does not function completely as a relational process.

P2. The arenas are timely and thematically bounded conversations possessing *dialogical capacity*; each arena consists of information input, dialogical discussion and an outcome in the form of documented joint decisions or shared understanding.

As knowledge-creating platforms, arenas help participants transcend the limitations of their perspectives. In inter-organizational settings, those limitations refer particularly to the buyer/seller role models usually observed in dyadic interaction, although the overall atmosphere is important too. However, it is not possible to build a trusting relationship from scratch in an *ad hoc* negotiation process. The dialogical interaction instead tries to capitalize on the prevailing state of social capital in a relationship by making it an issue. The arenas become meaningful spaces for dialogue, when relevant information is fed in, conversations are long enough and the expected outcome of the discussion is clearly stated. The premature termination of a dialogue must be avoided, but an endless dialogue is not ideal either (Koschmann *et al.*, 2012). Furthermore, in the local solution reported in this study, we used various tools (slide-sets, analysis tools, process maps) to build a common focus and to enhance common understanding and dialogue. These were important to enable knowledge sharing and creation within the relational core group developing the service solution.

5.4 Practical implications

Scholars of business-to-business marketing and network management have called for managerial frameworks to assist practitioners to optimize the value creation potential of the interactions within a business relationship (Enz and Lambert, 2012). The present study underlines the importance of dialogical interaction between the buyer and seller in an emerging community of interest. It emphasizes not only dialogical principles, but also the importance of effective modes of action. Binding these two, partly contradictory, aims together enables the formulation of a negotiation procedure and a general model highlighting certain ideas central to effective inter-organizational dialogue. For practical purposes, the general model should be understood as a general reference model that guides the development of local context-bound solutions to various issues. In our case, the inter-organizational negotiation process was facilitated by researchers. This is rarely the case in real-life situations where practitioners have to cope with ill-defined problems alone. We consider the practical change from transactional to relational business behavior as an area full of ill-defined problems due to the profound shift needed in managerial thinking. The pragmatic approach of this article offers guidance on the practical development of meaningful networked business.

5.5 Limitations and future research suggestions

As in any study based on an individual case, the generalizability of the results is limited. Despite this limitation, we posit that certain theoretical principles are more general than case-specific (cf. the propositions above) and, therefore, possess theoretical value). Furthermore, in this study, we integrated service blueprinting, stage-gating and dialogical interaction to build an efficient model for relational solution development; however, we were not able to integrate other promising theoretical ideas to our model. Future research could analyze similar relational processes from strategic learning (Crossan *et al.*, 1999; Sirén, 2012; Sirén *et al.*, 2012) and boundary spanning (Carlile, 2002; Levina and Vaast, 2005) perspectives. Additionally, the design science approach we applied in this case is relatively new to marketing. Nevertheless, as it allowed us to emphasize the practical

relevance of the research, we highly encourage future studies to consider using this approach, as it is a viable alternative to other methods when researching relational practices.

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Joint learning in R&D collaborations and the facilitating relational practices

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ABSTRACT

The present study considers joint learning as a relational dynamic capability and examines the role of relational practices as enablers of joint learning in R&D collaboration between suppliers and their customers. The study applies a qualitative comparative case method to analyze seven dyadic cases, selected based on a quantitative dataset and cluster analysis. Our results indicate that in dyadic relationships, firms would benefit from developing practices related to relational investments, relational structures, and relational capital that facilitate joint learning and yield collaborative advantages from R&D interactions. This paper contributes to the existing literature on joint learning in R&D collaborations by defining joint learning as a relational dynamic capability and by focusing on the practices that facilitate it in R&D collaboration.

1. Introduction

Business relationships and relational exchanges have received considerable attention in the relationship marketing and business network literature (Ford, 2011; Håkansson & Ford, 2002; Henneberg, Naudé, & Mouzas, 2010). Existing studies have considered the antecedents, mechanisms, and outcomes of relational product exchanges (Palmatier, Dant, Grewal, & Evans, 2006) using causal modeling techniques. In addition to product exchanges, the existing interorganizational network research has analyzed research and development (R&D) collaborations between firms and universities (Un, Cuervo-Cazurra, & Asakawa, 2010), supplier involvement in customers' product development (Johnsen, 2009; Song & Di Benedetto, 2008), and, to a lesser extent, customer involvement in manufacturing companies (Campbell & Cooper, 1999; Ritter & Walter, 2003). The existing literature emphasizes the importance of customer interactions in the development of industrial products (Von Hippel, 1978; Wren, Souder, & Berkowitz, 2000), services (de Brentani, 1995) and integrated solutions (Windahl & Lakemond, 2006). For instance, Alam (2006, p. 468) notes that "a firm can benefit substantially by optimizing and improving the fuzzy front-end of an innovation process" and that "customer interaction is very useful in the front-end stages of an innovation process." Li, Eden, Hitt, Ireland, and Garrett (2012, p. 1193) add that "it is important for partner firms to exchange information, share knowledge, and make relationship-specific investments in order to realize the alliance's potential for joint value creation. R&D alliances are therefore designed to encourage intended knowledge sharing."

Nevertheless, the existing research falls short in its analysis of the relational practices in dyadic R&D collaborations in supplier–customer relationships. Relatively little attention has been paid to R&D collaborations between suppliers and customers, which is surprising considering the value creation potential of such R&D collaborations, especially in the development of complex solutions (Alam, 2006; Bonner, 2005). Moreover, the existing R&D collaboration literature, which has been mainly quantitative, provides minimal information about the activities and mechanisms behind joint learning that occur through R&D interactions between suppliers and their customers. Indeed, Davis and Eisenhardt (2011, p. 160–161) state that R&D (innovation) collaboration "research strikingly neglects the collaborative process. Yet as a handful of process studies indicate, the interactions between partners in intensely participative alliances such as technology collaborations seem likely to influence performance." In addition, many studies view alliance capability as a firm-level phenomenon (Kale, Dyer, & Singh, 2002; Walter, Auer, & Ritter, 2006), whereas relatively little research can be found on relational capabilities in which such capabilities are viewed as relational-level phenomena (Kohtamäki, Partanen, & Möller, 2013; Mitrega, Forkmann, Ramos, & Henneberg, 2012). Kale and Singh (2007, p. 996) call for studies on practices that firms deploy in business relationships, suggesting that "a firm's alliance learning process leads to greater overall alliance success by presumably improving its first-order alliance management skills… Scholars could attempt to do that either through case-based research or by collecting detailed data on these practices for a small subset of

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firms and their alliances." In summary, the network literature suffers from the lack of relational case-based research on the practices that facilitate joint learning in R&D collaborations between suppliers and their customers.

The present study is designed to fill this gap through an examination of the relational practices that enable joint learning in R&D collaborations between suppliers and their customers. Specifically, we ask the following research question: *How do suppliers and their customers facilitate joint learning in R&D collaborations*? We apply the concept of joint learning to an examination of the relational learning process, where joint learning is defined as a relational dynamic capability. We utilize the concept of relational dynamic capability to build on the dynamic capability view, according to which "dynamic capability refers to the capacity of an organization to purposefully create, extend, or modify its resources or skills" (Helfat, 2007; Kale & Singh, 2007, p. 982). Joint learning, as a relational dynamic capability, is critical for the renewal that takes place in the relationship between the parties. In relationships with high information asymmetries, knowledge sharing, joint sense-making, and knowledge integration are needed to continuously renew and reconfigure resources. Moreover, practices related to relational investments, relational structures, and relational capital are needed to enable joint learning (Chang & Gotcher, 2007; Kohtamäki, Vesalainen, Henneberg, Naude, & Ventresca, 2012). We omit generalizable causal considerations, leaving them for quantitative studies. We also distinguish this study from the deductive approach, make only a brief theoretical synthesis of the existing research, focus particularly on those empirical practices that are found in the relational case studies, and note how the observed practices reflect the existing theory (Eisenhardt, 1989). Our case-based relational data are particularly well suited to this task because the cases were selected systematically from a quantitative dataset of manufacturer–customer relationships by clustering the relational cases in terms of the extent of the R&D services and joint learning involved in the relationships. Our cases were selected from the cluster where both R&D services and joint learning were most extensive.

2. Theoretical background

Building on the perspective of evolutionary economics (Nelson & Winter, 1982) and organizational dynamic capability (Teece, 2007; Zollo & Winter, 2002), the relational view considers interorganizational relationships as sources of innovation, learning and renewal (Corsaro, Cantù, & Tunisini, 2012; Jiang, Henneberg, & Naudé, 2011; Kale & Singh, 2007; Ritter, 1999) for both suppliers and customers (Helander & Möller, 2007; Kale & Singh, 2009; Madhok & Tallman, 1998). Typically, studies of alliance capability take the firm as the unit of analysis, neglecting inter-firm relationships. For instance, studies view alliance learning capability as a firm-level dynamic capability that enables learning from alliances—a definition that approaches absorptive capacity (Dushnitsky & Lenox, 2005; Kale & Singh, 2007, 2009). We define joint learning as a relational dynamic capability that takes place at the level of R&D collaboration and is facilitated by such practices as relational investments, relational structures, and relational capital (Heimeriks, Duysters, & Vanhaverbeke, 2007; Kohtamäki et al., 2012).

This study analyzes joint learning and the facilitating relational practices in R&D collaboration and adopts the supplier–customer relationship as its unit of analysis. Specifically, R&D collaboration refers to complex services offered and exchanged, such as product design, feasibility studies, usability analyses, prototype development and testing, manufacturability analyses, and product customization (Bettencourt, Ostrom, Brown, & Roundtree, 2002; Kohtamäki et al., 2013). These services involve vast knowledge asymmetries that generate high transaction costs (Baldwin, 2007; Rindfleisch & Heide, 1997; Stump, Athaide, & Joshi, 2002). In particular, effective R&D collaboration requires an exchange of tacit knowledge in which joint learning becomes critical. For instance, Martinez-Noya, Garcia-Canal, and Guillen (2013, p. 24) highlight that "the way partners manage the collective learning process plays a key role in the success or failure of strategic alliances, as the opportunistic learning strategies followed by partners may undercut the collective knowledge development in the alliance." Prior studies caution about the effects of opportunism, competition, and hostages in R&D collaboration (Adler, 2001; Katila, Rosenberger, & Eisenhardt, 2008) and emphasize the roles of in-depth interaction (Grönroos & Voima, 2012), dialog (Ballantyne, Williams, & Aitken, 2011) and learning (Chang & Gotcher, 2007), where such activities may be related to product, service, or solution development (Shankar, Berry, & Dotzel, 2009). In the present study, we focus on practices that facilitate joint learning because that is the critical element in R&D interactions that involve exchange of tacit experimental knowledge that is difficult to share, make sense of, and implement.

2.1. Joint learning

This study draws on the extensive organizational learning literature (Crossan, Lane, & White, 1999; Kandemir & Hult, 2005; Kuwada, 1998; Sirén, Kohtamäki, & Kuckertz, 2012) in which organizational learning is viewed as a dynamic capability (Kale & Singh, 2009). We build on the work of Selnes and Sallis (2003, p. 80), who define joint learning as a joint activity between the supplier and customer, where the parties 1) share knowledge, 2) jointly make sense of that knowledge, and 3) integrate that knowledge into relational memory. We consider joint learning to be a relational dynamic capability that yields collaborative advantages for both of the parties.

Knowledge sharing refers to the transfer of knowledge through informal and formal interactions between the supplier and customer (Chang & Gotcher, 2007; Selnes & Sallis, 2003; Sluyts, Matthyssens, Martens, & Streukens, 2011). Interaction has been viewed as "an important means of gaining and transferring new knowledge, gathering relevant information about new businesses, and finding external support and services" (Corsaro et al., 2012, p. 780). An open atmosphere is a central factor in the sharing of tacit R&D knowledge (Garvin, 1993; Kohtamäki & Bourlakis, 2012; Nahapiet & Ghoshal, 1998).

Joint sense-making highlights the importance of seeking a shared understanding, building consensus between the parties, and finding an appropriate fit between the customer's expectations and the supplier's capabilities (Chang & Gotcher, 2007; Crossan et al., 1999; Kuwada, 1998). Sense-making is the social process of searching for a common understanding (Narayanan, Zane, & Kemmerer, 2011; Weick, 1995) and is particularly difficult in a relational context, where physical, psychological, and cultural distances between actors are often greater than in intra-organizational contexts. Appropriate interaction platforms are needed to reduce the cognitive distance between parties (Fang, Fang, Chou, Yang, & Tsai, 2011; Henneberg et al., 2010).

Knowledge integration into relationship-specific memory involves the establishment of knowledge in relational structures, working procedures, routines, products, or services, all of which are relatively independent of individuals' actions (Johnson, Sohi, & Grewal, 2004; Lukas, Hult, & Ferrell, 1996; Moorman & Miner, 1997). Prior studies refer to this phase as knowledge implementation or institutionalization (Crossan et al., 1999; Kuwada, 1998; Sirén, 2012). During this phase, created, shared, and combined knowledge is transferred from individuals to become an organization or relationship-specific property (Lukas et al., 1996; Moorman & Miner, 1997). Moreover, Song and Di Benedetto (2008; see also Petersen, Handfield, & Ragatz, 2003, 2005) find that supplier involvement in product development improves new product performance. The role of relationship-specific memory in relationships is critical because the relational actors inevitably change, affecting the relationship's continuity (Fang et al., 2011). Thus, the existing research underlines the importance of joint learning dimensions, such as knowledge sharing, joint sense-making, and relationship-specific memory in complex business networks. Additionally, relational investments,

relational structures, and relational capital are required to facilitate joint learning (Kohtamäki et al., 2012).

2.2. Relational investments

The role of relationship-specific investments has been emphasized by several authors (Dyer & Singh, 1998; Madhok & Tallman, 1998; Yu, Liao, & Lin, 2006). The effects of relationship-specific investments on joint planning activities (Claro, Hagelaar, & Omta, 2003), joint learning (Chang & Gotcher, 2007), trust (Suh & Kwon, 2006), transaction costs (Rindfleisch & Heide, 1997; Williamson, 1985), and economic performance (Jap, 1999; Kohtamäki et al., 2012) have been recognized. However, as most prior studies have examined relational investments from the perspective of transaction cost economics, consideration has been limited to relationship-specific investments and specifically to safeguarding mechanisms applied to the supplier–customer relationship. Thus, the role of relational investments as a source of learning and innovation has been neglected (Chang & Gotcher, 2007).

2.3. Relational structures

Relational structures refer to the systematic practices and work routines shared by supplier and customer (Adler, 2001; Kohtamäki et al., 2012). We build on those organizational studies that have considered the Janus-faced role of organizational structures as coercive or enabling (Adler & Borys, 1996; Hallett & Ventresca, 2009), and we concentrate on those relational structures that enable in-depth R&D collaboration between a supplier and customer. Existing studies on R&D collaborations, customer involvement, supplier involvement, and supplier–customer relationships provide many examples of structural practices in R&D relationships. Studies identify central practices, such as 1) supplier participation in new product development teams (Ragatz, Handfield, & Scannell, 1997), 2) management control, incentive structures and mutual dependency on relational learning (Farrell, Oczkowski, & Kharabsheh, 2011; Storey & Kocabasoglu-Hillmer, 2013; Wathne & Heide, 2004), 3) relational steering groups (Kohtamäki et al., 2012), 4) network learning teams (Dyer & Hatch, 2004; Hines, Holweg, & Rich, 2004), 5) training conducted jointly by the supplier and customer (Petersen et al., 2003; Ragatz et al., 1997), 6) relational process descriptions (Bonner, 2005), and 7) equity ownership (Dyer, 1997; Gulati, 1995; Ragatz et al., 1997).

2.4. Relational capital

The literature on interorganizational networks underlines the roles of social relationships, trust, and interactions between suppliers and customers. Classic papers on social embeddedness have suggested that all economic exchanges are embedded in social interactions (Granovetter, 1985; Uzzi, 1997). It has also been argued that social capital is a broad umbrella concept encapsulating various social phenomena, for which the concept has also been criticized (e.g. Adler & Kwon, 2002). Moreover, interorganizational relationship literature has used the concept of relational capital to assess the level of social capital in exchange relationships (Chang & Gotcher, 2007). Consequently, we decided to define relational capital, in the context of R&D collaboration, as a combination of relational trust, relational structures, and relational interaction (Kohtamäki et al., 2013; Krause, Handfield, & Tyler, 2007). Relational capital has been suggested to play a particularly important role in joint learning, relational innovation, and intellectual capital (Chang & Gotcher, 2007; Muthusamy & White, 2005), while creating a safe space for open relational interaction that enables knowledge sharing, joint sense-making, and the integration of knowledge into relationship-specific memory.

3. Data and methodology

This paper relies on a multiple case study approach based on an analysis of seven dyadic R&D collaborations. Considering the complexity of evolving relationships and interactions in business networks, the multiple case study approach allows for the collection of in-depth information through interviews and provides evidence of the practices that companies follow in such relationships (Beverland & Lindgreen, 2010; Dubois & Araujo, 2007).

We decided to study multiple cases to a) establish an area of focus, b) obtain an in-depth view of each relationship, and c) achieve data saturation. To increase the study's reliability, we applied a data triangulation technique (e.g., Beverland & Lindgreen, 2010; Huberman & Miles, 1994) that involved collecting information from firms' websites and annual reports both before and after interviewing the supplier and customer, first by phone and then in face-to-face interviews. This procedure follows the approach suggested by Brennan and Turnbull (1999), who call for relational studies that involve interviewees from both sides of the relationship to validate the analysis.

3.1. Case-selection and sample

The dyadic relationships were selected based on a quantitative dataset collected in Finland in 2010. Selecting cases from a quantitative dataset through cluster analysis has been described as an "innovative practice" (Piekkari, Plakoyiannaki, & Welch, 2010, p. 114). First, the quantitative data were collected using a survey that had been sent to Finnish manufacturers employing 20 or more people. In total, 91 of the 404 firms targeted responded, corresponding to a satisfactory response rate of 22.5%. To identify interesting extreme cases, we applied k-means clustering with two validated average variables: 1) the breadth of the R&D services and 2) the extent of joint learning in the relationships.

Based on the k-means cluster analysis, we identified 22 relationships where both the R&D service offering and joint learning were remarkably high. From this group, we chose the seven relationships exhibiting the highest values in terms of R&D services and relational learning. The number of relational cases investigated also accords with Eisenhardt's (1989, p. 545) proposal regarding an appropriate number of cases. Fig. 1 describes the three clusters derived from the k-means cluster analysis of the 91 relational cases. The cluster on the upper right describes the 22 cases from which we chose the seven cases that scored highest in both dimensions for in-depth analysis. The cases on the upper left represent high joint learning but only with few R&D services provided, and the cases in the lower left corner exhibit few R&D service offerings and low joint learning.

3.2. Pilot study

We conducted a pilot study to familiarize ourselves with the method and gain insight from the relational dynamic capability viewpoint in R&D collaboration. The pilot study allowed us to test, develop, and validate our semi-structured interview template. Furthermore, it increased our understanding of the topic, the appropriateness of the planned data analysis procedures and assisted us to improve the interview template (Yin, 1994). At this stage, we interviewed the senior executives responsible for the development of the supplier–customer relationship. Based on the collected data, we produced a within-case table representing relational information on 1) the scope of R&D services in the relationship, 2) the type of R&D cooperation undertaken (white/gray/black box), 3) the interdependency between the partners (evaluated partner switching-time), 4) relational investments, 5) relational structures,

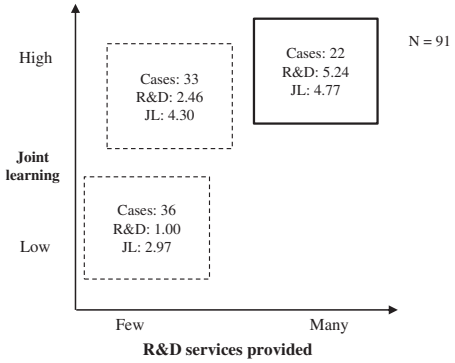

Fig. 1. The three clusters found from analysis of the quantitative data; the seven cases selected originated from the upper-right cluster.

6) relational capital between the parties, 7) joint-learning practices, and 8) the relationship's contribution to new product development.

3.3. Data collection process

Interviewees were selected based on the respondent's knowledge of and responsibility for the relationship; our respondents held such positions as Area Manager, Key Account Manager, Sales and Marketing Director, Business Manager and CEO. The face-to-face interviews lasted from 60 to 90 min and all interviews were recorded with permission and transcribed verbatim shortly after each interview took place. The interviews were conducted by two researchers, and the researchers applied equivalent semi-structured interview templates to encourage open and detailed discussion of the topics covered. In summary, we conducted 26 interviews, comprising 13 telephone interviews and 13 face-to-face interviews, with key decision makers from both sides of the relationships.

The interview data collection started with a phone call to the firms' respondents to establish convenient times for the telephone and face-to-face interviews. The aim of the telephone interview was to collect general information on the products and R&D services provided within the relationships and on how the relationships had evolved. Phone interviews prepared respondents for the face-to-face interviews to be conducted at the firms' headquarters. Once the interview was concluded, the two researchers discussed their initial feelings about the basic issues raised and made notes that later provided additional material when the transcribed interviews were analyzed. To protect interviewees' confidentiality, the quotations in this article are identified only by the interviewee's position and the firm type. However, in the case of relationship G we were unable to interview the customer because the supplier's policy prohibited revealing customer contact information.

The interviews focused on R&D services, relational practices, and capabilities within the identified dyadic relationships. The interview content was interpretative in nature, as the interviewees held their own views about the relational history, applied practices, and capabilities of each company. All the interviewees held senior positions and so had specific knowledge of the relationship. Additionally, their interpretations may have been influenced by their previous working history or their personal views about the relationship, making the data interpretative in nature. However, these issues were controlled for and discussed during the interview. Given the potential biases, the suppliers' responses were compared with those of their customers and vice versa to enhance the study's reliability.

Table 1 describes the selected cases and the characteristics of the collaboration. The extended-case method was used to apply the theory of relational dynamic capabilities because the method involves many cycles of data and theory, forcing researchers to collect complementary data and imagine alternative concepts because the data analysis and examination of the literature are conducted simultaneously (Eisenhardt, 1989).

3.4. Data analysis

When analyzing the literature and transcripts, we repeatedly compared the collected empirical data with the literature on relational/dynamic capabilities, joint learning, and R&D collaboration. To clarify and organize the data, we took notes, held several rounds of discussion regarding the cases, and compared data from different cases to establish similarities and differences. We then started analyzing the data, proceeding from a descriptive to an explanatory analysis and from the more concrete to the more abstract (Huberman & Miles, 1994).

We draw from Huberman and Miles (1994, p. 432), who present guidelines on how to generate meaning from data. To analyze the data and to discern and structure substantive issues in terms of relational dynamic capabilities, we began by discussing each case separately and then trying to find patterns across different cases. We used NVivo 9 software to compare the cases by listing and categorizing all the practices that the firms employed in the analyzed relationships. We documented the distinct resources/capabilities that firms possessed within the relationship and coded the interviews under the sub-themes of relational investments, relational structures, relational capital, and joint learning. This effort culminated in the production of a within-case table constructed based on the categories of relational investments, relational structures, and relational capital and the dimensions of joint learning. Then, cross-case analyses were conducted by categorizing substantive issues in terms of how relational investments, relational structures, and relational capital facilitated joint learning.

To avoid misinterpretation of the data, the researchers thoroughly read all the transcripts several times, cross-checked each other's independent interpretations in both within-case and cross-case analyses and compared their interpretations with those of others on the team, highlighting possible topics that were not covered in the first analysis (Eisenhardt, 1989). We verified our results with data triangulation by application of various data sources, such as interviews, annual reports and websites, and data auditing technique (Huberman & Miles, 1994) that involved two researchers reading the transcripts thoroughly and reviewing the researchers' interpretations against the data for accuracy and representativeness. Eventually, the results were sent to the interviewees via e-mail for further comments and to validate the analyses.

4. Results

4.1. Relational case description and within-case analyses

Relationship A was established when a customer divested its operations into a separate firm. The supplier supports the customer in its strategic activities by customizing products and branding them at the customer's request. The supplier has also established spare part centers in proximity to the customer's international facilities to achieve optimal service levels. Interestingly, the owners of the supplier hold a large number of shares of the customer company and managers from both sides share strategic information and seek out business opportunities to place the supplier's products with the customer's other business units.

Relationship B concentrates on the exchange and development of a product that is critical to the customer. The firms belong to the same group of companies and most of the supplier's revenues are derived from the particular customer relationship examined. The customer's divisional manager is also the CEO of the supplier. The customer actively influences the development of the supplier by working with the

Table 1
Description of relational cases.

a)

	Pilot study		Relationship A		Relationship B		Relationship C	
	Pilot customer	Pilot supplier	Customer A	Supplier A	Customer B	Supplier B	Customer C	Supplier C
Total revenue	€1000 million	€20 million	€1300 million	€15 million	€300 million	€12 million	€100 million	€7 million
Number of employees	800	20	3000	100	1000	30	200	15
Main products/ services	Plants and delivered turnkey projects.	Metal components.	Product machines and turnkey technological solutions.	Industrial valves, pumps, and services.	Pipe systems and delivered turnkey technological solutions.	Specific technology products and subcontracting. Modernization and maintenance services for installed base.	Material–handling systems.	Metal components for material-handling systems.
R&D services provided in the particular relationship	Product tailoring, product design services, and building prototypes.		Product tailoring, product development, prototyping, and testing services.		Product tailoring, product development, prototypes (to some extent), and modernization.		Product tailoring, consultation in product configuration, product development, prototyping, technical testing of materials, and inspections during the lifetime of the product.	
Type of R&D collaboration	White box/gray box.		Gray box/black box.		Gray box/black box.		Gray box.	
Partner's evaluated switching time	< 3 months.	24–36 months.	6–12 months.	24–48 months.	1–3 months.	36–48 months.	2–4 months.	36–48 months.

b)

	Relationship D		Relationship E		Relationship F		Relationship G	
	Customer D	Supplier D	Customer E	Supplier E	Customer F	Supplier F	Customer G	Supplier G
Total revenue	€500 million	€16 million	€20 million	€25 million	€400 million	€60 million	€600 million	€6 million
Number of employees	1500	50	60	100	700	150	1500	30
Main products/ services	Infrastructure maintenance.	Maintenance equipment.	Power transmission equipment.	Spare parts, maintenance services, product tailoring, and design services.	Paper products.	Lubrication systems (including information and communication technology (ICT) systems).	Industrial material processing systems.	Special technology and services related to specific technologies.
R&D services provided in the particular relationship	Product tailoring, dedicated product development, and prototype construction (testing facilities offered by the customer).		Product tailoring, particularly for demanding products.		Mainly process–related services (process–analyzing services).		Product development services, product tailoring, product design services, prototype construction, prototype components, special component manufacturing, and modeling services.	
Type of R&D collaboration	Gray box.		Black box/gray box.		Gray box/black box.		Gray box.	
Partner's evaluated exchange time	6 months.	> 36 months.	–	–	12–24 months.	3–6 months.	24–36 months.	12–24 months.

supplier's product developers and challenging accepted solutions and working methods. The supplier develops sub-systems for the customer's products. R&D collaboration and joint projects encourage trust and joint learning through reciprocal interactions. Projects are carefully tracked using documentation recorded in IT systems.

The supplier in *Relationship C* was founded as the result of a divestment by the customer to expedite the unit's sales growth. The supplier's products are critical to the reliability of the customer's end products and the supplier is dependent on the customer because a considerable proportion (20%) of the supplier's revenue is derived from that relationship. Some of the customer's managers serve on the supplier's board of directors, and the supplier's CEO reports economic information to the customer's senior management on a weekly basis. The parties regularly share market knowledge, and the customer has even been known to pay its invoices before their due date at the supplier's request to ease cash flow problems.

Relationship D has changed dramatically over the last 10 years because of market deregulation, which has increased competition and forced the customer to seek competitive/collaborative advantages from its supplier relationships. The supplier develops products in close collaboration with the customer, while the customer offers test facilities for the supplier's new products and prototypes. The customer's employees test products, provide feedback, and share their knowledge.

The firms in *Relationship E* possess highly complementary and distinctive capabilities. The firms belong to the same group of companies, and the relationship has been built on mutual dependence to accelerate the benefits of vertical integration. The parties share knowledge regarding changes in their customer markets and provide

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Table 2
Within-case table on relational cases.

	Relationship A	Relationship B	Relationship C	Relationship D	Relationship E	Relationship F	Relationship G
Relational investments (site, physical, human)	1. Supplier has established spare part centers in proximity to the customer internationally. 2. Product branding in the customer's specification. 3. Supplier has a team dedicated to this customer and a Key Account Manager. Supplier's business owner personally holds a large share of the customer's stock.	1. Supplier's plant is physically proximate to customer's headquarters. 2. Supplier has internationalized, largely due to this customer relationship. Customer finances supplier. 3. Customer's executive is also the CEO of the supplier. Supplier's employees frequently work on the same projects with the customer.	1. Plants are located next to each other. 2. Product planning for this customer only. Customer finances supplier and pays invoices before due date at the supplier's request. 3. CEOs meet with each other occasionally.	1. Supplier's plant is physically proximate to customer's main strategic business unit. 2. Customer offers testing facilities for the supplier. Product planning for this customer only. 3. Supplier has employees in the plant performing only relationship-specific tasks.	1. Physically proximate plants. 2. Product tailoring at the customer's request. 3. Top management team and development team collaborate actively (seeking new manufacturability solutions).	1. Supplier's spare parts warehouses located near customer. 2. Supplier has tailored analytical and lubrication systems to this customer. 3. Supplier's personnel operate at the customer's facilities (open access to IT systems). Only one person collects data.	1. Plants are located in different countries in Europe (Finland/Germany). 2. Product tailoring on demand. Customer helps finance the supplier. 3. Top managers and project engineers know each other well and communicate regularly.
Relational capital (trust, open interaction, shared destiny)	1. High levels of trust, particularly among top managers. 2. Open discussion, particularly among top managers. 3. Agreement to expand collaboration to customer's other business units.	1. Open discussion about projects, customers, and markets. 2. Open interaction, particularly on projects. 3. Overall profit of the parties affects bonuses paid by both firms.	1. High levels of trust across the companies. 2. Completely open interaction between companies at all levels. 3. Mutually agreed profit margin for the supplier guides both companies toward a shared economic goal.	1. Voluntary spare time events along with high interdependency facilitate trust between companies. 2. In cases of incremental development, communication is fully open. 3. Joint interest in terms of development work not documented.	1. Open discussion about joint processes and joint development projects create trust among the parties. 2. Open interaction through participation in joint development projects and managerial processes. 3. Joint tax planning reflects common economic goals.	1. Long-lasting relationships and written (global) agreements create trust between the parties. 2. Straightforward meetings between the parties. 3. Both parties dependent on each other.	1. Parties share cost data and market information openly to adapt to market changes more rapidly. 2. Open interaction on markets, demand conditions, and technology. 3. Parties rely on each other due to highly complementary resources/capabilities.

Relational structures (management/ steering groups, development teams, joint IT systems, process descriptions)	1. Strategic management team includes members from top management. 2. Developing a team to concentrate on operative issues. 3. Customer has access to dedicated online product database. 4. Relationship's process description jointly compiled between supplier and customer's business unit.	1. Management teams meet monthly. 2. Simultaneous development activities on projects. 3. Joint enterprise resource planning (ERP) system (the main user is the customer's business controller). 4. No process description of the relationship.	1. Customer represented on supplier's board. 2. Project-based development teams. 3. Both parties have access to the other's databases. Customer has access to the supplier's cost information. 4. No process description of the relationship.	1. Joint discussions at strategic level annually. Development collaboration and operative actions are strictly separate. 2. Project-based development team uses technical resources from both parties. 3. No joint IT systems in the relationship. Information on product details is not fully shared. 4. No mutual process descriptions.	1. Top managers meet a few times each month. 2. Joint development projects related to projects and processes. 3. Parties save data to the same IT system.	1. Top managers meet each other at least once per month. 2. Supplier's key account manager arranges for technical engineers to execute certain development tasks. 3. Customer owns the system of measurement, which the supplier maintains. 4. Mutual process description in general collaboration and project manual. 4. Processes and responsibilities are described in the quality system.	1. Top managers (Supplier's CEO/ Marketing Director and Customer's CTO/Plant Manager discuss markets and production volumes weekly. 2. Project managers and people responsible for technology development discuss feasibility and risks related to technology. 3. Supplier is connected to the customer's financial measurement systems. Customer has access to all measurement data related to the products. 4. Process description of the overall relational and order delivery process.
Joint learning (knowledge sharing, joint sense-making, relationship-specific memory)	1. Local units around the world obtain feedback directly from the customer's local staff. 2. Top managers' intervention is key when parties seek mutual commitment. 3. Supplier uses global online CRM to save all relevant data on the relationship.	1. Systematic sharing of knowledge between management groups. Parties engage in discussions during common projects. 2. Social interaction is open and informal. 3. Every project and initialization is documented and reported.	1. Market information is shared at the CEO level on a weekly basis. 2. When there are defects, both parties invest in objective investigations to prevent the same defects in the future. 3. Informal data storage on both sides. Data stored mainly in e-mail accounts.	1. Customer provides supplier with completely open and direct access to users. 2. Close physical proximity allows parties to establish mutual commitment in face-to-face meetings. 3. Both sides save information about the relationship in their own systems.	1. Daily interaction regarding markets, products, and deliveries. 2. Top managers meet occasionally. 3. All meetings, plans, processes, and orders are documented. Reports of the reclamations and service work are prepared.	1. Sharing of information on markets between managers. Parties also share knowledge via e-mails and spreadsheets. 2. Global representatives of the corporations negotiate prices, and local key account managers meet the customer's local representatives at least once per month. 3. Supplier possesses data information on processes and shares it when required.	1. Parties use videoconference systems to share knowledge on a daily basis. Product orders are made via e-mail/fax. 2. Parties compare data collected separately to increase data reliability. They also agree on their targets. 3. Shared product data management (PDM) and ERP systems and connected customer relationship management (CRM) and financial administration systems.

constructive feedback on the functionality and effectiveness of the other's processes. Due to quality requirements, the firms have codified their joint processes and responsibilities. In addition, all joint meetings, plans, orders, reclamations, and service work are documented in the databases of both firms.

The firms involved in *Relationship F* collaborate on a global scale and both ensure that relational best practice is shared globally. The firms have a long joint history and long-term partnership. The supplier operates and develops one of the customer's core processes and collects and interprets data on the customer's other processes. The supplier and customer often jointly analyze the data, seeking ways to develop the customer's processes and reduce breakdowns and downtime. Collaboration is active and based on trusting relationships that have resulted from cooperation spanning decades.

The supplier in *Relationship G* develops knowledge-intensive products that are critical to the operation of the customer's product. The customer had acquired the supplier several years before the survey took place to obtain access to the supplier's highly valuable technology. The supplier's products indirectly enable the customer to generate almost 10% of its total revenue. Communication between the top managers and development teams within the relationship is exhaustive, as the top managers from both sides collaborate on a weekly basis through videoconferences. Both parties share knowledge about their product development activities and market conditions. The parties compare and match their separately collected market data to achieve a better understanding of market developments (Table 2).

4.2. Cross-case analysis

According to Eisenhardt (1989), cross-case analysis forces researchers to go beyond their initial impressions, thereby increasing the likelihood of extracting novel findings from the data. Table 3 synthesizes the relational dynamic capabilities of R&D collaboration. In this cross-case section, we analyze how relational investments, relational structures, and relational capital facilitate each dimension of joint learning.

4.2.1. Relational investments and joint learning

In our cases, investments in relational-level IT systems play an important role in facilitating knowledge sharing. Indeed, all but one of our studied relationships include joint information systems. Investments in relational information systems, such as CRM systems, supplier management systems, and CAD systems, are considered important for knowledge sharing. The information systems supporting collaboration vary in our cases, from a dedicated product database in an extranet to extensive partnering using PDM, ERP, CRM, and financial administration systems. In addition, both suppliers and customers emphasize the importance of having the suppliers' site in close proximity to the customer. Close proximity facilitates effective face-to-face contact and product development meetings, which are important for the explication and sharing of tacit knowledge.

> "We have a shared IT system with a customer. We have this common program that both of us use…Of course, there are parts where we don't have access or they don't have access, but basically it's a shared system."
>
> [(Export Manager/Supplier)]

> "The geographic location is important. One good thing is that our customer is Finnish, so the main activities are close."
>
> [(Area Manager/Supplier)]

Relational IT investments also encourage joint sense-making by providing a virtual platform for interaction. For instance, interaction is necessary to acquire a shared understanding when developing solutions. Moreover, knowledge investments play an important role in joint sense-making. Arriving at a mutual understanding requires significant investments in time and effort from the staff of both parties. In addition, knowledge investments, in terms of dedicated employee resources, may also increase relational trust and commitment (Dyer, 1997; Dyer & Singh, 1998). Furthermore, the close proximity of sites, as noted above, facilitates joint meetings in which parties can work collaboratively on solutions. Joint meetings are important because R&D knowledge is often conceptual and tacit and finding a common understanding requires explanation and discussion (Kogut & Zander, 1992; Szulanski, 1996). Therefore, close proximity facilitates joint sense-making, as described by our interviewees.

> "Since we are located in the same city, it's easy to go to their site or they can come here. Thus, we can sit around the same table and think about mutual issues."
>
> [(Export Manager/Supplier)]

> "Trust is also important because when you have a partner in Finland who knows you and you have collaborated for a long time, then it's also more efficient because you don't always have to cover your back."
>
> [(Maintenance Specialist/Customer)]

> "Well, both of us had been developing this idea by ourselves, but one time, we sat around the same table and started to take this forward."
>
> [(Sales Manager/Supplier)]

Table 3
Synthesis of the shared mechanisms of relational capabilities and joint learning dimensions.

		Joint learning		
		Knowledge sharing	Joint sense-making	Integration into relationship-specific memory
Relational capability	Relational investments	Investments in relational information systems. Investments in physically proximate sites that enable effective collaboration.	Time investments in finding a shared language.	Investments in relational information systems and time spent on careful documentation.
	Relational structures	IT systems and meetings for knowledge sharing.	Development teams create social platform for sense-making and open discussion.	Relationship steering group management of knowledge implementation.
	Relational capital	Mutual trust and familiarity enable knowledge sharing and effective collaboration.	Relational capital enables open dialog, critical considerations and provides a basis for agreement with the partner.	Relational capital generates commitment to knowledge implementation and integration.

Moreover, the integration of knowledge into relationship-specific memory requires investments in knowledge management systems that can be utilized for documentation and knowledge retrieval. Documentation in each case is time consuming and requires discipline and effort from both parties. Our interviewees' highlighted the importance of knowledge documentation and retrieval:

> "We conclude every [mutual] project with a final meeting. Users from salespeople to the employees report how the solution operates throughout the product life cycle."
> [(Sales Manager/Supplier)]

4.2.2. Relational structures and joint learning

Relational structures facilitate knowledge sharing through relational forums that enable interaction. In our analysis, we found examples of various types of relational structures, such as relational steering groups (Farrell et al., 2011; Malhotra, Gosain, & El Sawy, 2007), development teams (Dyer & Hatch, 2004), and IT systems (Subramani, 2004), all of which facilitate knowledge sharing. Interviewees highlighted the importance of interaction and the proactive sharing of market knowledge in these relationships. Some noted both exploitation and exploration at a relational level, suggesting that some customers support suppliers in the search for new business.

> "Today, our joint objective in this relationship is to bring suggestions to the customer's other business units as well, but it requires a lot of work from us because it also means that we are heading toward global markets because the customer also does R&D work abroad."
> [(Area Manager/Supplier)]

> "We have weekly video conferences when we handle these technical issues. In addition, we use e-mails, we make phone calls, and once in a week, we have this kind of continuous project meeting."
> [(Sales and Marketing Director/Supplier)]

> "The market information still goes through the top managers. There, we discuss certain customer relationships, their demands and volumes, and what might come up in the future. Technical specifications are shared through the meetings. At the top management level, during the meetings on weekends, we discuss upcoming cases, technical requirements, and possible problems. However, these business issues are discussed between the top managers; what the volumes have been, to whom the products have been sold, what the requirements are, and what's coming next."
> [(Sales and Marketing Director/Supplier)]

Relational structures play an important role in relational sensemaking. Interviewees involved in relationships B, F, and G, describe the importance of relational top management meetings in forging a common understanding of existing markets, technological developments, and the future of the industry. Relational structures, such as relationship steering groups and development teams, provide relatively continuous forums that encourage discussion and improved understanding of the strategies and expectations of both firms. In the relationships investigated, relational steering groups included business managers from the customer's side and top managers from the supplier's side. Relationship development teams would be expected to include key personnel relevant to the development of the relationship.

> "We openly discuss the market information and competitors. If one of us sees something new or big over there, I think we receive the information quite well, whether through informal or more formal meetings."
> [(Sales Manager/Supplier)]

> "They have one key account manager whose job is to represent the company. I only have to call him, and he will tell me what help I will need."
> [(Maintenance Specialist/Customer)]

> "We discuss [issues]; we share knowledge between us. Similarly, we try to figure out whether this picture is accurate, and we try to ensure that everybody has the same understanding of the overall market situation."
> [(Sales and Marketing Director/Supplier)]

Our results did not provide clear evidence on the usability of process descriptions for the purpose of joint learning. Formal process descriptions were applied to a significant extent in only two relationships (relationships E and G). In those relationships, process descriptions were followed and updated occasionally and the firms' organizational cultures were geared to the practice. However, our interviewees noted that in complex business relationships such as in R&D collaborations, formal process descriptions may not be feasible because working procedures among different actors are fairly unique, complex and heterogeneous (Corsaro et al., 2012). Formal process descriptions are instead perhaps more useful in more standardized exchange processes (Alvarado & Kotzab, 2001; Spekman & Carraway, 2006).

> "We try to evaluate [the process description of the relationship] biannually in terms of whether we do still act according to it. However, at least once a year, we thoroughly evaluate whether this is reality… and in special cases, we have discussions if they are exceptions or if they happen regularly and why we did it this way. Then, we have a conversation about whether we need to make changes or not in our procedures."
> [(Sales and Marketing Director/Supplier)]

> "We have documented these processes even though it's rather difficult because the projects are different. However, we tried to describe it, and we have made a project handbook."
> [(Key Account Manager/Supplier)]

Relational structures, such as relational IT systems, provide a tool for the integration of knowledge into relational memory. Interviewees highlighted the importance of relational IT systems in documenting and codifying relational information, such as memoranda on relational meetings, operational delivery, and quality information, as well as agreed strategies, other agreements, and contracts. IT systems like customer relationship management and supplier management systems are important for storing relational data and promoting a close supplier–customer relationship:

> "The meetings are documented, and somebody takes the minutes of the meetings. These [minutes] are saved and sent to the parties via e-mail."
> [(Export Manager/Supplier)]

> "When we have had a meeting, there is also a memorandum of what happened in the meeting."
> [(Director of Sales Support/Supplier)]

> "Everything is documented: meetings, plans, processes, and customer orders."
> [(Director of Sales Support/Supplier)]

4.2.3. Relational capital and joint learning

Relational capital plays an important role in facilitating knowledge sharing. Trust enables the parties to share strategically important knowledge critical to R&D collaboration without prohibitive transaction costs. The relationships studied highlighted the importance of close physical and psychological proximity, familiarity between people and trust that the other party will not behave opportunistically.

> "We don't really have any contracts. We have a contract only about the price of the component, and I think it's a two-sided trust."
>
> [(Business Division Director/Customer)]

> "There is this kind of mutual respect for each other, trust for one another's skills and mutual trust that neither of us will stab the other one in the back."
>
> [(Business Division Director/Customer)]

> "When the supplier's personnel don't change all the time, it increases trust."
>
> [(Maintenance Specialist/Customer)]

> "We have been able to inspire confidence. In these joint projects, the more successful the projects have been, the more likely they will ask for our help again, which means more work, which is a good thing."
>
> [(Sales and Marketing Director/Supplier)]

Relational capital plays an important role in joint sense-making because it enables partners to talk openly and share ideas in-depth. Sense-making is not a straightforward task because it necessitates looking at the existing problem from different angles. Interviewees emphasized the role of trust and open dialog in joint sense-making:

> "[R&D collaboration] is a really close interaction, and [there is] continuous joint discussion between us."
>
> [(Sales and Marketing Director/Supplier)]

> "When we're creating something new and we want to achieve the targets, then we'll find the solution together…When we have our target, we don't focus on insignificant details in a discussion that sidetracks attention from the main issue."
>
> [(Maintenance Specialist/Customer)]

One particular practice we found to improve sense-making is pair work (vis-à-vis practices) as observed in supplier–customer relationship G, which facilitates familiarity and trust, thus supporting joint sense-making. In other relationships, we observed team-level collaboration across organizational boundaries.

> "We have tried to achieve a point in mutual processes where the person on the opposite side responsible for a certain area, such as purchasing, communicates with our production managers so that we have a connection between decision makers. For instance, if we have technical problems or technical questions, then we have a meeting once a week between the people responsible for technical issues. Then, once a week, the customer's purchasing/production team talks to our people responsible for logistics or production. Therefore, we are always aware of what's happening on both sides."
>
> [(Sales and Marketing Director/Supplier)]

> "Today, the collaboration between us is relatively active. In this kind of cooperation, we are having multi-level activities: the top management level, the middle management level, and the operational level. At every level, there are regular meetings where different kinds of topics are discussed… [At the top management level], the collaboration's longer-term performance is followed, whereas at the middle management level, the focus is on annual basis activities, which means updating and fixing things…We have appointed main contacts at the top management level, and at the middle management level, we have dedicated persons who are responsible for the relationship. In addition, we have a team in the factory that performs only these tasks [with respect to the customer]."
>
> [(Area Manager/Supplier)]

Relational capital facilitates the effective integration of knowledge into relationship-specific memory. It also facilitates the emergence of social norms, which increases reciprocal relational commitment to knowledge implementation.

> "If the cost level that we report is in line with the customer's experience, they will trust that the information we provided matches with reality. Then, they have much more interest in collaborating."
>
> [(Sales and Marketing Director/Supplier)]

> "The information documentation is rather weak because the information is useful only for the people who were involved. Of course, the individual responsible for the product will remember it."
>
> [(CEO/Customer)]

> "We can trust that we can work with them [supplier] over the long-term and that we can collaborate with them next year, too. We don't have to think about whether we should change to someone else. On the other hand, I also trust that they don't want to milk us. They want to keep this [relationship], and we can keep this process cost-efficient, so they take care of it."
>
> [(Maintenance Specialist/Customer)]

To summarize, the present study has defined joint learning as a relational dynamic capability and has examined joint learning and the practices that facilitate it. Fig. 2 provides an overview of the study's results and findings, demonstrating how social capital, relational practices, and joint learning are interrelated and embedded in R&D collaboration between a supplier and customer. Furthermore, it encapsulates the issues discussed in previous chapters.

5. Discussion and implications

5.1. Theoretical implications

Whereas existing studies have paid considerable attention to organizational learning and knowledge absorption from partnerships and strategic alliances, relatively little research has been conducted on joint learning and enabling practices in the context of R&D collaboration between suppliers and their customers. Building on evolutionary economics (Nelson & Winter, 1982; Nelson & Winter, 2002) and the existing organizational research on dynamic capabilities (Eisenhardt & Martin, 2000; Teece, 2007; Zollo & Winter, 2002), our study is one of the first to define joint learning as a relational dynamic capability.

As a first contribution, our results extend the existing literature on the role of relational investments in the development of relational dynamic capabilities (joint learning). These findings add to prior empirical research on the role of relationship-specific assets, research that has paid considerable attention to both transaction costs and the collaborative rents derived from such relationships (Dyer & Hatch, 2006). Our study contributes to the existing literature by demonstrating the important role of relational investments in various aspects of learning. We

find that knowledge sharing is facilitated by investments in relational information systems and in physically proximate service sites. The former supports effective virtual collaboration, whereas the latter brings suppliers' services physically closer to the customer. Moreover, time invested plays an important role in joint sense-making, allowing for the development of a common language that supports solution development. Knowledge implementation in relationship-specific memory is facilitated by investments in relational information systems and time invested in careful documentation. These findings add value to the theory regarding the enabling role and effects of relational investments (Chang & Gotcher, 2007; Dyer & Hatch, 2006).

The second main contribution of the current research is to extend existing knowledge of relational structures by revealing the important mechanisms through which they influence joint learning. Our results highlight how relational interaction platforms can support knowledge sharing, joint sense-making, and the integration of knowledge into relationship-specific memory. The existing literature offers several examples of relational structures that facilitate improved interaction and joint learning between suppliers and customers (e.g., Johnsen, 2009; Kohtamäki et al., 2012; Ragatz et al., 1997). The present study extends that literature by demonstrating how relational structures enable improved interaction and joint learning, by documenting managers' experience with such relational structures. Prior studies also indicate that relational structures facilitate learning (e.g., Kohtamäki et al., 2012), but do little to describe the mechanisms through which they contribute to joint learning. In this study, we find that IT systems and meetings in particular support knowledge sharing by providing virtual platforms for document sharing and discussion. Furthermore, we find evidence that development teams provide an important social platform for joint sense-making and open discussion, allowing for the development of a shared language that facilitates dialog, as suggested by Ballantyne (2004). We wish to emphasize that interorganizational teams are far more difficult to coordinate than conventional teams. In these complex conditions, finding a shared language that facilitates dialog is more challenging than in intra-organizational contexts, upon which much of the existing research draws. Finally, the results highlight the importance of relationship steering groups in the management of knowledge implementation as a critical phase in the acquisition of relational knowledge. These results build on customer relationship management research but extend it, suggesting a more balanced model in which the supplier–customer relationship is guided by joint steering groups that achieve improved participation, commitment, and loyalty. Participation may be an effective way to promote loyalty (Collier, Fishwick, & Floyd, 2004; Liedtka, 2000). In addition, relational structures appear to support improved coordination and generate peer pressure that is important in furthering the development of the relationship. Shared steering groups and development teams create social forums where participants jointly control the progress of shared development projects, creating social pressure for timely implementation. Our results contribute to the existing literature on relational structures by providing evidence of the importance of such relational steering groups and development teams in effective R&D collaboration (Dyer & Hatch, 2004; Farrell et al., 2011; Malhotra et al., 2007).

Our third main finding concerns those mechanisms and practices through which the relational form of social capital affects joint learning. First, our results support the conclusions drawn by others that relational capital affects learning and interacts with relational structures and relational investments (Chang & Gotcher, 2007; Kohtamäki et al., 2012). Based on our results, relational capital appears to play an important role in alleviating fears of unbalanced benefits and in facilitating knowledge sharing, joint sense-making, and the integration of knowledge into relationship-specific memory. More specifically, our results confirm that mutual trust increases with familiarity (Gulati & Sytch, 2008; Lewicki, Tomlinson, & Gillespie, 2006). As trust alleviates the fear of opportunism, it enables knowledge sharing and reduces the transaction costs of R&D collaboration (Zaheer, McEvily, & Perrone, 1998). Moreover, trust in the capabilities of the other party appears to facilitate joint sense-making by enabling open dialog, critical consideration, and the mutual acceptance of ideas (Ballantyne, 2004). Finally, in terms of knowledge implementation, our results suggest that relational capital plays an important role in generating commitment through the social norm of reciprocity, which then contributes to knowledge implementation and the integration of knowledge into relationship-specific memory.

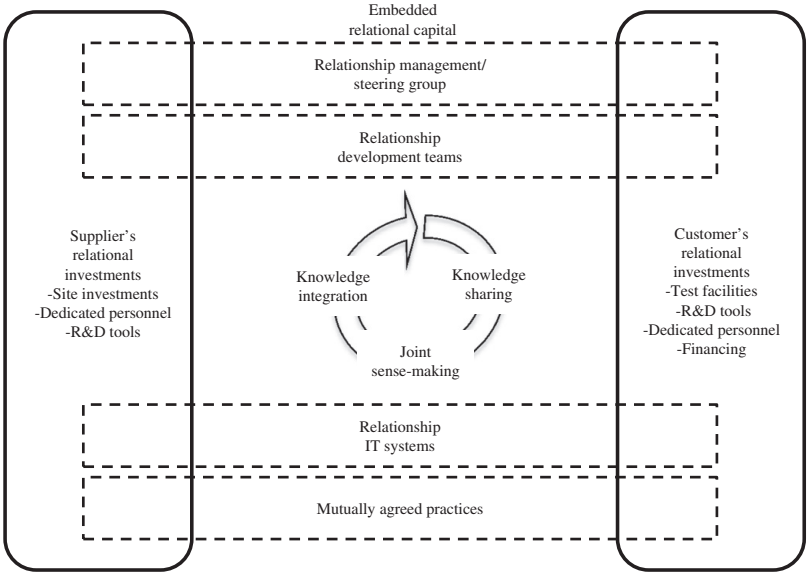

Fig. 2. Joint learning and relational practices in R&D collaboration.

Fourth, we provide a broad overall illustration of how joint learning is a relational dynamic capability, together with the relational practices that support it. Fig. 2 captures the learning processes (knowledge sharing, joint sense-making, relationship-specific memory) and the practices that facilitate joint learning (relational investments, relational structures, and relational capital) alongside social capital. Fig. 2 suggests that certain factors are embedded in the R&D collaborations between a supplier and customer. It is important to notice that the practices interact and jointly enable learning. For instance, relational investments and relational structures interplay with the relational form of social capital to facilitate knowledge exchanges, sense-making and implementation. This has been suggested, and to an extent established, by prior quantitative studies (Chang & Gotcher, 2007; Kohtamäki et al., 2012), but our Fig. 2 presented at the end of the Results section nicely illustrates these practices in a holistic framework. The interplay between these relational practices and the dimensions of joint learning is central, and the latter are particularly important. Whereas knowledge sharing enables the spread of development ideas and knowledge, joint sense-making facilitates the search for shared understanding with regard to new ideas that enable joint knowledge development. Finally, relationship-specific memory reinforces the memorization and implementation of knowledge so that it might be utilized in the future. We believe that the model developed offers valuable insight for both researchers and managers (Dyer, Kale, & Singh, 2001; Ford & Håkansson, 2006; Håkansson, Havila, & Pedersen, 1999; Henneberg et al., 2010).

5.2. Managerial implications

With regard to managerial impact, our study presents interesting cases that provide useful benchmarking opportunities for directors and managers involved in relational interactions. This study highlights the importance of relational investments, relational structures, and relational capital in joint learning. The results indicate the importance of time and IT system investments that facilitate knowledge sharing, joint sense-making, and knowledge implementation. It is a finding that should persuade firms to make relational investments to facilitate joint learning. Moreover, managers should be aware of the important role of relational capital, which is critical in all phases of joint learning (Chang & Gotcher, 2007). Trust is particularly important in knowledge sharing and joint sense-making, where participants must engage in open discussions to understand each other's viewpoints. In addition, relational structures are important in creating platforms for interaction (Kohtamäki et al., 2012). Such platforms promote increased trust and dialog that may further facilitate relational investments.

The roles of joint learning and the individual mechanisms are particularly critical. Managers should pay attention to joint learning processes, such as knowledge sharing, joint sense-making, and relationship-specific memory. In the absence of joint learning, a relationship may end up in a relational learning trap, where relational resources are only being exploited, rather than being explored for their innovative potential. The existing literature on organizational learning focuses on organizational competence traps (Levitt & March, 1988), exploitation traps (Sirén et al., 2012), and success traps (Levinthal & March, 1993). To avoid being trapped in a cycle of exploitation, parties involved in R&D collaboration should be alert to the possibilities of joint learning and invest in learning practices. One particularly interesting practice managers could promote in R&D relationships is systematic independent data collection, where data collected by each partner is subsequently compared. This practice is particularly useful in joint sense-making.

Managers must also decide whether to facilitate relational learning at the team or individual level. Whereas team-level collaboration is more risk averse and promotes knowledge sharing with the various parties to the relationship, for example, individual-level collaboration facilitates strong communication between individuals within the relationship, making the firm-to-firm relationship more dependent on individuals.

Relational investments, relational structures, and social capital influence learning if the parties can learn jointly, share information, develop a common understanding, and embed their joint knowledge into relationship-specific memory. In the absence of relational learning capability, the parties will repeat errors and fail to adapt to changing circumstances.

Our study also indicates that formal relationship process documentation is not particularly useful in complex R&D collaborations even though the potential of formal documentation should not be ignored. At its best, process documentation steers the activities of a relationship by establishing standardized, effective working methods in the relationship. However, at its worst, formal process documentation hinders joint learning and makes management of the relationship bureaucratic and unnecessarily rigid. Firms should carefully consider how to utilize process descriptions in knowledge-intensive collaborations.

The results highlight the importance of relational investments and joint learning as activities that enable a partner to observe the other partner's relational commitment, which is critical for joint development. The overall observation is that these factors are largely interconnected and systemic, as the IMP school of network research has argued.

5.3. Limitations and future research

This study has some limitations that should be considered. First, because our data are qualitative in nature, the results are not generalizable to the population (Dubois & Gibbert, 2010; Eisenhardt & Graebner, 2007). However, the cases were selected based on quantitative cluster analysis and were chosen from a cluster of extensive R&D service exchanges and joint learning, suggesting that these relational cases provide some interesting insights into the relational capabilities involved in R&D collaborations between suppliers and their customers. Future research might benefit from a similarly mixed approach, where cases are systematically selected based on quantitative data to ensure that they will offer insight into the phenomenon under study. Second, because we examined relational capabilities and dynamic relational capabilities in the context of relationships, perhaps future qualitative case-based research could explore multi-level research settings, where the mediating mechanisms of absorptive capacity in firm-specific learning from R&D relationships are analyzed. Third, our data are cross-sectional in nature and further evidence could be provided by longitudinal research settings. However, our results and reports were read and commented on by the interviewees and external researchers, providing support for the validity and reliability of our interpretations. Finally, future research should look into the interactions between various relational practices and joint learning. Prior studies, such as Kohtamäki et al. (2012) and Chang and Gotcher (2007) have provided some evidence on the interplay between different relational practices, but more is needed. Moreover, we encourage future studies to consider non-linear relationships between practices, their interactions, and outcomes.

6. Conclusion

The present study contributes to the interorganizational network literature by providing evidence on relational practices, such as relational investments, relational structures, and relational capital that facilitate joint learning in dyadic R&D collaborations. We introduce the concept of dynamic relational capability to highlight the importance of joint learning as a source of relational renewal. The results of this study suggest that firms should consider how to reconfigure practices within complex R&D interactions to facilitate continuous product, service, and solution development. This study provides a holistic framework for managers to apply to consider the organization of R&D collaboration.

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