THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Conceptualising Solutions in Business Networks: The Case of Heavy Vehicle Maintenance

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Abstract

This thesis problematises and conceptualises the phenomenon of solutions in business networks based on processual approaches to solutions and the Industrial Network Approach to business markets. In particular, the thesis focuses on the interorganisational and interactive aspects involved in solutions embedded in business networks.

Driven by demands for more sustainable transport, lower transport costs and changes of the roles and business models within the transport industry, actors strive to improve the efficiency of transport systems. Vehicle maintenance, as an enabler for uptime and robustness of transport, has therefore drawn attention. Managers strive to elucidate whether alternative approaches and designs can result in new vehicle maintenance solutions to boost the efficiency of firms, vehicle utilisation and transport.

Supporting this quest, this thesis aims to extend current understandings concerning solutions in business networks based on a single case study encompassing a selection of firms involved in road transport in Sweden. The case study focuses on maintenance solutions for heavy vehicles. In order to situate those solutions within the setting of road transport, empirical data concerning firms and other, related, solutions in the broader context of heavy vehicle maintenance has been collected.

The case analysis shows that solutions rely on combining and adapting resources. Beyond that, however, the results of the thesis stress that solutions also depend on the linking and adjustment of activities and the involvement of actors; it is through the interaction among actors that firms jointly organise the activities and resources required for solutions. Based on the conceptual model developed, the thesis highlights the temporal and spatial aspects of solutions embedded in business networks and points to interdependencies among the activities and resources involved. The thesis also underscores how the interdependencies among solutions in business networks can result in that a change to one solution could have ramifications for the perceived efficiency, effectiveness and value of other solutions.

Finally, the thesis highlights the importance of actors to transcend a product-centric or customer-centric logic and suggests an *interaction-centric* approach to solutions that acknowledges the interconnected and interdependent characteristics of solutions in business networks.

Keywords

Solutions, Business Networks, Temporal Embeddedness, Spatial Embeddedness, Industrial Network Approach, ARA Model, Interaction Centric, Heavy Vehicle Maintenance

PREFACE & ACKNOWLEDGEMENTS

The doctoral project reported in this thesis was initiated as a response to managerial challenges faced in projects and strategy development at AB Volvo. Specifically, the challenges concern the development of aftermarket offerings for heavy trucks, i.e. the products, services and solutions that support customers in using and maintaining their vehicles.

With an ever increasing focus on improving the efficiency and environmental sustainability of vehicles and transport, the role of aftermarket solutions has gained increasing attention. The need for new and improved aftermarket solutions supporting efficient and sustainable transport solutions is thus a strong driver for my research.

My research and publications would never have been possible without the inspiration and support that I have received from my family and my colleagues and friends at Chalmers, AB Volvo and within the research community. Specifically, I would like to thank my family for love and support, and my supervisors Professor Frida Lind, Professor Anna Dubois and Dr Jan Ove Östensen for outstanding and inspiring coaching.

This research has been carried out as part of the project "Efficient Maintenance for Sustainable Transport Solutions" (EMATS), a project co-financed by FFI, the Swedish Strategic Vehicle Research and Innovation programme, with grant 2014-06245.

I hope that you will find the thesis interesting, and that I will succeed in my aspiration to pass on some of my enthusiasm and fascination regarding research on solutions in business networks and aftermarket solutions for sustainable and efficient road transport!

Klas Hedvall

Chalmers University of Technology
Gothenburg, February 2020

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1. INTRODUCTION

1.1 Heavy vehicle maintenance: A managerial concern

Never ceasing to gain attention, the need to improve the efficiency of transport is underpinned by demands for more sustainable transport (e.g., Ellram & Murfield, 2017), lower transport costs (e.g., Christopher & Gattorna, 2005) and changes in the roles, structure and business models of the transport industry (e.g., Christopher & Holweg, 2011). As defined by the Swedish Government, *efficient transport* enables availability, sustainability and competitiveness by way of energy, environmental and economic efficiency (Näringsdepartementet, 2018). According to that definition, fewer resources offering improved capacity and utilisation should accomplish the transport work of tomorrow—in short, that transport systems should provide more with less.

In road transport systems, vehicles are key components. The vehicles of hauliers transport goods between hubs, distribute them in urban environments and collect waste produced by citizens, to name only a few of their applications. Efficient road transport thus requires the efficient utilisation of the vehicles involved, which have to be available, operational and energy-efficient (cf., Simons, Mason, & Gardner, 2004). To those ends, maintenance—both preventive maintenance (PM) and corrective maintenance (CM)—is vital (Basri, Abdul Razak, Ab-Samat, & Kamaruddin, 2017; Murthy, Atrens, & Eccleston, 2002). Whereas PM keeps vehicles operational and prevents unplanned stops, CM resolves breakdowns, faults, and anomalies. PM for vehicles chiefly reflect a "preventive approach" in which the product's technical specification and usage have central roles (Alsyouf, 2007; Basri et al., 2017).

In efforts to improve efficiency and reduce transport costs, the role of heavy vehicle maintenance has attracted scrutiny in the transport industry (Kilcarr, 2015; Roeth, 2018). In particular, the suppliers and buyers of maintenance have become increasingly interested in understanding how maintenance solutions can and should be designed and delivered. With efficient, effective maintenance, vehicle utilisation and reliability can improve and, in turn, benefit the efficiency and robustness of transport.

Adding to the challenges faced by the transport industry in improving maintenance solutions, new technologies such as automation and electrification, for instance, continue to

require changes to the scope and methods of maintenance. In response, managers of hauliers, workshops and heavy vehicle manufacturers are concerned with how maintenance solutions can be adapted to accommodate changing requirements and whether solutions with alternative designs can boost the efficiency and revenues of firms. Reflecting their concerns, three managerial issues establish an empirically grounded starting point for the research presented in this thesis:

- Which aspects of heavy vehicle maintenance are pivotal to improving the efficiency of road transport?
- How can the efficiency of road transport be improved by using alternative approaches to heavy vehicle maintenance solutions?
- Which key aspects should a heavy vehicle manufacturer consider when striving to improve the value of its maintenance solutions in the perspectives of its customers?

Taken together, managers are keen to understand whether new solutions for heavy vehicle maintenance can support the improvement of firms' operations. The concerns of firms involved in supplying and buying maintenance solutions are thus similar to those addressed by firms involved in business-to-business offerings in a broader perspective. After all, by developing and implementing enhanced offerings, suppliers and buyers strive to improve the efficiency and effectiveness of their operations. Therefore, with the objective to address those managerial concerns, the thesis adopts a perspective wherein heavy vehicle maintenance is situated in a broader context, starting with an introduction to two perspectives derived from previous research and of particular importance for the thesis: a processual perspective on solutions, and an interorganisational perspective on solutions.

1.2 A processual perspective on solutions

In business-to-business contexts, suppliers offer products, services and combinations thereof to customers. Offerings that combine products and services are typically termed *solutions* by scholars and practitioners alike (Brax & Jonsson, 2009). For high-volume products, the design and functionality of suppliers' products could often be more or less standardised and involve limited, if any, adaptation to customers' operations (Davies, 2004). For solutions, by contrast, adaptation to the context, operations and needs of customers plays a fundamental role. According to Windahl and Lakemond (2006, p. 806), solutions thus

"address specific customer needs implying a shift in focus from product functionality to the actual outcomes of their products and services for customers' operations and processes."

Manufacturing firms with a history of developing and selling equipment such as machinery or vehicles, for instance, often view their products as the core of their offerings (Tukker, 2004). The so-called "product core" can be conceived as being bundled with—or embedded in—a variety of services; services that often are defined as being *product-oriented* (Tukker, 2004). The product-oriented services of a bundled offering could, for example, help customers to use the equipment in safe, efficient ways (e.g. operator training), reduce operating costs (e.g. fuel coaching for drivers) or ensure availability and uptime (e.g. maintenance).

Beyond the perspectives situating the product in the centre, the discussion on solutions increasingly also involves new and supplementary points of view. As an alternative to the product-centric perspective on solutions, scholars instead suggest a processual view on solutions (Aarikka-Stenroos & Jaakkola, 2012; Petri & Jacob, 2016; Tuli, Kohli, & Bharadwaj, 2007; Töllner, Blut, & Holzmüller, 2011), which focuses on the processes involved in solutions and emphasises the importance of interaction amongst firms.

In their influential article, Tuli et al. (2007) argue that many customers view solutions as a set of relational processes involving suppliers and buyers. For that reason, the authors argue, customers emphasise the centrality of those relational processes whereas the integrated, customised product–service bundle remains in the background. In response, Tuli et al. (2007) developed a solution model encompassing four relational, interactive processes: *requirements definition, customisation and integration, deployment*, and, *postdeployment support*. The processual approach to solutions has since attracted considerable attention, and the importance of relational processes to enabling solutions has been stressed (e.g., Bigdeli et al., 2018; Storbacka, Windahl, Nenonen, and Salonen, 2013). Hence, whereas the product-centric approach to solutions highlights the centrality of products and the importance of bundling, the processual approaches points to the importance of supplier-buyer interaction.

1.3 An interorganisational perspective on solutions

In research on solutions, scholars have often adopted the supplier's perspective (e.g., Galbraith, 2002; Parida, Sjödin, Wincent, & Kohtamäki, 2014; Storbacka, 2011). Parida et

al. (2014), for instance, have studied how Finnish and Swedish manufacturing firms move into the marketing and sale of product–service systems. Additionally, scholars have also taken the buyer's perspective (Töllner et al., 2011) or focused on the supplier–buyer dyad (e.g., Brax & Jonsson, 2009; Petri & Jacob, 2016). For example, Petri and Jacob (2016) explore how customers and providers of knowledge-intensive business service solutions view customer's contribution to value creation.

However, the dominant focus on suppliers, buyers or supplier–buyer dyads has been extended to encompass multiple actors of business networks, chiefly by taking an interorganisational perspective that acknowledges the interconnectedness of firms (Cantù, Corsaro, & Snehota, 2012; Jaakkola & Hakanen, 2013; Raddats, Kowalkowski, Benedettini, Burton, & Gebauer, 2019; Windahl & Lakemond, 2006). After all, the suppliers and buyers involved in interaction for solutions are embedded in the business landscape and rely on interaction with multiple other firms, including partners and customers.

To study the interaction between firms embedded in the business landscape, the Industrial Network Approach is often applied (e.g., Håkansson & Snehota, 2017b; Håkansson, Ford, Gadde, Snehota, & Waluszewski, 2009). According to the Industrial Network Approach, business relationships connect firms to each other and enable interaction (Håkansson & Snehota, 1995). Also connected with each other, those relationships and the firms themselves form a business network (Håkansson et al., 2009). The business relationships between firms enable the linking of activities and combining of resources. With respect to resources, Cantù et al. (2012) has discussed the combining of resources in relation to actors jointly developing complex solutions. As an implication of the aspects discussed above, also the definition, development and deployment of solutions can be conceived as a phenomenon embedded in the business network (Hedvall, Jagstedt & Dubois, 2019).

1.4 An alternative approach to maintenance solutions

The managerial concerns articulated in Section 1.1 highlight managers' aspiration to identify new or alternative approaches to offering vehicle maintenance, especially approaches that improve vehicle utilisation, firms' operations and transport efficiency. To spark ideas concerning such alternative approaches, the perspectives discussed in the two preceding sections are considered to be key contributions.

First, as an alternative to the product-centric perspective, the ideas involved in a processual approach to solutions could help redefine the orientation with respect to how to design and perform vehicle maintenance. The supplier-buyer interaction reflected in the processes of solution models (e.g., Aarikka-Stenroos & Jaakkola, 2012; Petri & Jacob, 2016) could result in alternative views on the aspects involved in the organising and customisation of maintenance solutions.

Second, going beyond the supplier–buyer dyad that is often in focus, an interorganisational perspective could shed light on how vehicle maintenance solutions relate to the efficiency of firms and the transport performed. The Industrial Network Approach (Håkansson et al., 2009) offers opportunities when the objective is to capture the interorganisational, dynamic and interactive aspects of the business landscape. As the extant literature highlights (e.g., Håkansson et al., 2009; Håkansson & Snehota, 2017b), the Industrial Network Approach serves well for analysing focal phenomena embedded in the interconnected, interactive and dynamic context of business networks.

Thus, to enable alternative perspectives on, and approaches to, maintenance solutions for heavy vehicles, the two extended perspectives on solutions discussed above—that is, the processual and the interorganisational perspectives—establish the key building blocks of the thesis.

1.5 Aim and contributions of the thesis

By way of research acknowledging the interorganisational and interactive context of firms and their offerings, hitherto untapped opportunities for improving vehicle maintenance solutions can be discovered. This, in turn, requires a means for understanding the phenomenon of solutions from an interorganisational and interactive perspective.

Therefore, the aim of this thesis is to problematise and conceptualise the phenomenon of solutions in business networks, with particular focus on the interorganisational and interactive aspects involved. With inspiration from the processual approaches to solutions, and drawing from the Industrial Network Approach, with embeddedness, interdependencies and interaction as central features of business networks, a conceptual model is developed. The conceptualisation is required to “open up” the processes of solutions and thereby highlight the implications of the embeddedness of solutions in a business network setting

and shed light on the mechanisms underpinning the need for interaction and the possibilities inherent therein.

By taking an interorganisational approach, the thesis contributes to and further develops the processual and relational approach to solutions. In particular, to highlight the implications of the conceptual model developed, it elaborates a re-conceptualisation of the model introduced by Tuli et al. (2007) and suggests how the Industrial Network Approach can be mobilised to develop knowledge about solutions and value creation in business networks. Hence, while the literature on services and solutions discuss challenges faced by actors in the business network, the thesis also illuminates some of the antecedents underpinning those challenges and suggests how they could be addressed by managers.

The research presented and discussed in the thesis draws from empirical material concerning a selection of firms involved in road transport in Sweden. The single case study, encompassing interviews and observations, specifically focuses on maintenance offerings for heavy vehicles. However, to situate vehicle maintenance solutions within the setting of road transport, data concerning connected relationships and solutions in the broader context of heavy vehicle maintenance were collected as well. Thus, the firms described and analysed in the thesis represent a variety of roles (e.g., transport buyers and transport providers) and transport operations (e.g., for timber and medical supplies) with relevance for heavy vehicle maintenance.

1.6 Structure of the thesis

Following this chapter, Chapter 2 describes the analytical framework of the thesis and articulates the research questions in its final section, Section 2.7, after which Chapter 3 discusses methodological considerations and choices for the doctoral project and the thesis. Next, Chapter 4 presents a firm-level analysis of the case study, which Chapter 5 supplements with a network-level analysis focusing on two examples of firms and solutions in their context. After that, Chapter 6 discusses the empirical material presented and analysed in Chapters 4 and 5 to develop a conceptual model. Additionally, Chapter 6 discusses that model as a means to answer the research questions articulated in Chapter 2. Last, Chapter 7 presents the major conclusions of the thesis, together with their managerial and theoretical implications as well as suggestions for future research.

2. ANALYTICAL FRAMEWORK

2.1 Introduction

The aim of this thesis implies the need for an analytical framework that captures the interactive and interorganisational aspects of solutions in business networks. As a first step to that end, Section 2.2 focuses on a selection of contributions belonging to the literature on solutions, a term generally defined to mean customised bundles of products and services, although a range of alternative definitions have been proposed (e.g., Brax & Jonsson, 2009). Following an introduction relating the discussion on solutions to the notions of complex offerings and systems selling, the section introduces two major, partly contrasting approaches to understanding solutions: the product-centric approach, which focuses on bundles of products and services, and the processual approach, which emphasises relational processes of supplier–buyer interaction. Reflecting the focus and aim of the thesis, the section engages in a more extensive discussion about the processual approach.

Next, to facilitate a discussion about solutions in business networks, Section 2.3 elaborates upon the notion of business networks. In particular, the section focuses on the Industrial Network Approach (e.g., Håkansson et al., 2009), in which the business landscape is viewed as a network of firms interconnected by business relationships. Because the Industrial Network Approach largely forms the theoretical basis of the analytical framework applied in the thesis, the section also identifies and discusses concepts that are crucial to analysing the structure, content and dynamics of the business network studied. Thereafter, to enable a more in-depth analysis of the business network with reference to the Industrial Network Approach, the three layers of the actors–resources–activities (ARA) model (Håkansson & Snehota, 1995) are explained and discussed in Sections 2.4, 2.5 and 2.6, respectively. In the final section of the chapter, Section 2.7, the notion of solutions in business networks is problematised by applying the Industrial Network Approach. Following upon that, the three research questions to be addressed in the thesis are articulated.

Although the thesis seeks to contribute both to the literature on solutions and the literature on the Industrial Network Approach, each stream plays a different role in the subsequent discussion of the thesis. On the one hand, the first stream of literature introduces the notion of solutions and some of the views on the concept applied by researchers. By extension, the literature discussed, and Tuli et al. (2007) in particular, establishes a reference point for the

contributions of the thesis. On the other hand, the second stream of literature, i.e. the Industrial Network Approach, provides concepts required for understanding and explaining the dynamics of business networks and affords a lens for analysing the empirical material collected. In sum, even if the thesis aims to contribute to both streams of literature, the application of and approaches to them differ.

2.2 Solutions

2.2.1 Business-to-business offerings

For firms, the term offering commonly refers to the products and services provided by suppliers to their customers. Whereas products, analogous to the notion of goods, are often conceived as being tangible, services are viewed as being intangible and perishable (Brax & Jonsson, 2009; Cova & Salle, 2008; Håkansson et al., 2009). Moreover, for firms that adopt strategies for adding services to their offerings and combine products and services in integrated, customised bundles (Brax & Jonsson, 2009), the term offering also encompasses those combined offerings.

The provision of complex, integrated offerings tailored to customers is neither a new phenomenon in the industry nor a novel focus for scholars of business-to-business marketing. More than half a century ago, Ansoff and Stewart (1967), for example, discussed strategies for "downstream" application engineering, and some years later, Mattsson (1973, p. 108) explained that *"in systems selling the seller provides, through a combination of products and services, a fulfilment of a more extended customer need than is the case in product selling."*

According to some scholars, however, many companies appear to have been slow to introduce services as a part of their offerings. More than two decades after the previously cited studies, Anderson and Narus (1995, p. 75) highlight that *"most manufacturers have focused only on the products themselves. They have largely ignored another element that plays a crucial role in differentiating a company's offerings and has a huge impact on costs and profits: services."*

Since then, however, the idea of integrating products with services for combined offerings has gained increased attention. Indeed, Cova and Salle (2008, p. 270) argue that, *"the last ten years have seen a major change in industrial companies: they have gone from offering*

products to offering products/services and then to offering solutions to improve their competitive position and to protect their profit margins."

Scholars continue to show interest in complex, integrated business-to-business offerings (e.g., Kowalkowski, Gebauer, & Oliva, 2017), recently, as an example, reflected in a special issue on Complex Product Systems (CoPS) in the Journal of Industrial Marketing Management (Appio & Lacoste, 2019). Thus, the following sections about solutions are underpinned by a discussion amongst practitioners and scholars that has lasted for more than 50 years (cf., Kowalkowski, Windahl, Kindström, & Gebauer, 2015; Raddats et al., 2019). Even so, though the bundling of products and services has received sustained scholarly and practical interest, the sections focus on a more recent object of attention: solutions as relational processes. Such relational aspects of solutions has been identified, for example, by Davies, Brady, and Hobday (2007, p. 185), who argue that *"[w]hereas systems sellers are organized to solve customer's operational problems, solutions sellers offer strategic advice to help a customer develop its business in existing or new markets."*

2.2.2 Two approaches to solutions: The product-centric and the processual

For managers and scholars, a product-centric approach to solutions has played a key role (e.g., Brax & Jonsson, 2009; Galbraith, 2002). From a product-centric perspective, the product (or products) establishes the core of the solution. Brax and Jonsson (2009, p. 137), for instance, argue that *"the basic assumption in the literature is that goods exist first in the firms' offerings, and the challenge in becoming a solutions provider is related to integrating services into the goods."*

In being central to integrated solutions, products are often regarded as tangible and represented by equipment, machinery and vehicles, for instance, whereas services are conceived as intangible and perishable (Cova & Salle, 2008). The services supplementing the products could, for instance, aim at improving the efficiency when using the equipment, lower operating costs or prevent equipment from breaking down. When bundled, the combined product–service offering should provide customers with value beyond what results from buying products and services separately (Brax & Jonsson, 2009). Adding services to a core product should thus improve the offering's value from a customer's perspective (e.g., Oliva & Kallenberg, 2003; Vandermerwe & Rada, 1988).

Reflecting the product-centric approach, some services offered by providers have thus also been referred to as *product-oriented services* (Tukker, 2004). According to Tukker (2004), in product-oriented services the core product forms the focal part of the offering, whereas the related services provide supplementary value for the customer while using the product. From that standpoint, the solution thus consists of a product core combined with one or more services, in a combination that has also been termed an *integrated solution* (Windahl & Lakemond, 2006).

A solution, however, should also be customised to address the specific needs and demands of a customer. Vandermerwe and Rada (1988, p. 318) have even argued that *"[c]ustomers demand more customization. The more information customers get, the more customization they want. Facilitated by technology, client specific services and services to deliver custom-tailored goods are becoming the norm."* By extension, an integrated offering may also be subject to customisation (Sawhney, 2006; Storbacka, 2011). According to Davies (2004), the goal of customisation is to enhance the value of an offering and enable it to better meet the needs of the customer.

Even though adapting offerings to customers is key, a solution provider also has to balance the need for customisation with internal demands for efficiency, which usually underscore the conflicting need for standardisation (Muffatto & Roveda, 2000; Oliva & Kallenberg, 2003; Rust & Chung, 2006). Oliva and Kallenberg (2003, p. 167), for instance, argue that firms offering services need *"to make an explicit decision about the degree of standardization of the service offer in order to balance between the transferability of services across markets versus customization for individual end-users."*

Whereas the product-centric approach situates the product of the bundle at the centre of a solution, a more recent, starkly different view stresses the centrality of the supplier–buyer interaction (e.g., Brax & Jonsson, 2009; Petri & Jacob, 2016). This comparably novel perspective on solutions rests upon the assumption that buyers of solutions emphasise the relational processes involved in a solution, whereas the integrated offering plays an important but less significant role. Advocating a processual approach, Tuli et al. (2007, p. 4) claim that *"[i]n sharp contrast to the view that is dominant in extant literature and among suppliers, most customers view a customized and integrated bundle of products as only a part of a solution and, even then, not the most frequently mentioned part."* To further define their processual view of solutions, Tuli et al. (2007, p. 5) add that:

"Given that the purpose of a solution is to satisfy a customer's business needs, we argue that it is useful to define a solution consistently with the views of customers. As such, we propose that a solution is a set of customer–supplier relational processes comprising (1) customer requirements definition, (2) customization and integration of goods and/or services and (3) their deployment, and (4) postdeployment customer support, all of which are aimed at meeting customers' business needs."

Figure 2.1 presents a model that draws on the conceptualisation of Tuli et al. (2007). Involving four processes, the model emphasises the supplier–buyer interaction occurring during the definition, development, deployment, and, postdeployment support.

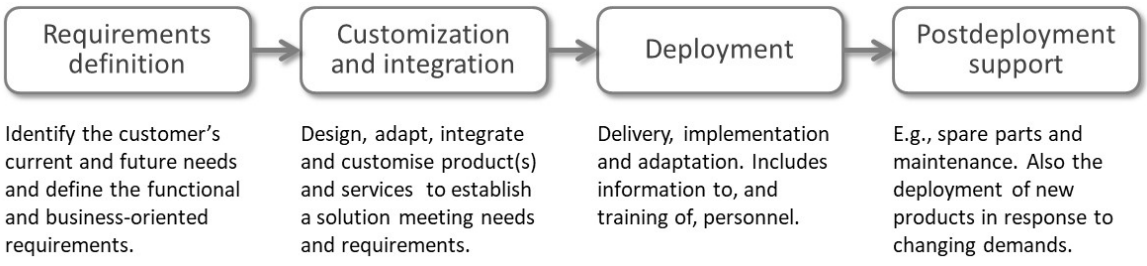

Figure 2.1: The processual model of Tuli et al. (Adapted from Tuli et al., 2007, p. 5)

As the processual, interactive approach to solutions has gained continued attention, scholars have not only suggested extensions to the model proposed by Tuli et al. (2007) but also discussed alternative views that draw upon the notion of interaction. The next section addresses some of the extensions and alternative models discussed in the literature.

2.2.3 Extended and alternative processual approaches to solutions

Since the contribution of Tuli et al. (2007), the discussion amongst researchers and practitioners about the processual and relational characteristics of solutions has broadened. In their corresponding contributions, extensions to the model of Tuli et al. (2007) as well as alternative models have been suggested.

Amongst those contributions, Töllner et al. (2011) have claimed that to better accommodate the characteristics of the capital goods industry, the original model of Tuli et al. (2007) should be further developed (see Figure 2.2). To that end, with reference to their study about

buyer representatives involved in procuring a capital good, Töllner et al. (2011) have proposed supplementing the original model with an initial process termed *signalling*. According to the authors, through this signalling process, suppliers could assure buyers of their competence, experience and commitment. Moreover, because buyers of capital goods *"consider coordination of the entire solution process as part of the solution"* (Töllner et al., p. 716), the authors introduced a sixth process, labelled *inter-process management*, which encompasses four sub-processes: *coordination, time management, incorporation and improvement,* and *proactive support.*

More recently, Petri and Jacob (2016) have also highlighted the need to further develop the model introduced by Tuli et al. (2007). Based on their findings about customers' contributions to value co-creation, Petri and Jacob (2016, p. 65) argue that

> *"[i]n contrast to Töllner et al.'s (2011) enhancement of Tuli et al.'s (2007) solution process, the interviewed customers and providers indicated that the solution process begins even earlier, when the customer defines the reason the provider is needed in the solution process."*

In response to those findings, Petri and Jacob (2016) introduce a supplementary process for the definition of problems and needs; a process that precedes the relational processes suggested by Tuli et al. (2007) and Töllner et al. (2011).

Figure 2.2 presents an aggregated model combining the relational processes suggested by Tuli et al. (2007), Töllner et al. (2011) and Petri and Jacob (2016). The aggregated model consists of six sequential processes along with the process for inter-process management suggested by Töllner et al. (2011).

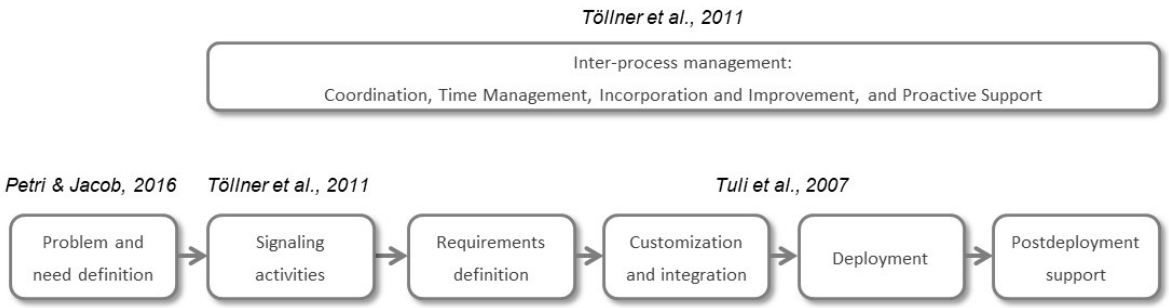

Figure 2.2: A model combining the seven processes defined by Tuli et al. (2007, p. 5), Töllner et al. (2011, p. 717) and Petri and Jacob (2016, p. 66)

The notion of linear, sequential processes has however been called into question. Drawing from the results of a qualitative study conducted amongst buyers and suppliers, Aarikka-Stenroos and Jaakkola (2012, p. 23) claim that *"the process does not necessarily progress in a linear fashion – the activities may occur in parallel and in diverse order."* In response, they suggest a cyclical model involving five dyadic collaborative processes: *diagnosing needs, designing and producing the solution, implementing the solution, managing value conflicts* and *organizing process and resources* (see Figure 2.3). According to the authors, value is co-created as a result of joint problem-solving enabled by those five collaborative processes.

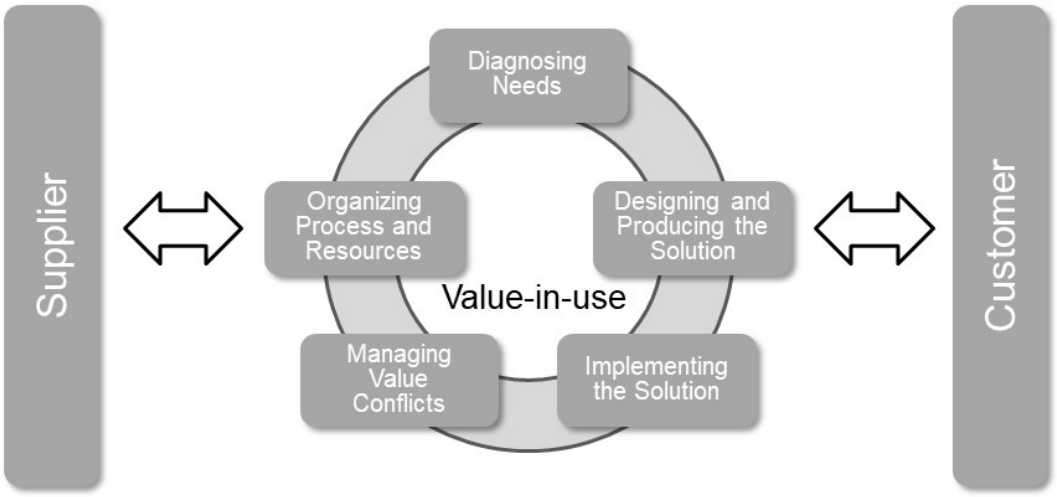

Figure 2.3: Joint problem-solving in collaborative activities in a dyadic context, adapted from Aarikka-Stenroos and Jaakkola (2012, p. 22)

In another contribution, Storbacka (2011, p. 699) has defined *integrated solutions* as

> *"longitudinal relational processes, during which a solution provider integrates goods, service and knowledge components into unique combinations that solve strategically important customer specific problems, and is compensated on the basis of the customer's value-in-use."*

In the contribution, involving a discussion on capabilities and management practices for solutions-oriented business models, Storbacka (2011) proposes a *solution business model framework* reflecting a processual approach. The framework of Storbacka (2011, p. 703), see Figure 2.4, involves four interconnected and iterative phases that the author identify as "*the four phases of the solution process"*: *develop solutions*, *create demand*, *sell solution*,

and, *deliver solution* (Storbacka, 2011, p. 702). Whereas the first two processes concern the provider's overall solution portfolio, the final two concern a specific customer solution. Along with these four phases, Storbacka (2011) introduces three parallel processes—*commercialization*, *industrialization* and *solution platform* (see Figure 2.5)—for addressing issues that arise in the cross-functional management required for the development, sale and value creation of solutions.

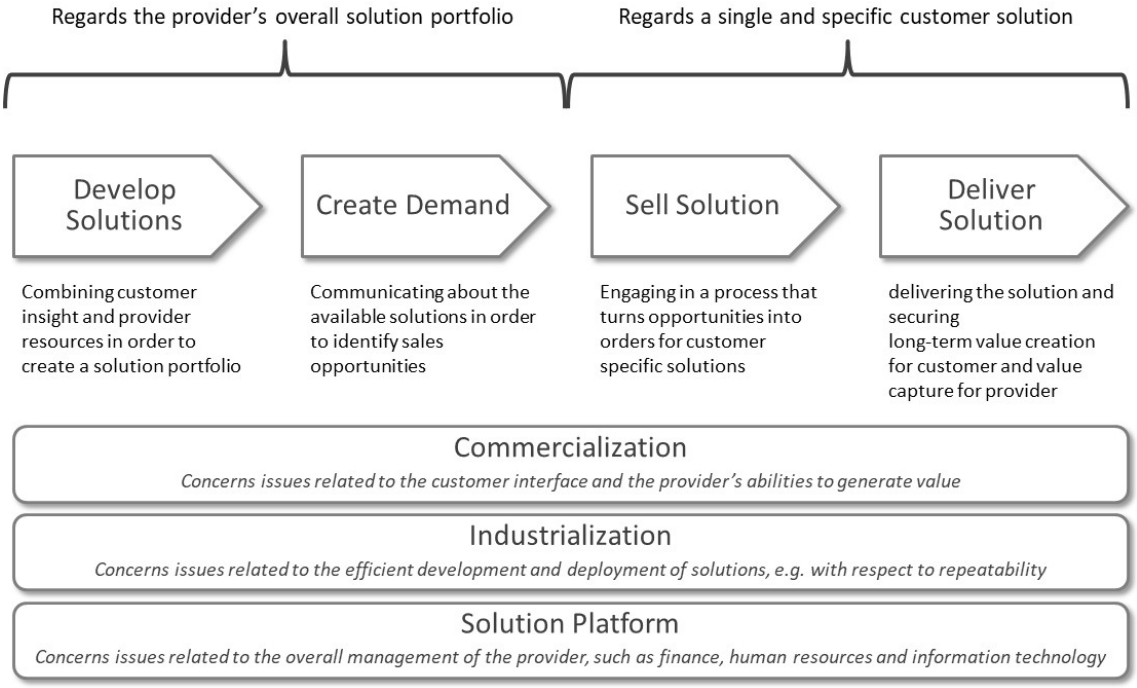

Figure 2.4: An overview of the four phases of the solution process (on top) situated in the solution business model framework, based on Storbacka (2011, pp. 700–703)

Taken together, the contributions discussed above exhibit similarities as well as differences. Although all of the proposed models involve relational and collaborative processes, their number of processes differs, as do the structure and the scope of each process. Moreover, whereas the models of Tuli et al. (2007), Töllner et al. (2011) and Petri and Jacob (2016) take sequential, linear approaches, the model of Aarikka-Stenroos and Jaakkola (2012) involves processes arranged cyclically. Further still, with respect to the perspective chosen by authors, Tuli et al. (2007) and Töllner et al. (2011) take the perspective of customers, Storbacka (2011) and Petri and Jacob (2016) take the perspective of providers, and Aarikka-Stenroos and Jaakkola (2012) takes a dyadic perspective. Another difference concerns the provider's solution portfolio. Unlike the other authors, Storbacka (2011) has addressed

activities and issues related to defining and developing complete solution portfolios as well as to customising solutions for individual customers. To provide an overview of the models discussed, along with the scope and structure of the processes involved, Figure 2.5 summarises some of the key aspects of each contribution.

	Tuli et al. (2007)	Töllner et al. (2011)	Petri and Jacob (2016)	Storbacka (2011)	Aarikka-Stenroos and Jaakkola (2012)
Structure and Focus					
Focus	• Relational processes • Supplier-buyer dyad • Process centric	• Solution processes • Supplier-buyer dyad • Different views of buying centre roles	• Customers' contribution to value (co)-creation • Supplier-buyer dyad	• Business model framework • Collaborative processes	• The dyadic collaborative process of value co-creation
Structure	• Linear and sequential processes	• Linear and sequential processes • Coordination in parallel	• Linear and sequential processes	• Linear, sequential, and iterative processes	• Non-linear process
Perspective	• Customers' perspective	• Customers' perspective	• Providers' perspective on customers	• Providers' perspective, capabilities and management practices	• Dyadic perspective
Empirical data	• Qualitative and explorative study • Suppliers and buyers in four industries	• Qualitative and explorative study • Buyers in capital goods industry	• Qualitative and explorative study • Suppliers and buyers in KIBS	• Qualitative and abductive study • Multinational industrial suppliers	• Qualitative and explorative study • Suppliers and buyers in KIBS
Processes Suggested					
	• Requirements definition • Customization and integration • Deployment • Postdeployment support	As for Tuli et al. (2007) plus: • Inter-process management • Signaling activities	As for Tuli et al. (2007) and Töllner et al. (2011) plus: • Problem and need definition	• Develop Solutions • Create Demand • Sell Solution • Deliver Solution • Commercialization • Industrialization • Solution Platform	• Diagnosing needs • Designing and producing the solution • Implementing the solution • Managing value conflicts • Organizing process and resources • Value in use

Figure 2.5: An overview of contributions to literature on the processual approach to understanding solutions

In all, unlike a product-centric approach, in which a product–service bundle is central to an offering, the processual approach emphasises the significance of supplier–buyer interaction. Even if the conceptual models discussed (e.g., Aarikka-Stenroos & Jaakkola, 2012; Storbacka, 2011; Tuli et al., 2007) display variety in the number, order and scope of their processes (see Figure 2.5), they all predominantly focus on processes and the notion of supplier-buyer interaction.

To address the aim of the thesis, the model by Tuli et al. (2007) is used as a reference point for the discussion in the subsequent chapters. Even though it has been questioned and alternative models have been proposed, the model of Tuli et al. (2007) nevertheless represents a significant contribution in the field. At the same time, to facilitate a more

extensive discussion about the inter-firm interaction stressed by Tuli et al. (2007), and enable for a study of the business relationships and joint organising that concerns the interconnected firms, additional concepts need to be mobilised. For that purpose, taking an interorganisational view of the business landscape could afford such concepts, hence the next section's shift in focus to interaction within business networks.

2.3 A business network perspective

2.3.1 Business networks and the Industrial Network Approach

The suppliers and buyers of products, services and combined offerings neither exist nor act in isolation but form part of a *business network* (Håkansson & Snehota, 1989). In the business network, the suppliers and buyers interact with each other as well as with other actors. To set the stage for a discussion about the implications of firms' interconnectedness and interactivity, the analytical framework applied should also include concepts related to the dynamics and characteristics of business networks. For this purpose, the following discussion introduces the Industrial Network Approach (INA), also called the IMP tradition.

A fundamental premise of the INA is to conceptualise the business landscape as a business network encompassing firms interconnected by business relationships (Håkansson et al., 2009; Håkansson & Snehota, 2017b). According to the INA, a business network has neither a specific centre nor any boundaries limiting the network in space. In that light, business networks entail complexity and comprise a vast number of firms and business relationships. However, to enable studies of firms in such business networks—for example, the case study presented in this thesis—the networks often have to be simplified and delimited to suit the purpose of analysis. Therefore, a set of firms involved in business with a specific scope or purpose—for instance, a network of firms involved in the transport of goods—may be conceptualised as a limited network which structure and boundaries draws from the perspectives of the firms involved in or concerned by a focal phenomenon.

Conceptualising interconnected firms as a business network stresses the importance of business relationships and the inter-firm interaction that they enable. In their discussion about value generation, La Rocca and Snehota (2014, p. 5) explain the fundamental importance of a business relationship:

> *"Typical of customer-supplier relationships in B2B is also the rich content, which usually consists of a range of products, services, logistics, communication and administrative routines, and involves numerous individuals. Such a relationship is complex as it connects two business systems with their various tangible and intangible resources and on-going activities. Numerous individual actors concur in defining not only product solutions but also solutions regarding all other aspects of the relationship content."*

In that sense, business relationships establish a medium for the connectedness and interaction of firms, and by way of such relationships, firms within the network influence and are influenced by each other. According to Håkansson and Snehota (1995, p. 20), *"[b]usiness relationships have the components of mutual orientation, commitment, adaptations, trust-building and social exchange over time. There is mutual interdependence of outcomes since they cannot be controlled unilaterally."*

In the context of the INA, the interaction within business relationships can thus be seen as a notion reflecting the ideas of Granovetter (1985). Granovetter (1985, p. 487) claim that:

> *"[a]ctors do not behave or decide as atoms outside a social context, nor do they adhere slavishly to a script written for them by the particular intersection of social categories that they happen to occupy. Their attempts at purposive action are instead embedded in concrete, ongoing systems of social relations."*

To that, Granovetter (1985, p. 482) added that embeddedness in a social structure and context imply *"that the behavior and institutions to be analyzed are so constrained by ongoing social relations that to construe them as independent is a grievous misunderstanding."* Such arguments align well with the INA's ideas that firms in a business network influence and are influenced by each other.

As the foregoing discussion implies, the idea of interaction is central to the INA. According to Håkansson et al. (2009), the interaction between firms occurs in episodes, which though conceivable as single, self-contained instances of interaction, should instead be conceived as being interconnected in space and time. As Håkansson et al. (2009, p. 35) have explained, the past, present and future all have implications for interaction. The interaction between two firms is influenced by their experiences from previous interaction and the results therefrom. Previous interaction will, for example, influence the attitudes and behaviours of

the actors that was involved or effected. At the same time, because previous interaction may have resulted in adaptations and adjustments, the options for present and future interaction may be constrained. Last, expectations for the future influence what happens in the present. Hence, as can be understood from the above, the temporal aspects concerning interaction in business networks are of high importance for the INA. Based on the work of Jahre, Gadde, Håkansson, Harrison, and Persson (2006, p. 54) and Håkansson et al. (2009, p. 35), Figure 2.6 illustrates the ideas of how experiences based on past interactions and expectations for the future influence current interaction taking place between firms.

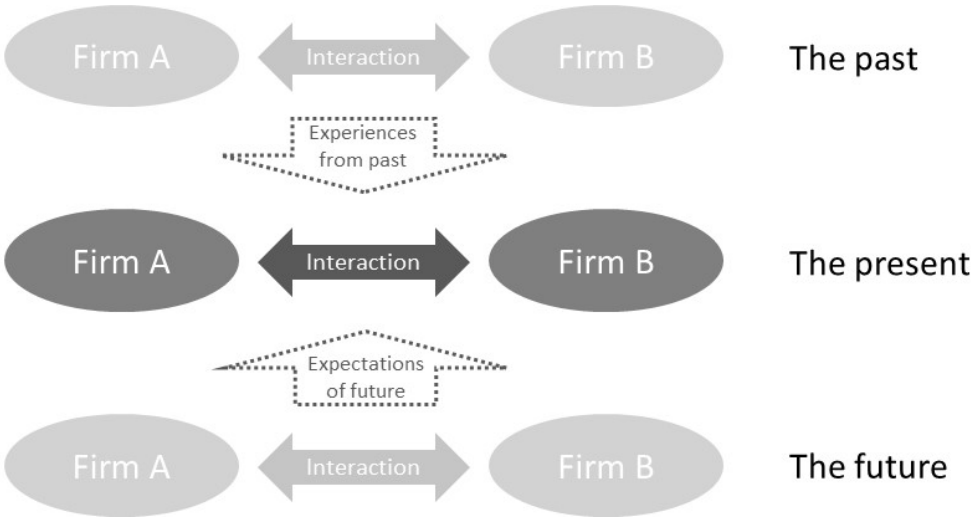

Figure 2.6: How past experiences and expectations about the future influence the interaction between Firm A and Firm B, based on Jahre et al. (2006, p. 54) and Håkansson et al. (2009, p. 35)

In addition to the temporal aspects, the spatial characteristics of interaction are also of key importance for firms (Håkansson et al., 2009). Therein, firms embedded in the business network are connected to other firms by way of business relationships, and because firms are often involved in several business relationships, they could thus be engaged in several instances of interaction simultaneously. Taken together, the interconnected firms and their business relationships forms a business network, a notion that could be imagined as a "business network space". As the business relationships embedded in the network are interconnected, the interaction within a particular business relationship influences and is influenced by interaction occurring elsewhere in the business network (Håkansson & Snehota, 1995). Figure 2.7 illustrates how the interaction in business relationships

embedded in a business network influence and is influenced by the interaction in other business relationships due to their connectedness and interdependencies. Due to such interconnectedness, ongoing interaction between actors can influence the intensity, direction and outcome of interaction elsewhere in the business network.

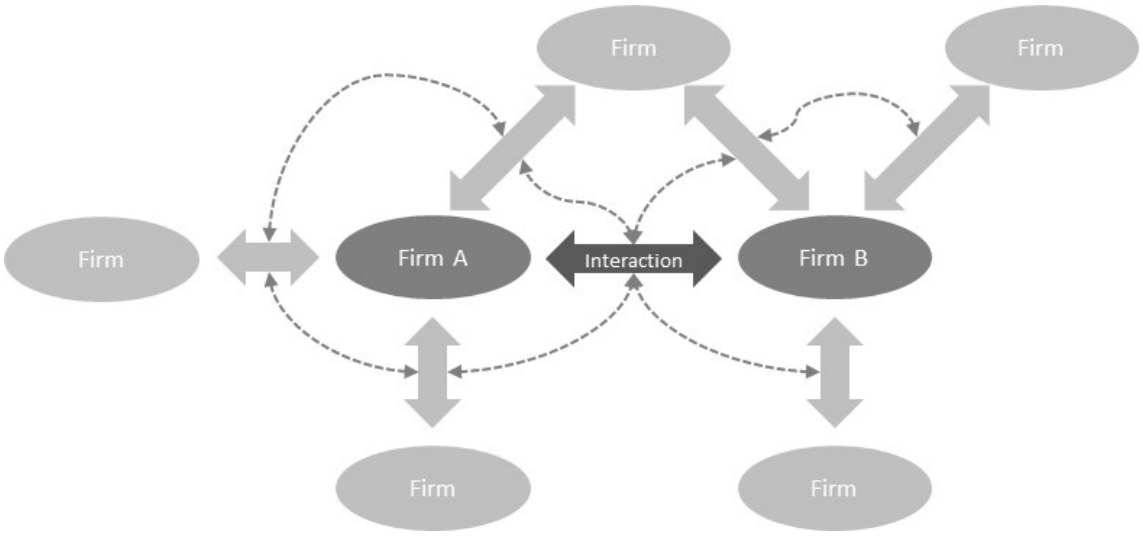

Figure 2.7: How the interaction in business relationships is influenced by the interaction in other business relationships within a business network

The temporal and spatial aspects of interaction reflect important characteristics of a business network; the interaction that takes place within a dyad cannot be conceived in isolation. After all, the interaction between firms connected by way of a business relationship influences and is influenced by past, current and future interaction in the business network. A critical implication of those aspects is that actors that interact cannot exert full control over the direction or outcome of their interaction.

For the thesis, applying a processual and interactive perspective on the phenomenon of solutions in business networks, the temporal and spatial dimensions establish key concerns. Indeed, as Törnroos, Halinen and Medlin (2017, p. 11) point to, *"[t]he constitution of process, comprising unfolding events, activities, and connected structures, relies on difference in space and time."* For the thesis, the dimension of time is most strongly reflected in the actors view on past and presents events, as well as their expectations about the future. In comparison to "clock time", the event based time is socially constructed by actors in interaction (Halinen, Medlin & Törnroos, 2012). The spatial dimension, as further discussed in Chapter 3, is reflected both in a more static view, such as the structures of

activities and resources in business networks, but also in relation to the dynamic context of business networks (cf., Törnroos et al., 2017).

For a more detailed analysis of business networks and the interaction taking place in business relationships, still other additional concepts and terms need to be mobilised. Therefore, the following sections expand the analytical framework for understanding business networks by a discussion on the characteristics and structures of the elements establishing the network.

2.3.2 Dimensions of a business network

Shown in Figure 2.8, the three-layered activities-resources-actors (ARA) model of the INA (Håkansson & Snehota, 1995) involves three types of elements: activities, resources and actors. In the INA, the *activities "... are performed by the actors which means that resources are combined, developed, exchanged or created by use of other resources"* (Håkansson, 1987, p. 15). Moreover, the *resources "consist of physical assets (machinery, material, etc.), financial assets, and human assets (labour, knowledge and relationships)"* (ibid., p. 16). And finally, the *actors* represents *"those who perform activities and/or control resources"* (ibid., p. 14), e.g., firms, departments or individuals.

The elements within each of the three layers of the ARA model are connected; activities are connected by *activity links*, actors are connected by *actor bonds*, and resources are connected by *resource ties* (Håkansson & Snehota, 1995). Furthermore, the three layers of the ARA model are interdependent (Håkansson, 1987). After all, activities are performed by actors, and both activities and actors use, produce and exchange resources. For those reasons, the business relationships within a business network could be conceptualised as being constructed by three interconnected, interdependent layers involving activity links, actor bonds and resource ties. However, as firms may encompass internal structures established by connected elements (i.e. activities, resources and actors), for the purpose of the thesis and the subsequent discussion, it is assumed that also the activities within firms are connected by activity links, the resources by resource ties and the actors by actor bonds.

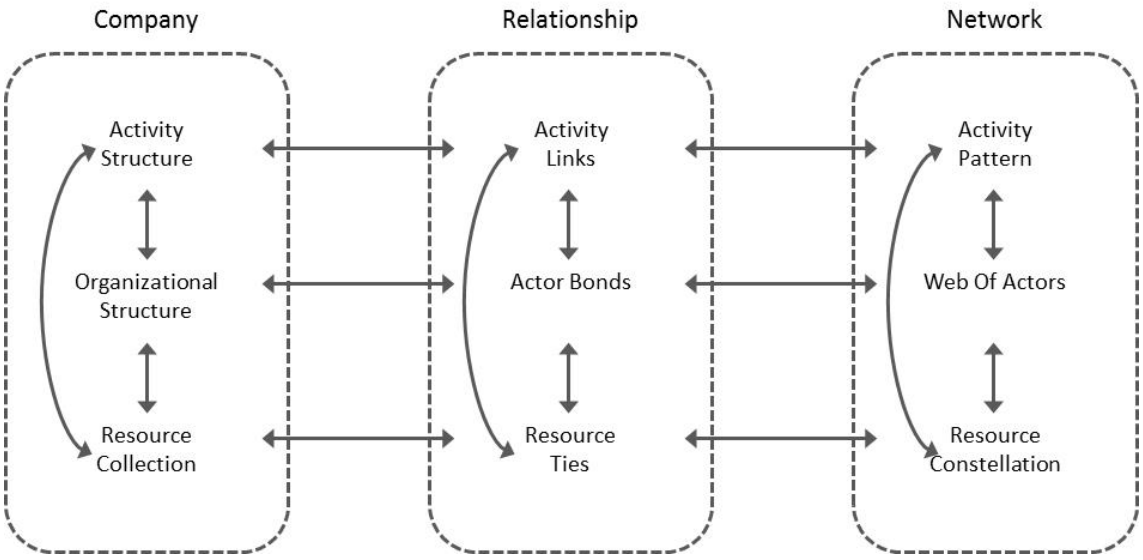

Figure 2.8: The actors–resources–activities (ARA) model, adapted from Håkansson et al. (2009, p. 67) and Håkansson and Snehota (1995, pp. 43–44)

Because the three layers of the ARA model are connected and mutually influence each other, changes in one layer may result in changes within one or both of the other two layers. Interaction within and amongst the layers results in adjustment and adaptation of elements and their structures that, in turn, prompt the further development of *interdependencies* (Håkansson et al., 2009). Interdependencies take different forms depending on which of the three layers is concerned, and to navigate interdependencies, actors tend to seek ways to manage activities and resources. Therefore, interdependencies amongst activities and resources can be conceived both as a cause and effect of interaction amongst actors within the business network (cf., Bankvall, 2011, p. 25).

All together, firms embedded in the business network are connected and interact by way of business relationships. Each business relationships involves activity links, resource ties, and actor bonds. To better understand the dynamics of interaction amongst firms, it is thus important also to study the three interconnected layers of the ARA model. Therefore, to facilitate a more detailed analysis of the interaction within business networks, the next three sections elaborate upon the activities, resources and actors of such business networks.

2.4 Activities in business networks

According to Håkansson (1987, p. 15), the two main categories of activities are *transformation activities,* which improve one resource by the use of others, and, *transaction*

activities, linking transformation activities, forming chains and creating relationships. As Håkansson and Snehota (1995) have explained, activities are arbitrarily delimited and often possible to divide into sub-activities as well as to include in overarching activities. The machining of an aluminium block, for instance, could involve the sub-task of drilling holes and simultaneously form part of an overarching assembly activity. By extension, in being connected by activity links, activities form activity structures and activity patterns. According to Håkansson and Snehota (1995, p. 26), *"[a]ctivity links regard technical, administrative, commercial and other activities of a company that can be connected in different ways to those of another company as a relationship develops."* An *activity structure* encompasses the interconnected activities of a single firm, whereas an *activity pattern* crosses firm boundaries and thus comprises the activities of multiple actors (Håkansson & Snehota, 1995).

Activity links form part of the business relationships amongst actors and influence as well as are influenced by the interaction that take place within those relationships. Because efficiency and effectiveness are important aspects of the activity layer, as actors interact to solve a problem or to improve the performance of the activity pattern, the activities linked together become subject to *adjustments* (Håkansson et al., 2009; Håkansson & Snehota, 1995). The adjustments of activities can affect, for instance, the exchange of information, transportation, physical handling, payment routines, rationalisation and/or reallocation, if not both, of production processes and product adaptations (Håkansson & Snehota, 1995). When made to influence activities that are linked to each other, such adjustments results in the development of interdependencies (Håkansson et al., 2009). At the same time, the adjustments of activities within a dyad can also influence the overarching activity pattern. Because business relationships are connected and interdependent, any adjustment in a specific business relationship can prompt the need for adjustments in other business relationships. Consequently, activities linked within a dyadic business relationship may have to be more or less continuously adjusted in response to events occurring elsewhere in the business network.

In effect, adjustments leads to that activities within activity structures and activity patterns exhibit interdependencies in various forms that previous research has sought to define. In an influential work on the operations of firms and intra-firm organising, Thompson (1967, pp. 54-55) defined three types of interdependencies: *pooled*, *sequential* and *reciprocal*. Although the interdependencies in the context that Thompson (1967) studied concerned the

structure and interaction of organisations, the definitions proposed have inspired scholars interested in the interdependencies of activities within business networks as well (e.g., Najafi, 2015). Therefore, for the purpose of this thesis, the definitions of Thompson (1967) are applied to discuss the interdependencies of activities in the activity layer of the ARA model.

For one, *pooled interdependence* refers to situations in which *"each part renders a discrete contribution to the whole and each is supported by the whole"* (Thompson, 1967, p. 54). If applied to the context of activities for machining, assembly and painting, for example, such activities contribute to, and also depend upon, the assembly of the final product. By contrast, *sequential interdependence*, Thompson (1967, p. 54) has explained, concerns situations in which an activity has to be completed before the next can commence, as is frequently the case on an assembly line, for instance. Last, *reciprocal interdependence* refers to situations in which the output of one activity establishes input for another, and vice versa (Thompson, 1967, pp. 54-55). Such interdependencies can be observed in the interaction between actors involved in services such as online banking and vehicle maintenance. According to Thompson (1967, p. 55), the three types of interdependencies are not exclusive, and *"all organizations have pooled interdependence; more complicated organizations have sequential as well as pooled; and the most complex have reciprocal, sequential and pooled."*

Because the interdependencies amongst activities exert significant impact upon the performance of firms' operations, firms have to find ways of managing, or coping with, those interdependencies and their effects. Therefore, as Thompson (1967, pp. 55-56) has explained, coordination is pivotal. By way of coordination, interdependencies can be addressed and the actors involved can find ways of coping with or counteracting their negative effects and, in turn, leveraging their benefits. For pooled interdependencies, Thompson (1967, p. 56) has advised coordination via *standardisation of routines and rules*, which requires *"that the situations to which they apply be relatively stable, repetitive, and few enough to permit matching of situations with appropriate rules."* Thompson (1967) has also suggested that sequential interdependencies, on the contrary, require *coordination by planning* and, last, that reciprocal interdependencies necessitate *coordination through mutual adjustment*. The coordination via planning requires scheduling, but also accommodates contexts that are more dynamic. For mutual adjustment, by some contrast, a

bidirectional exchange of information is necessary, which accommodates variable, even unpredictable contexts.

Over time, as a result of their interaction and the evolution of activity patterns, actors tend to specialise (Håkansson et al., 2009) as a means to enhance their productivity and reduce costs. According to Håkansson et al. (2009), the adjustment of activities over time can also result in specialisation, which allows for improved efficiency and effectiveness by, for instance, making activities repetitive, routinised or standardised. Furthermore, via specialisation, firms can become able to leverage economies of scale. The specialisation of activities within a firm can thus be conceived as a driver of decisions concerning the division of labour amongst actors. As Dubois (1994, p. 30) has explained, the *"economies of specialisation related to scale and learning are naturally important explanations of why transformation activities [are] performed by different specialising actors."* Therefore, the specialisation of firms in using a certain technology, applying certain knowledge or implementing a certain set of activities, as examples, will influence actors' make-or-buy decisions and, in turn, affect the division of labour. At the same time, however, specialisation can have undesirable effects as well. For instance, as Håkansson et al. (2009, p. 43) have cautioned, *"[a]djustment in one interaction process in order to increase specialization in one activity pattern frequently lead to problems in another pattern."*

The definition, development and deployment of solutions, as well as post-deployment support for them, involves activities performed by suppliers, buyers and partners. Therefore, for firms, it is pivotal to understand the interdependencies among, and manage the organizing of, activities involved in the solutions. Moreover, because activities use, produce and exchange resources, it is also important to understand and manage the interplay between the activity layer and the resource layer of a business network. To enable such analysis, the next section will expand the discussion on resources of the business network.

2.5 Resources in business networks

Addressing the resource layer of the ARA model, Håkansson (1987, p. 16) has posited that resources *"consist of physical assets (machinery, material, etc.), financial assets, and human assets (labour, knowledge and relationships)."* However, since then, the initial typology of resources has been further developed. The *4R model* proposed by Håkansson and Waluszewski (2002a) establishes a framework emphasising the interaction of resources.

According to the 4R model, also known as the *resource interaction approach* (Holmen & Pedersen, 2012), there are four types of resources: *products, production facilities, business units* and *business relationships* (Håkansson & Waluszewski, 2002a, pp. 35-37). Even though the physical and tangible aspects of products have often been emphasised in the literature, scholars have also pointed out that services form part of the scope. According to Bocconcelli, Murmura, and Pagano (2018, p. 103), for example, *"[p]roducts are goods and services, or a combination of these, that are exchanged and utilized by organizational units."* Because solutions are frequently viewed as bundles of products and services—that is, resources combined with each other (Cantù et al., 2012)—the claims of Bocconcelli et al. (2018) is of specific interest to this thesis.

Resources embedded in a business network are not only connected by resource ties but also form structures. As Håkansson and Snehota (1995, p. 26) have explained, "*[r]esource ties connect various resource elements (technological, material, knowledge resources and other intangibles) of two companies"* and *"result from how the relationship has developed and represents in itself a resource for a company."* By extension, a set of resources belonging to a single actor is called a *resource collection*. By even further extension, as firms interact, their various resources become interconnected via resource ties, and the set of their total resources is called a *resource constellation* (Håkansson & Snehota, 1995). In business relationships, actors interact and combine resources in various ways and for various purposes, a process also termed as *resource interaction* (Baraldi, Gressetvold, & Harrison, 2012; Håkansson & Waluszewski, 2002b). Gadde and Håkansson (2008) explain that this inter-firm interaction and resource combining is a means for firms when accessing, designing and using resources. Complicating such interorganisational resource interaction, however, as Cantù et al. (2012, p. 146) have noted, is that *"different actors perceive the same combination of resources as different solutions to different problems."*

A core theoretical assumption related to the value of resources concerns the notion of *heterogeneity* (Holmen & Pedersen, 2012; Penrose, 1959). As Axelsson and Easton (1992, p. 17) have noted, however, *"[t]he sources of heterogeneity are easy to describe, less easy to model."* To that, Håkansson (1994, p. 258) has added, that *"[a] resource is said to be heterogeneous when its value (performance) is dependent on which other resources it is combined with. Consequently, a homogeneous resource has the same value regardless of which resources it is combined with."* For instance, the value of a workshop machine, as a tangible resource, therefore depends on which raw material, as another tangible resource, it

is combined with to produce products, which are yet other tangible resources. Another implication of the relative value of resources is that the value of one resource may be changed, improved for instance, due to its interaction with others. Therefore, by way of interaction, a buyer can influence the value of resources provided by a supplier (Håkansson et al., 2009, p. 72).

In the process of resource interaction over time, resources are combined and re-combined. As a result of that interaction, resources are subject to adaptation, i.e. they develop and change. Håkansson et al. (2009, p. 70) explain that *"[t]he effects of previous interactions are expressed in specific resource features and resource interfaces that strongly influence how each resource can be used."* Therefore, resource interfaces enable the combining of specific resources, and the more interfaces a resource has, the greater its *resource versatility* (Holmen, 2001).

As the literature reveals, various types of resource interfaces have been defined; Dubois and Araujo (2006) have identified two types—*technical interfaces* and *organizational interfaces*—to which Jahre et al. (2006) added a third, supplementary type: *mixed resource interfaces*. According to Dubois and Araujo (2006), *technical interfaces* concerns interfaces between elements and products—for instance, between components of sub-systems—whereas *organisational interfaces* regards interfaces between organisational units within and amongst firms. Consequently, *mixed interfaces* concern the interfaces occurring between technical and organisational resources (Jahre et al., 2006).

As actors engage in resource combing to realise certain objectives and accomplish certain results, resources become combined and re-combined time and again. Over time, such resource interaction generates resources that are mutually adapted and interdependent (Håkansson & Snehota, 1995). Firms that engage in resource interaction invest time and money to ensure that the adaptation of resources achieves the desired goals. Due to resource interaction and resource adaptation, the resources involved form specific and unique combinations. In turn, as Håkansson (1994, p. 259) has explained,

> *"[c]ost and revenue effects will then occur due to this uniqueness. In order to take advantage of the uniqueness it is necessary to learn about the counterpart, i.e. to develop a relationship with it […]. At the same time, there are costs related to handling and adapting to individual counterparts."*

Continuing the discussion, Håkansson (1994, p. 260) argued that *"[t]he costs of exchanging one relationship for another will be quite substantial."* In the same vein, Håkansson and Waluszewski (2002b) introduce the notion of *heaviness*. From their perspective, firms make investments when developing resources in relation to each other, and *"[d]ue to many related investments, these together create a heavy structure that has to be used over time"* (Håkansson & Waluszewski, 2002b, p. 562).

The implications of the investments discussed by Håkansson (1994) and the consequence of the heaviness discussed by Håkansson and Waluszewski (2002b) point in the same direction. Due to the adaptation of resources and the time, effort and monetary means required for those adaptations, it may be difficult for firms to change from one technology to another or from one supplier to another. Adaptations resulting from resource interaction may therefore lead to a so-called "lock-in", in which firms continue to use a technology, solution or business partner. Håkansson et al. (2009, p. 71), for example, have explained that *"[t]here is no empty space waiting for a new resource. Each has to generate its own space and find its role in relation to existing resource combinations."*

Focusing on the activities and resources of the ARA model, the two preceding sections imply the importance of actors to the interaction and dynamics of a business network. Therefore, the next and final section concerning the three dimensions of the ARA model focuses on actors and their roles within business networks.

2.6 Actors in business networks

Actors represent the elements of a business network that perform activities, combine resources and interact with others by way of business relationships (Håkansson, 1987; Håkansson et al., 2009). Therefore, in organising activities in industrial processes (Dubois, 1994) and in combining resources to offer solutions (Cantù et al., 2012), actors play a central, pivotal role.

From the perspective of the INA, the actors within the business network can represent different levels of organisations (Håkansson, 1987). At a "small-scale" level, for instance, actors may represent particular individuals in firms and organisations, whereas at a more aggregated level, the actors may represent entire firms or even multinational corporations. For that reason, the level examined in a given study depends on the level of analysis, the phenomenon being studied and the scope of the research. At the same time, the question of

which level to investigate also arguably relates to the question of where to draw the boundary; the individual forms part of a department that is organised within a business unit that, in turn, belongs to a firm of a multinational company group. As highlighted by scholars, the question of boundary setting has implications for both practice as well as research (e.g., Dubois, 1994; Gadde, 2013; Holmen, Aune, & Pedersen, 2013; Lind, 2006; Munksgaard, Olsen, & Prenkert, 2017). Reflecting the case study presented in this thesis, the discussion in subsequent chapters mostly conceives actors as firms that take on various roles in relation to each other.

The actors in a business network are connected by actor bonds and collectively form what is called a *web of actors*. According to Håkansson and Snehota (1995), actors bonds influence the construction of identity as well as the formation of trust and commitment, meaning that actors become mutually oriented and identified in relation to other actors. By extension, an actor's roles and actions are influenced by its interaction with other actors and its knowledge about resources owned and activities managed by other actors. As a result, the actions performed by an actor are based upon its intentions informed by its knowledge of and perspectives on the business network and the intentions of other actors (Håkansson et al., 2009). Even if an actor simultaneously embodies several roles—for example, as a buyer and as a supplier—the actor does not create those roles in isolation. On the contrary, each role is jointly created in interaction with others (Håkansson & Snehota, 1995).

As mentioned, actors in the ARA model represent a variety of organisational forms, ranging from individuals to multinational company groups. Therefore, the analysis of the interaction amongst actors in a business network may be performed at different levels depending on the focus and purpose of the study. For example, some studies focus on the bonds between individuals, whereas others focus on the business relationships amongst large firms. In any case, however, actors are assumed to act according to their intentions as well as their perceptions of the business network and the roles, actions and intentions of other actors. Therefore, actors are not isolated but influence and are influenced by other actors in the network (Håkansson & Snehota, 1995). Following the same logic, an actor's evolution depends upon its interactions with other actors. Through interaction, firms combine and adapt their resources as well as link and adjust their activities, all of which means that firms do not evolve in isolation but co-evolve along with others in the business network (Håkansson et al., 2009).

Reflecting the embeddedness of actors and how actors influence each other, the roles and the actions of an actor also depend upon the intentions and actions of other actors (Håkansson & Ford, 2002; Håkansson et al., 2009). In being embedded, actors thus encounter various opportunities as well as obstacles. A firm striving to realise a certain goal, for instance, could try to influence a supplier's actions in order to more easily reach that goal. At the same time, due to the interdependencies of firms and their business relationships, both actors are also subject to the influence of other actors embedded in the same business network. Therefore, although actors may attempt to act freely according to their own intentions, their organising of activities and resources will be influenced by the actions of other actors.

In light of the embeddedness of actors as well as the implications of business relationships and interdependencies, studies concerning the organising and management of activities and resources in a business network benefit from adopting an interorganisational approach. Encompassing a problematisation of solutions in business networks and the articulation of research questions, the final section of this chapter thus draws from the Industrial Network Approach and its concepts related to the three layers of the ARA model: activities, resources and actors.

2.7 Solutions in business networks: Problematisation and research questions

2.7.1 Solutions and business networks

Literature discussing solutions relates to several different streams, such as the servitization literature, the marketing literature and the literature on operations management (Storbacka, 2011), and applies a range of different theoretical perspectives. Although many of the studies share the method applied, i.e. being case studies involving interviews, the specific focus of the research ranges over a wide array of topics. The areas discussed includes topics such as value creation (e.g., Jaakkola & Hakanen, 2013; Skarp & Gadde, 2008; Cova & Salle, 2008), business models (e.g., Storbacka et al., 2013; Ferreira, Proença, Spencer, & Cova, 2013; Frankenberger, Weiblen & Gassmann, 2013), organising (e.g., Davies et al., 2007; Hakanen, 2014; Salonen & Jaakkola, 2015), and, relationships (Windahl & Lakemond, 2006; Skarp & Gadde, 2008).

In many cases, the literature applies a perspective in which solutions are seen as integrated bundles (e.g., Jaakkola & Hakanen, 2013; Davies et al., 2007, Salonen & Jaakkola, 2015;

Ferreira et al., 2013). A lower number of publications instead apply a processual approach to solutions. In addition to the literature discussed in Section 2.2.3, a processual perspective has also been applied in a few additional contributions. Storbacka et al. (2013), for example, define solutions as longitudinal relational processes, and Skarp and Gadde (2008) define three phases forming the problem solving process. Moreover, Biggemann, Kowalkowski, Maley and Brege (2013) *"aim to derive further insights into solution processes"* and La Rocca, Moscatelli, Perna and Snehota (2016) suggest a process for "New Solution Development" (NSD).

As mentioned in Chapter 1 and Section 2.2.3, a large part of the literature emphasises a focus on the supplier's perspective or the provider's perspective (e.g., Davies et al., 2007; Hakanen, 2014), the customer's perspective (Töllner et al., 2011), or, a dyadic focus (Tuli et al., 2007; Petri & Jacob, 2016). However, even though some contributions involve a discussion pointing to the network in which firms are embedded, a business network perspective on solutions is seldom applied. Adding to the literature discussed in Section 2.2.3, the list of exemptions involves contributions from Skarp and Gadde (2008, p. 734) who points to that *"the buyer's received value requires interaction among the resources of many actors in the network"*, and Biggeman et al. (2013, p. 1084) who explore *"the real-world involvement of multiple parties."*

Against that backdrop, the interactive, processual, and interorganisational approach to solutions that the thesis applies should thus result in a contribution that expand the discussion focusing on solutions in general, and the processual approach to solutions in particular. Based on a better understanding about the interactive and dynamic characteristics of solutions in business networks, the research on issues such as organising, value creation and business models could be further developed.

2.7.2 Problematisation

The preceding sections of this chapter have focused on the literature and theoretical concepts required to problematise and conceptualise the phenomenon of solutions in business networks. By extension, Section 2.7 articulates the three research questions to be answered in the thesis. To identify research questions, so called "gap spotting" is often used. For defining the research questions of this thesis, though, an approach inspired by what Alvesson and Sandberg (2011) have termed *problematisation* has been applied.

The foregoing discussion of literature addressing processual approaches to solutions (e.g., Aarikka-Stenroos & Jaakkola, 2012; Storbacka, 2011; Tuli et al., 2007) and concepts of the Industrial Network Approach (e.g., Håkansson et al., 2009; Håkansson & Snehota, 1995) highlight the various ways in which an interactive and interorganisational context poses challenges for firms developing and using solutions. However, those same aspects could also present firms with new perspectives that eventually could result in opportunities for new, and improved, solutions. Therefore, based on the concepts of the INA discussed in Sections 2.3–2.6, Section 2.7.3 problematises solutions as both an interactive and an interorganisational phenomenon. The INA framework has proven valuable for research addressing the interactive aspects of business (e.g., Abrahamsen, Havenvid & La Rocca, 2017). Moreover, the INA provides concepts applicable for studies concerning the spatial and temporal aspects involved in the interaction between firms (Håkansson et al., 2009). Thus, the ideas and concepts of the INA also seem applicable to research on the phenomenon of solutions in business networks. In particular, applying the ideas of the ARA model of the INA framework (Håkansson & Snehota, 1995) is assumed to enable a deeper understanding concerning what goes on under the surface of a solution´s processes. The problematisation results in three research questions that reflect the aim of the thesis. To conclude this chapter, Section 2.7.4 provides a brief background to and motivation for the conceptualisation of solutions in business networks that form part of the thesis.

2.7.3 Research questions

In the literature, solutions are commonly understood as integrated, customised bundles of products and services (Brax & Jonsson, 2009; Galbraith, 2002; Windahl & Lakemond, 2006). Applying the INA to the notions of products, services and solutions can elucidate how those terms relate to each other and to the ARA model. According to Håkansson (1987, p. 16) resources *"consist of physical assets (machinery, material, etc.), financial assets, and human assets (labour, knowledge and relationships)."* Drawing from that early conceptualisation, Håkansson and Waluszewski (2002a, p. 33) identify products as one of four categories of resources in a business network. As Håkansson et al. (2009, p. 67) later explain, such products *"are usually combinations of tangible resources produced and used by different units in the business landscape."* To that, Bocconcelli et al. (2018, p. 103) more recently add that *"[p]roducts are goods and services, or a combination of these, that are exchanged and utilized by organizational units."* Consequently, reflecting the literature

discussed above, the combining resources in the resource layer of the ARA model is a central aspect of solutions (cf., Cantù et al., 2012).

Drawing from the discussion on activities in Section 2.4 and on actors in Section 2.6, however, it becomes clear that, for solutions, the actor layer and the activity layer matter as well. First, in offering solutions, the actors involved have to interact in order to combine their resources by way of resource ties. Second, to define, develop, deploy and utilise the solutions, actors have to link and coordinate their activities. Håkansson (1987, p. 15), for example, point to that "*activities are performed by the actors which means that resources are combined, developed, exchanged or created by use of other resources."* Thus, for solutions, all three layers of the ARA model appear to be critical.

Therefore, in contrast to a product-centric perspective from which solutions tend to be defined as bundles of products and services (cf., Brax & Jonsson, 2009), as well as the approach in which solutions are defined by their relational processes (e.g., Tuli et al., 2007), the INA emphasises the importance of actors, activities and resources in the definition and conceptualisation of solutions. Addressing those ideas Research Question 1 (RQ1) is articulated as follows:

RQ1 How can the Industrial Network Approach and the ARA model contribute to the understanding and conceptualisation of solutions?

Through RQ 1, and with a focus on the ARA model of the INA, the thesis takes on to develop our current understanding of the structures and mechanisms establishing the inner core of the processes involved in solutions (see also Section 2.7.4). It is assumed that the connectedness and interdependencies of actors, activities and resources strongly influence the definition, development, deployment and use of solutions.

For the organising of activities and resources in a supplier-buyer dyad, the interaction between the firms is essential (Håkansson et al., 2009; Håkansson & Snehota, 1995). The importance of interaction between suppliers and buyers is also stressed in processual approaches to solutions (e.g., Aarikka-Stenroos & Jaakkola, 2012; Tuli et al., 2007; Töllner et al., 2011). For instance, interaction is described as a means to defining a customer's needs, customisation and post-deployment adaptation (Tuli et al., 2007). Additionally, as Töllner et al. (2011) have argued, the buyers of solutions identify the coordination of offerings and

the processes concerned as vital to the solutions themselves. Indeed, supplier–buyer interaction is a key enabler of such coordination.

The interaction, however, could also concern firms beyond the focal supplier–buyer dyad. Whereas some literature on solutions as relational processes takes a supplier-based perspective (Petri & Jacob, 2016; Storbacka, 2011), a buyer-based perspective (Tuli et al., 2007; Töllner et al., 2011) or a dyadic perspective involving both actors (Aarikka-Stenroos & Jaakkola, 2012), a fundamental aspect of the INA is conceiving the supplier, the buyer and their business relationship as part of a business network (Håkansson et al., 2009; Håkansson & Snehota, 1995). From that standpoint, a solution provider could, for instance, rely on the resources of suppliers and partners, meaning that solutions could result from the resource interaction involving multiple firms. In that light, neither the supplier, nor the buyer, should be understood as operating in isolation. Or, in the words of Håkansson and Snehota (1989), "*No business is an island*."

As discussed, firms embedded in a business network are connected by way of business relationships (Håkansson et al., 2009; Håkansson & Snehota, 2017a). Such business relationships enable interaction resulting in that firms influence and are influenced by each other (Håkansson & Snehota, 1995). The interaction between firms could therefore be seen as both the cause and result of interdependencies (Bankvall, 2011; Håkansson et al., 2009). Moreover, reflecting the three layers of the ARA model, their interaction results in activities being linked into activity patterns, resources being tied into resource constellations, and, actors forming actor webs (Håkansson & Snehota, 1995). In turn, because firms strive to improve the effectiveness and efficiency of their operations and the value of their offerings they interact with other firms to adjust their activities and adapt their resources (Håkansson et al., 2009).

Because business relationships are interconnected (Håkansson & Snehota, 1995), the events and interaction occurring within a business network influence the preconditions for and outcomes of interaction involving the firms of other dyads therein (Håkansson et al., 2009). For that reason, the outcome sought by suppliers and buyers of solutions is also influenced by interaction occurring elsewhere in the network. Therefore, Research Question 2 (RQ2) draws from an interorganisational perspective on firms and solutions and their embeddedness in the wider space of the business network:

RQ2 What are the key implications of conceptualising a solution as being embedded in a business network?

The notion of embeddedness in relation to RQ2 concerns the spatial dimension of business networks. For research on business in networks, several concepts involving the notion of space have been defined (Törnroos et al., 2017). For the research presented in the thesis, the perceived, the structural and the dynamic aspects of the spatial dimension are of importance.

Evidently, the interorganisational characteristic is not the sole aspect that comes to the fore when processual models for solutions are scrutinised. Supplier–buyer interaction within relational processes that form solutions extend over time, beginning in early phases with activities such as signalling (Töllner et al., 2011) and defining need (Petri & Jacob, 2016) and far beyond the deployment and installation of solutions as part of activities such as post-deployment adaptations (Tuli et al., 2007).

Therefore, whereas a product-centric approach centres on the selling and buying of a product–service bundle, processual models span across time and may encompass multiple episodes of interaction amongst the firms involved. Specifically, the models proposed by Tuli et al. (2007), Töllner et al. (2011) and Petri and Jacob (2016) acknowledge the need for interaction beyond the point of deployment, including the interaction required for adapting a solution to new demands. Therefore, as Evanschitzky, Wangenheim, and Woisetschläger (2011, p. 657) have argued, a solution *"is rather an ongoing relational process, in which the solution provider continuously satisfies a defined demand, which may be dynamically developing over time."*

Business relationships between firms in a business network enable and embody interaction that occurs as consecutive episodes, wherein an episode is influenced by the results from previous episodes, and the expectations concerning episodes yet to take place (Håkansson et al., 2009; Jahre et al., 2006). Over time, such interaction prompts the adjustment of activities and the adaptation of resources, and as a result, interdependencies develop amongst the elements of the network (Håkansson et al., 2009; Håkansson & Snehota, 1995). Current interdependencies limit the possibilities for firms to act independently but also enable firms to influence the actions of others (Håkansson & Ford, 2002). For solutions, that dynamic highlights the importance of interaction over time and its implications for

interdependencies amongst actors, activities and resources. Such reasoning prompts Research Question 3 (RQ3):

RQ3 What are the key implications of conceptualising a solution as being embedded in time?

In RQ3, the notion of time concerns how actors of the business network view the processes taking place and the interaction between firms (cf., Halinen et al., 2012). Even though a "clock-based" view on time is of high importance for firms operating in supply chains (see Chapter 4), it is the "event-based" perspective that is in focus for the discussion in the thesis.

Figure 2.9 depicts the relationship between the aim of the thesis and the three research questions. RQ1 reflects the choice of the INA to problematise and conceptualise solutions in business networks. In drawing from the key characteristics of the INA, RQ2 (i.e. involving a focus on the spatial dimension) and RQ3 (i.e. focusing on the temporal dimension) are thus closely related to RQ1.

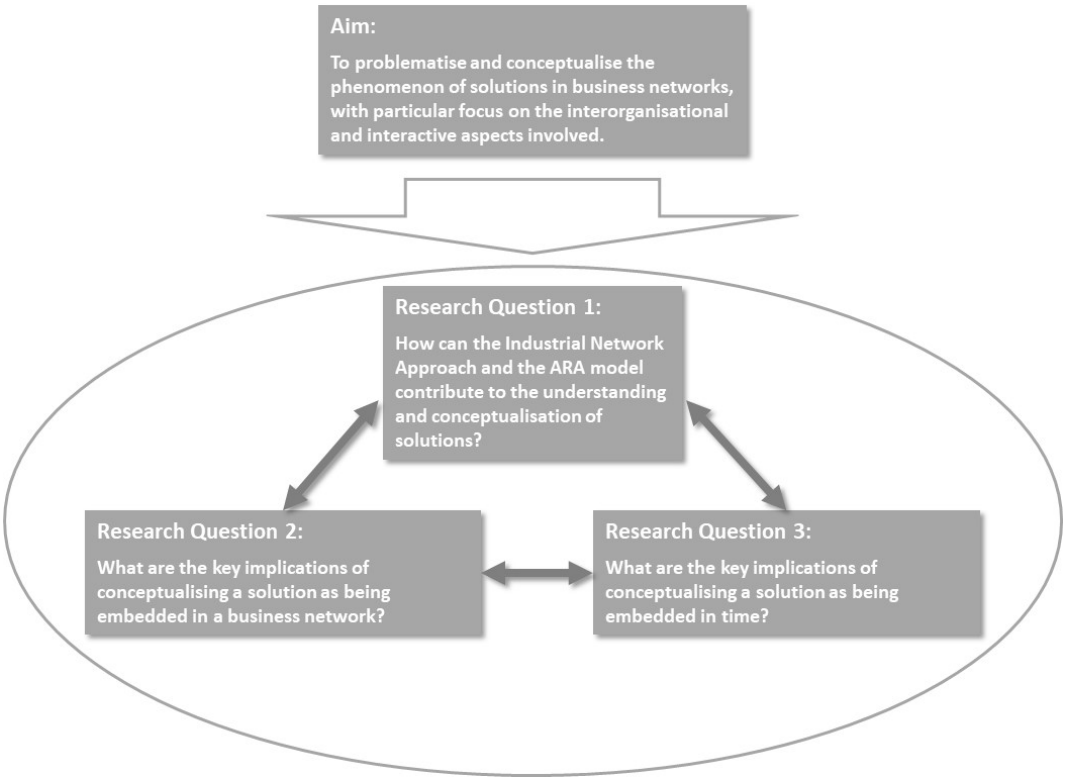

Figure 2.9: Aim of the thesis and the three research questions

2.7.4 Conceptualising solutions in business networks

Adopting a processual approach to solutions that acknowledges the relational and interactive aspects of solutions has extended our understanding of solutions in a B2B context. Biggeman et al. (2013, p. 1083), for example argue that the *"view of solutions as embedded in relational processes—what Tuli et al. (2007) refer to as a process-centric view—not only contrasts with extant product-centric perspectives […] but also enables a more in-depth understanding of the nature of solutions processes."* Adding an interorganisational perspective to this should also further develop our understanding regarding the embeddedness of solutions in business networks (Hedvall et al., 2019). What remains, however, is to open up the "black-boxed" (La Rocca et al., 2016) solution processes and elucidate the antecedents and implications of structures, interdependencies and dynamics that characterise solutions. To that purpose, the INA and its ARA model (Håkansson et al. 2009; Håkansson & Snehota, 1995) are applied in Chapter 6 for a conceptualisation of solutions in business networks.

3. RESEARCH METHOD

3.1 Introduction and background

This chapter presents an overview of the methodological approach and methodological considerations applied in the doctoral project completed for this thesis. The subsequent section, Section 3.2, explains the motivation behind adopting a qualitative research strategy and a single case study design, after which Section 3.3 describes the case and casing process. Next, Section 3.4 discusses the collection of empirical material via interviews, whereas Section 3.5 discusses the analysis of the empirical material collected. Last, Section 3.6 presents strategies used to ensure the project's research quality.

The doctoral project underlying the thesis was initiated as a response to managerial challenges faced in projects and strategy development at AB Volvo (Volvo). Specifically, the challenges concern the development of aftermarket offerings for heavy trucks: the products, services and solutions that support customers in using and maintaining the vehicles produced. The organisations responsible for aftermarket offerings at Volvo frequently confront questions and dilemmas that remain difficult to answer and resolve without sustained, in-depth investigation. To address some of those challenges, reflected in the managerial issues articulated in the introduction of the thesis, as well as to generate new knowledge and spark novel ideas for future solutions, the doctoral project was conceived and executed.

In an initial phase, resulting in a licentiate thesis (Hedvall, 2016), three cases involving different transport industry settings were studied with the objective to investigate how transport buyers and transport providers currently address and manage issues related to heavy vehicle maintenance. Thus, for this first phase of the doctoral project, firms taking the roles of transport buyers and transport providers were in focus. The results of that investigation underscored the implications of embeddedness in the business network and the interdependencies amongst actors, resources and activities for the handling of heavy vehicle maintenance.

The second phase of the doctoral project took the results reported in the licentiate thesis as its starting point. As discussed in Section 3.3, the continued casing process resulted in the involvement of additional actors. Moreover, to reflect both the results of the licentiate thesis and the continued casing, the theoretical scope of the project was widened. While the

licentiate thesis was theoretically grounded in the Industrial Network Approach (INA; Håkansson et al., 2009), the doctoral thesis extends the scope of inquiry to also include perspectives from the literature addressing solutions.

As with the first phase of the doctoral project, the second phase also formed part of a broader research project initiated by Volvo: the Efficient Maintenance for Sustainable Transport Solutions project (EMATS). The project, which was completed in 2019, involved Volvo, Postnord, ARHO and Chalmers University of Technology and was co-financed by Vinnova FFI, the Swedish strategic vehicle research and innovation programme, with grant 2014-06245.

3.2 A qualitative case study

To fulfil the aim of the thesis and to answer the research questions articulated in Chapter 2, the design of the study needed to enable the collection of data that could capture the settings, intentions, actions and interaction of firms embedded in business networks. To achieve such objectives, case studies have been suggested as an applicable approach (Easton, 2010). Moreover, according to Yin (2014, p. 14), a case study design has advantages *"when a "how" or "why" question is being asked about a contemporary set of events, over which a researcher has little or no control."* Adding to that, Maxwell (2013, p. 30) explains that qualitative research enables an understanding of *"the particular contexts within which the participants act"*, as well as of *"the meaning, for participants in the study, of the events, situations, experiences, and actions they are involved with or engaged in"* and *"the process by which events and actions take place."* For such an understanding, the variety of perspectives held by actors within the business network, a phenomenon called the "*pluralisation of life worlds*" by Flick (2009, p. 12), requires a research design capable of identifying and probing the various views, acts and strategies of different actors in the network. For those reasons, research addressing a diversity of actors should be firmly grounded in the empirical context of the participants, to which purpose a qualitative research design is preferred (Flick, 2009).

In particular, conceptualising the notion of solutions in business networks based the INA and its ARA model (Håkansson et al, 2009; Håkansson & Snehota, 1995) requires a description and analysis of how firms interact in order to manage the structures of, and interdependencies among, the activities and resources involved in the solutions embedded

in the business network. Following the INA (Håkansson et al., 2009) as a fundamental part of the analytical framework calls for a research design that allows the study of the structures and dynamics of the network of firms. On that topic, Easton (1995, p. 388) has posited that *"[c]ase studies are a powerful research method and one particularly suited to the study of industrial networks."* In the same vein, Halinen and Törnroos (2005, p. 1286) argue that *"[…] it is obvious that case strategy is most suitable for the study of business networks. It allows the study of a contemporary phenomenon, which is difficult to separate from its context, but necessary to study within it to understand the dynamics involved in the setting."*

Because a business network involves several actors interconnected by relationships, a spatial focus is required (Håkansson et al., 2009). Suppliers and buyers are not only connected to each other but interact with, influence, and are influenced by, numerous other actors in the business network. Moreover, as Halinen and Törnroos (2005, p. 1286) have explained, "*[n]etworks are typically characterized as loosely coupled systems and flexible by nature, which also means that change is an inherent feature in them. The temporal dimension cannot therefore be ignored in research."* Therefore, both the spatial and temporal dimensions are critical for the study of business networks. To address the challenges faced in such research—challenges involving complexity as well as spatial and temporal characteristics—case studies have been identified as a useful research strategy (Easton, 2010; Halinen & Törnroos, 2005). Beyond that, for research related to value creation, the literature has stressed the need for case studies. In particular, Kohtamäki and Rajala (2016, p. 10) have called for *"top journals and researchers in the field to open up to single-case research designs to arrive at a more thorough understanding of the contingencies in which value co-creation takes place."*

3.3 Case and casing

The study presented in the thesis is a single case study with multiple embedded units (Yin, 2014) representing solutions being developed, sold, purchased and used by firms. Reflecting the managerial concerns articulated at the outset of the thesis, the case takes its starting point in the solutions for heavy vehicle maintenance that are embedded in a business network encompassing firms that offer, buy, influence or are influenced by, the maintenance performed.

The interest in, and empirical starting point for, the study of heavy vehicle maintenance solutions was grounded in my role as an industrial doctoral student at Volvo. The same empirical interest has also influenced the design of the study, beginning with the initial phase of the doctoral project reported in the licentiate thesis. Although Volvo, as an OEM, was identified early on as a key firm for the case, the so-called *casing* process (Ragin, 1992) was initiated by adhering to a more open-ended approach (Dubois & Araujo, 2004). To capture the network context of heavy vehicle maintenance, an *"outside-in approach"* was followed (see Figure 3.1). The chief idea of the outside-in approach was to first interview network actors rather distant from Volvo, in order to enable a broader understanding of the phenomenon embedded in the business network. Thus, because the vehicle OEM's operations and strategies were already somewhat familiar, data to achieve a better understanding of how heavy vehicle maintenance relates to the activities and resources of other actors in the business network were gathered. Accordingly, for the initial interviews performed during the first stage of the doctoral project, the transport providers and the transport buyers were in focus. Via purposive sampling (Bryman & Bell, 2011), firms belonging to those two actor categories were selected, with particular attention to the variety of their organisation, operations and type of transport operations, all as observed *ex ante* (Eisenhardt & Graebner, 2007). Moreover, all firms selected were based in Sweden, which reflects the scope of EMATS, the project in which the doctoral project formed a part. The initial scope, which form the empirical foundation for the licentiate thesis (Hedvall, 2016), is depicted as part of Figure 3.1.

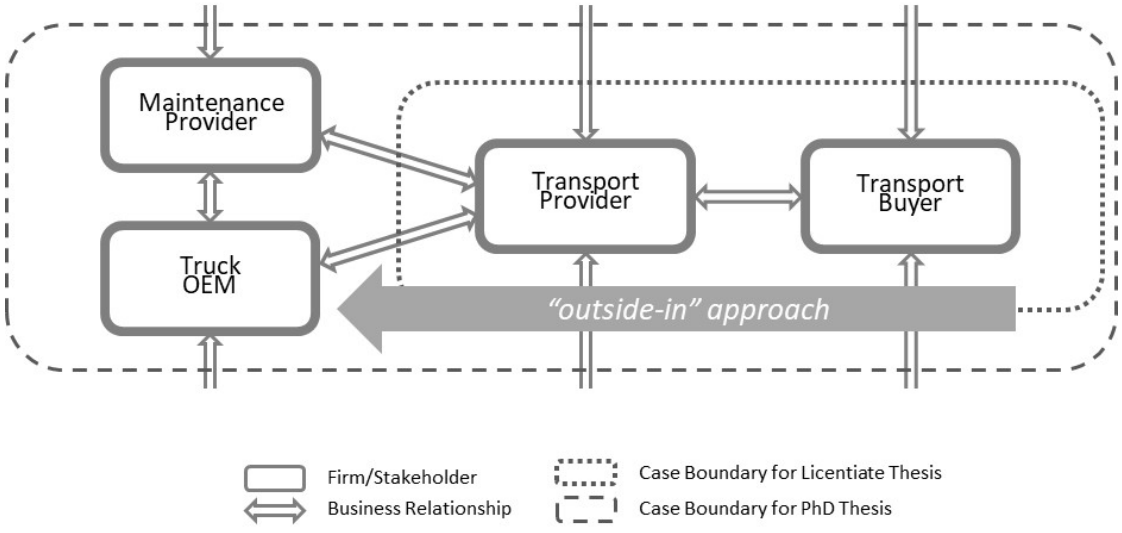

Figure 3.1: Visualisation of the casing process, the outside-in approach, and the four key actor categories

As an extension of the research reported in the licentiate thesis, and by way of purposive sampling, the casing process continued throughout the doctoral project with the extended aim of studying additional key actors involved in, influencing, or being influenced by, the heavy vehicle maintenance solutions. As in many studies of business networks, the casing process became intertwined with the review of literature, the process of articulating the research questions and the theoretical framing of the phenomenon being investigated (Dubois & Araujo, 2004). Following the initial outside-in approach of the licentiate thesis, the vehicle OEM and the actor category of maintenance providers were included as parts of the case for the doctoral thesis.

The boundary of the extended case described and discussed in this thesis thus encompasses four categories of actors: transport buyers, transport providers, maintenance providers, and the OEM's organisation (see Figure 3.1). Thus, as shown in Table 3.1, additional firms were incorporated in the scope of the doctoral project. However, not all of them were included in the case descriptions and analysis of the doctoral thesis; of all firms interviewed in the case study, only firms of particular interest in relation to the aim of the thesis were selected for inclusion herein.

Table 3.1: Firms of the case study

Firm	Transport Buyer	Transport Provider	Maintenance Provider	Vehicle OEM	Addressed in Lic. Thesis	Addressed in PhD Thesis
Medical Supplies (MS)	X				-	X
Retail Corporate Group (RCG)	X				X	-
Dairy Products (DP)	X				X	X
Construction Company (CC)	X				-	X
Dairy Products (DP)	X				X	X
Forest Products (FP)	X	X			X	-
Rapid Transports (RT)	X	X			X	-
General Cargo (GC)	X	(X)			-	X
Refuse Haulier (RH)	(X)	X			-	X
Transport Contractor (TC)		X			-	X
Milk Haulier (MH)		X			X	X
Timber Haulier (TH)		X	X		X	X
Independent Workshop (IW)			X		-	X
OEM 1 Workshop (OW)			X		-	X
Truck OEM 1 (OEM)				X	-	X

Due to limitations of time and resources, the expansion of the case, both over time and in terms of the number of firms examined, had to be restricted. As a result, the final case boundary, as pictured in Figure 3.1, and the list of firms, as shown in Table 3.1, does not

encompass all of the various actor categories identified during the project. Instead, the case study involves the key informants (Halinen & Törnroos, 2005) most relevant to the phenomenon studied and the empirical focus of the case studied—that is, heavy vehicle maintenance.

3.4 Collection of empirical material

The complexity, variety and dynamics of the business network context studied demanded the collection of rich, in-depth data (Dubois & Araujo, 2007; Dyer & Wilkins, 1991), hereafter referred to as "*empirical material*" (Alvesson & Kärreman, 2007). For that purpose, interviewing was chosen as the primary method. Interviews can shed light on the actions of actors, as well as the motivations behind those actions (Yin, 2014). They can also provide access to information about the past, as well as expectations of the future, i.e., experiences and ideas related to the temporal dimension, and provide insights into the network of business relationships involving firms, actors, activities and resources, i.e., in relation to the spatial dimension. Therefore, among the areas in focus for each interview, the interviewees were asked to share their understanding of the key business relationships in which the firm is involved, the connectedness and interdependencies of activities and resources, previous developments and the expectations of the future. However, the collection of empirical material regarding each firm has been limited to a specific point in time (cf., Halinen et al., 2012).

Lasting between 45 minutes and 2 hours, each interview was performed at the interviewee's firm, which facilitated supplementary observations of his or her daily work and the general operations of the firm. All interviews were semi-structured (Bryman & Bell, 2011), audio-recorded using a portable recorder and, for synthesis, subsequently transcribed using the transcription function in NVivo. Thereafter, the synthesised transcript of each interview, except for a few that captured interviews conducted within the OEM, was sent to the interviewee for respondent validation (Maxwell, 2013).

To direct the interviews, an interview guide was developed (Maxwell, 2013), as shown in the summary in Appendix 1. The development of the guide helped to ensure a fit between theory, the research questions and the empirical material collected. The guide was based on the one used in the interviews reported in the licentiate thesis, but was adapted to suit the aim and scope of the second phase of the doctoral project, the result of which is this doctoral

thesis. Even if a guide was developed and used, the discussion of the interviews flowed freely. During the interviews, the guide thus served more as checklist to ensure that all relevant issues were addressed.

In order to secure access to the empirical material required and to capture the diverse perspectives of actors, the interviewees were selected depending upon their roles and knowledge. The interviewees needed to be familiar with the operations of the firm and its business relationships with suppliers, partners and buyers. In all, 29 interviews were performed for the doctoral project during a period ranging from June 2014 to August 2019. Of the total amount of interviews, 18 establish the empirical material used for this doctoral thesis. Of these 18, 4 were also part of the empirical material discussed in the licentiate thesis. Table 3.2 provides an overview of the 18 interviews informing the doctoral thesis together with information about the roles of interviewees.

Table 3.2: Overview of interviews informing the doctoral thesis

Firm	TB	TP	MP	OEM	Interviews	Role of interviewee(s)
Medical Supplies (MS)	X				1	Manager Transport Purchasing
Dairy Products (DP)	X				2	Managers Transport Purchasing & Planning
Construction Company (CC)	X				1	Manager Transport Purchasing
General Cargo (GC)	X	(X)			1	Corporate Fleet Manager
Refuse Haulier (RH)	(X)	X			1	Manager Fleet and Transport Purchasing
Transport Contractor (TC)		X			1	Part Owner and Manager
Milk Haulier (MH)		X			1	Part Owner and Driver
Timber Haulier (TH)		X	X		2	Owner, Technicians
Independent Workshop (IW)			X		1	Service Market Manager
OEM 1 Workshop (OW)			X		1	Workshop Manager
Truck OEM 1 (OEM)				X	6	Managers: Service Market, Retail Network Development, Aftermarket Requirements, Market Sweden, Services, Process & IT

TB = Transport Buyer, TP = Transport Provider, MP = Maintenance Provider, OEM = Vehicle OEM

In addition to the 18 interviews accounted for in the doctoral thesis, four of the 29 interviews have been addressed in the licentiate thesis. Moreover, seven supplementary interviews were performed during the doctoral project in order to gain additional input that could spark ideas concerning the collection and analysis of the empirical material for the doctoral project. Six of those additional interviews were conducted with representatives from other key functions parts of AB Volvo, whereas the other was conducted with representatives of a maintenance provider in the rail industry.

3.5 Analysis of empirical material

The analysis of the empirical material was performed in three steps (see Figure 3.2). The two latter steps formed the basis for the firm-level analysis presented in Chapter 4 and the network-level analysis presented in Chapter 5.

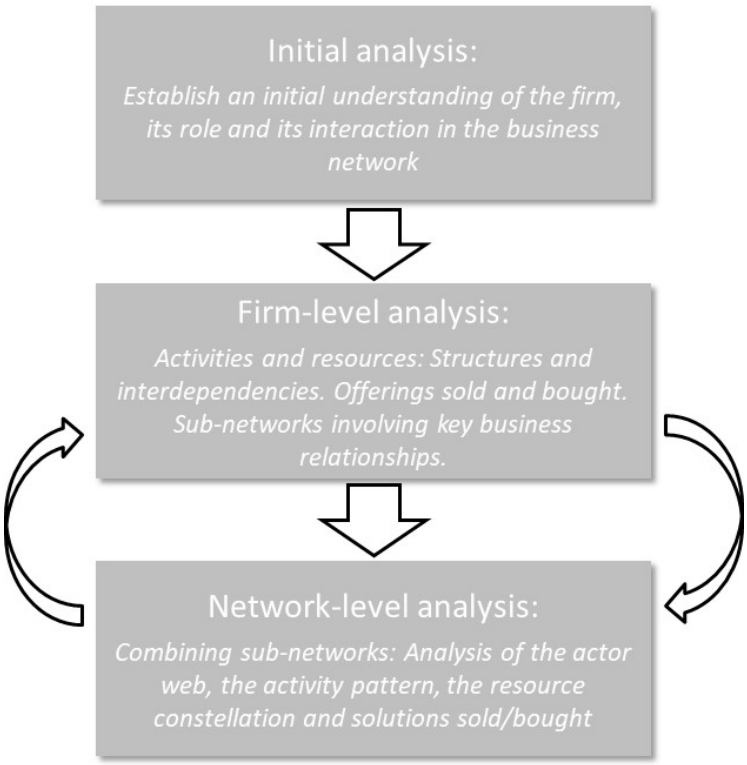

Figure 3.2: The three steps of the analysis performed

The first step of analysis, performed while transcribing the recordings of the interviews, involved establishing an initial understanding concerning the operations and business of each firm, as well as its activities, resources, business relationships and offerings sold/bought. The chief objectives of that first step was to establish an initial conception of the firm, its role and its interaction in the business network, and as input into the casing process and continued data collection.

The second step of analysis, presented in Chapter 4, was performed at the firm level. The data forming the basis for the analysis, i.e. the firm-level case descriptions, were analysed with a focus on the activities, resources and business relationships related to each firm's operations. Moreover, reflecting the focus on solutions in business networks, the key

offerings sold or purchased by the firm were examined. A chief objective of the second step of analysis was to identify the structures of, and interdependencies between, the activities and resources of the firm and its customers, partners and suppliers with regard to the solutions in which the firms were involved. Information about the overarching processes, past events and expectations concerning the future, shed light on how structures and interdependencies related to the firms and their offerings develop and change over time. As a result, a principal business network from the perspective of the firm was established. The business networks depicted, termed "*sub-networks*" in the thesis, encompass each firm and the key business relationships perceived by the interviewees, i.e. related to the ideas of a "*mental network dimension*" (Törnroos et al., 2017).

In the third and final step of analysis, performed at the network level (see Chapter 5), two examples of connected sub-networks were studied. The analysis focused on the actor web, the activity pattern and the resource constellation resulting from the combined sub-networks. In comparison to the preceding step, Step 2, the spatial perspective applied thus relates to the notion of the *"structural network dimension"* defined by Törnroos et al. (2017). Specific attention was paid to the interdependencies amongst actors, activities and resources involved in, influencing or influenced by, solutions purchased and sold by the firms. For that third step, drawings representing the web of actors, the activity pattern and the resource constellation establish important instruments supporting the analysis. Taken together, the third step thus helped to avoid an overly narrow focus on a single solution that may have caused the implications of its embeddedness in the business network to be overlooked (Halinen & Törnroos, 2005, Yin, 2014).

Although the three steps of analysis are explained in sequential order, the last two steps followed an iterative approach. When performing the third step of analysis, some of the conclusions resulted in a revision and refinement of the second step. The outcome from the second and third steps inform the discussion in Chapter 6.

3.6 Research quality

3.6.1 The role as an industrial doctoral student

My role as an industrial doctoral student and my position at Volvo influenced the scope and aim of the doctoral project and the doctoral thesis. The phenomenon, context and firms studied, relate to the challenges and responsibilities of the organisation to which I belong.

At the same time, being an industrial doctoral student has imposed other conditions upon the doctoral project that warrant mention in the thesis.

For industrial doctoral students, playing the dual role of practitioner and scholar affords considerable benefits. Being part of an industrial organisation not only facilitates access to empirical material but also grants experience and knowledge through daily work that can enable a more thorough understanding of the empirical context studied. By the same token, however, the dual role in general and the employment in particular, pose challenges for industrial doctoral students as researchers. In what follows, the major challenges are discussed together with the measures taken to improve the rigour of the research.

Research funding and industrial employment are two circumstances of industrial doctoral students that merit ethical consideration. In my case, the research presented in this thesis was co-funded by the same organisation at which I am employed. As a consequence, those circumstances, if not addressed properly, could cast doubt upon the rigour and credibility of the research performed. Moreover, as a representative of Volvo, my organisational affiliation could have affected the dynamics of the interviews conducted, swayed interviewees and biased the analysis of data. Beyond those risks, being a practitioner in the industry investigated could have influenced the choice and use of theory as well as the collection and analysis of the empirical material. To mitigate those risks, a robust research design and research transparency were principal objectives while planning and performing the study.

The first measure taken was ensuring that the selection of firms was free from the influence of my employment. To that end, when approaching the empirical context, I applied an outside-in approach, starting with firms that were distant from my employer. Moreover, the companies to be interviewed were selected based on the type of operations performed and their role in the transport business network and not their affiliation with Volvo. Thus, in selecting transport providers, as an example, the characteristics and operations of the firm, not the make of the vehicles used by the haulier, were the focal criteria. As a result, I was able to study transport operations involving trucks of several makes at firms that buy vehicles or transport solutions from a broad range of vehicle OEMs.

Second, during interviews as well as data analysis, I had to remain wary of research bias and researcher reactivity (Bryman & Bell, 2011). To avoid research bias (i.e. research

subjectivity), it was important for me to understand how to prevent my employment and previous experience from influencing each interview situation and the analysis of the empirical material collected. By some contrast, to avoid researcher reactivity, I had to remain continuously aware of my role as an employee of a truck OEM and its possible influence upon each interviewee. Thus, during each interview, for the sake of transparency, I was upfront about my employment but also underscored that my role in the interview was as a researcher at a university.

Third, in the reporting of my research and findings, I have had to be unambiguous about my role as an employee and industrial doctoral student. In a sense, such transparency has served as a means to preventing doubts, questions and concerns about my contributions, and both at seminars and conferences as well as for publications, I have clearly communicated my dual role.

3.6.2 Transparency and validity

Qualitative research from a business network perspective often involves dealing with different, sometimes conflicting viewpoints (cf., Easton, 2010). Interviewees involved in the same operations or business relationship could perceive circumstances differently and thus make identifying a single common, objective reality impossible. As an alternative, the empirical material collected should aim at reflecting the various views held by the interviewees. To that aim, in the collection of empirical data, a case study can afford a model of such a reality: a model reflecting variation in the perspectives of interviewees (cf., Dubois & Gibbert, 2010).

To enable transparency and address the need for empirical material that reflects various perspectives and understandings, the goal pursued in the research was collecting rich, detailed data (Dubois & Araujo, 2007; Dyer & Wilkins, 1991). As Dyer and Wilkins (1991, p. 615) have explained, rich data can be used *"to provide a rich description of the social scene, to describe the context in which events occur, and to reveal . . . the deep structure of social behaviour."* Thus, to capture the various aspects of the firms' operations and business in the case, managers were selected to be interviewed based on their roles and knowledge.

To ensure that the empirical material collected provided a relevant picture of the transport operations as well as the business context and key business relationships, attention was also paid to the scope and questions of the interviews. An interview guide (Maxwell, 2013) was

therefore used to provide direction during the semi-structured interviews (Bryman & Bell, 2011). The guide was evaluated by way of initial pilot interviews and thereafter updated over the course of the study in order to reflect and include new knowledge gained. To further reduce the risk of researcher bias, ensure that the data collected in interviews were accurately understood and to answer any lingering questions, respondent validation (Maxwell, 2013) was applied for most the interviews performed (see Section 3.4).

On the topic of transparency, Dubois and Gibbert (2010, p. 135) have explained that:

> *"the main point is to provide a transparent approach to the interplay between theory, empirical phenomenon and method. Transparency here refers to reducing (rather than increasing) the level of complexity and walk the reader through the various stages of the argument, in an effort to make the logic, reasoning, and causalities evident."*

Hence, in striving for reliability and validity (Dubois & Gibbert, 2010; Yin, 2014), attention was also paid to transparency in the research design in general, such as issues involved in case methods (Halinen and Törnroos, 2005), and the design in relation to the research aim and empirical context in particular. Transparency in the casing strategy, the choice of theory, and choices made regarding methods was prioritised throughout the study and has also been prioritised in this thesis.

4. THE CASE STUDY: A FIRM-LEVEL PERSPECTIVE

4.1 Introduction

Following an interorganisational approach, the analytical framework of the thesis maintains that the actors, activities and resources do not exist in isolation but are embedded in a business network. Moreover, due to interaction over time, interdependencies develop amongst those elements. Consequently, and as argued in Chapter 3, the notion of business networks has influenced the focus and scope of the case study reported in this thesis.

Maintenance solutions for heavy vehicles constitutes the empirical starting point in the case study. The maintenance provider, the maintenance activities and the resources required do not exist in isolation, however. The maintenance provider, for example, is connected to its customers, i.e. the transport providers, through business relationships. Meanwhile, other business relationships connect the maintenance provider to the vehicle original equipment manufacturers (OEMs) that produce the vehicles for which the provider offers its maintenance services. Taken together, the maintenance provider, the maintenance activities and the resources required should be conceived and studied as existing within their wider context.

In this chapter, a firm-level perspective is applied. Accordingly, in the subsequent discussion, the notion of actors, with a few exceptions, refers to the firms studied. The case subject to analysis involves multiple actors with different roles and within this array of actors, certain *key actor categories* are expected to more closely influence the preconditions for, or be influenced by the performance and results of, the maintenance solutions. Thus, as discussed Chapter 3, firms belonging to those actor categories were selected for the case study (see Figure 4.1). However, to reflect some of the variety expected *ex ante* amongst the firms involved in different types of operations, empirical material was collected from firms embedded in different contexts (see Table 3.1).

Figure 4.1 displays a simplified part of the business network focusing on the four key actor categories that have been identified as key in relation to the focal solution. The first category is of transport providers—that is, the firms that own or operate, if not both, the vehicles used for transport. The transport providers are the key customers of the maintenance providers, which are the actors that form the second category. The transport buyers, representing a third category, require transport to be performed and therefore purchase transport services

from the transport providers. Last, the fourth category includes the vehicle OEMs that develop and sell the vehicles operated by the transport providers.

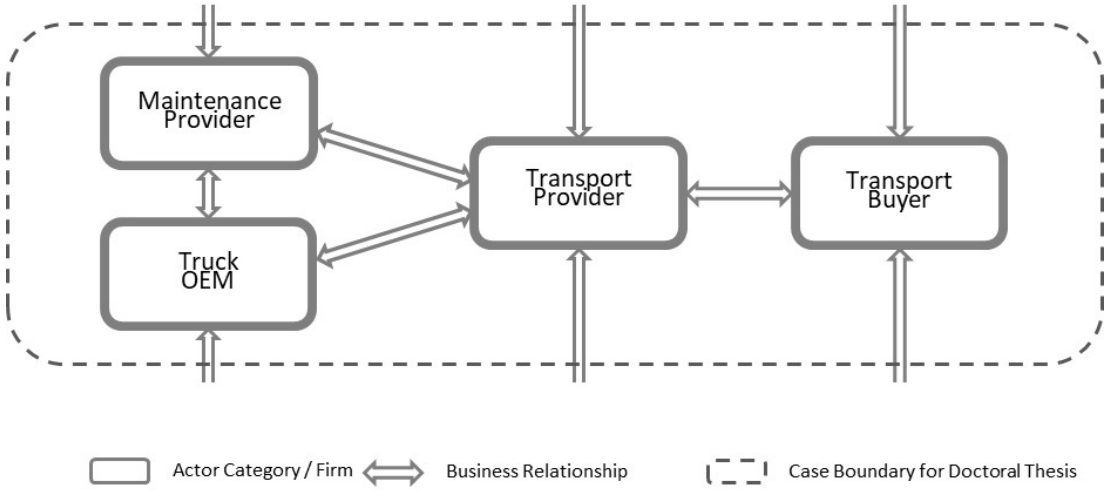

Figure 4.1: A simplified business network including the four key actor categories studied

The chapter is structured according to the four actor categories identified in Figure 4.1. To begin, as indicated in Table 4.1, three firms in the category of maintenance providers are presented, after which the focus shifts to four firms representing the transport providers (i.e. the customers of the maintenance providers). The subsequent section presents four firms in the category of transport buyers (i.e. customers of the transport providers), followed by a final section addressing a firm in the category of vehicle OEMs. It should be noted that one firm, the Timber Haulier (TH), appears twice in Table 4.1, because it is discussed in relation to two of its roles: as a maintenance provider and as a transport provider.

Table 4.1: Overview of the firms included in the firm-level case description and analysis

Actor Categories	Firm	Acronym	Role of interest
Maintenance Providers	The OEM 1 Workshop	OW	
	The Timber Haulier	TH	Maintenance Provider
	The Independent Workshop	IW	
Transport Providers	The Transport Contractor	TC	
	The Refuse Haulier	RH	
	The Milk Haulier	MH	
	The Timber Haulier	TH	Transport Provider
Transport Buyers	Medical Supplies	MS	
	Dairy Products	DP	
	The Construction Company	CC	
	General Cargo	GC	
Vehicle OEMs	Truck OEM 1	OEM	

In the selection of firms to be presented in the thesis, the organizing of transport and maintenance as well as the variety in their operations were taken into account. The firm-level case descriptions thus reflects not only some of the features common amongst the firms but also some of their characteristics that differ.

As mentioned above, the remainder of this chapter is structured according to the four categories of actors identified in Figure 4.1, for each of which the firms selected from the case study are presented. For each firm, the nature of the business and its operations are summarised in a section titled "Firm-level description." The description focuses on key aspects of the firm, such as the firm's operations and key processes, business and business relationships, and key solutions offered and bought. The firm level descriptions draw on the empirical material collected as described in Chapter 3.

Thereafter, in a subsequent section, titled "Firm-level analysis", an analysis of each firm is presented. Drawing from concepts of the Industrial Network Approach, each firm-level analysis focuses on the key activities, resources and business relationships of importance for the focal firm (i.e. the firm described in each section) and the additional actors identified as key for its operations. It should be noted that the business networks presented as part of the analysis, identified as *sub-networks*, reflect the views of the interviewees; therefore, only the key business relationships identified by the interviewees are included.

4.2 Maintenance providers

4.2.1 Introduction

Maintenance providers, also called “workshops”, represent the category of actors that provide their customers with vehicle maintenance. In the case study, three types of maintenance providers were investigated: workshops within the dealer networks of OEMs, workshops within a haulier’s organisation and independent, third-party workshops. In the thesis, the OEM’s workshops are represented by the OEM Workshop (OW) that forms part of the dealer network of Truck OEM 1. The workshop of one firm, the Timber Haulier (TH), represents the category of workshops owned and managed by hauliers, whereas the Independent Workshop (IW), a workshop part of the IW Company Group, represents the independent workshops.

4.2.2 The Original Equipment Manufacturer Workshop (OW)

Firm-level description

The OW is part of the dealer network owned and managed by the Truck OEM 1 (see Section 4.5). One of the largest in Europe, the OW’s facility encompasses 22 vehicle bays, and the OW employs approximately 70 people, including 45 technicians and four customer receptionists. Two of the customer receptionists focus on planning, whereas the other two manage the interaction with customers at the front desk. One group of the OW’s staff is dedicated to the preventive maintenance of vehicles, a second group performs supplementary maintenance jobs, and a third performs repairs. For the preventive maintenance in particular, four technicians work in each of the two shifts. In addition, a separate team works with the tyre-related services offered by the OW.

In providing services involving paint jobs, hydraulic systems and cooling systems, the OW cooperates with various partners. In addition, for the yearly inspection of vehicles, it cooperates with a firm that performs the inspection while the OW supports the customers with the administration and processes involved. When the OW outsources jobs to partners, it nevertheless continues to coordinate the activities, and as a result, the customers also pay the OW, even though the job has been performed by an external partner. According to the OW, it has become increasingly important to offer one-stop shopping to its customers, who expect to engage in only one interface for all maintenance services required.

The OW's facility is open 5 days a week from 7:00 a.m. to midnight and is managed by a staff that works in two shifts. In addition, to support customers that require maintenance to be performed during weekends, the workshop is open one Saturday per month. Most of the OW's maintenance work is performed at the facility, with exceptions for roadside assistance and, on occasion, limited on-site support at the facilities of customers. The workshop's planning of service appointments for evenings is set a few weeks in advance, whereas planning for the daytime schedule is more flexible in order to allow for emergency jobs. In those cases, customers requiring immediate support report to an express queue. In the past, the workshop's entire schedule was fully planned 2 or 3 weeks in advance. Today, by contrast, customers require far more flexibility and a short planning horizon. For the OW, however, a longer planning horizon and a schedule fixed a few weeks ahead of time would be preferred.

Most of the OW's customers, which include bus operators as well as hauliers using trucks, are based in the workshop's vicinity, although other customers temporarily in the area use its services as well. Because the workshop is located in an urban area, most of its customers that are trucking companies perform distribution, whereas fewer are long-haul, refuse and construction companies. Amongst the hauliers, the two largest are involved in distribution and the regional hauling of general cargo. One of these firms, the Transport Contractor (TC; see Section 4.3.2), depends fully on OW for all maintenance required. Meanwhile, a customer and transport provider in the refuse sector, the Refuse Haulier (RH; see Section 4.3.3), operates its own maintenance facility but purchases specialised maintenance services and spare parts from the OW.

Most of the OW's customers that purchase vehicles also invest in maintenance contracts. After all, today's customers are highly aware of the total cost of owning a vehicle, and in purchasing trucks, for example, the OW's customers focus not only on the price tag but also on the cost of operating and maintaining their vehicles. For some customers, a yearly maintenance plan is established that specifies which month each vehicle is due for preventive maintenance. However, even if such a plan exists for a haulier's vehicles, there is always room for flexibility. For instance, when the time for maintenance arrives, the vehicle may be occupied in transport. In that case, with a slot reserved at the workshop, the haulier may seize the opportunity by sending another of the fleet's vehicles. In that way and others, the plans of the OW and the hauliers are constantly subject to adaptation.

Unlike in the past, the OW currently experiences that interactions with customers are pivotal, as is the ability to adapt services to the specific context and needs of each customer. As part of those interactions, maintenance planning and fleet follow-up constitute two central activities. Thus, even though new technologies pose challenges for the future operations of the OW, the most important challenges concern customers' expectations of close cooperation and support for their operations. To be able to meet those expectations, the OW has to understand the business and operations of each customer and be able to adapt its internal operations according to each customer's needs.

Firm-level analysis

For its operations, the OW relies on multiple business relationships involving customers as well as partners. Figure 4.2 depicts the key business relationships identified by OW's representative, whereas other business relationships not mentioned have been excluded from the diagram. Because the OW emphasises the importance of offering its customers one-stop shopping, its cooperation with partners that offer supplementary or specialised services, if not both, is critical. In general, in facilitating supplementary services required by customers, the OW aims at developing business relationships with firms situated near the maintenance facility. At the same time, because it is important for the OW to adapt the services offered to the needs of each customer, the maintenance services offered to its customers differ. The OW's customers include, for example, firms that use trucks to transport goods and ones that perform public transport. Even then, the services offered to the TC and the RH, both of which are transport providers, have different scopes and objectives. To enable the workshop's services offered to hauliers and bus operators, the support provided by the organisation responsible for the Swedish market of the Truck OEM 1's network is important.

The activity structure of the OW comprises activities for the maintenance of vehicles and supplementary services related to the maintenance performed. The maintenance activities performed by the OW primarily involve preventive maintenance, corrective maintenance and tyre management. For the coordination of those activities, the OW also performs activities related to planning and the management of staff, facilities and equipment. Prior to engaging in such activities, the OW engage in interactions with customers in an effort to ensure that the workshop is prepared for the job to be performed. In that process, the OW's customer receptionists plan the maintenance of customers' vehicles, which links the

workshop's activity structure with the activity structures of customers. In turn, the activities of all parties exhibit sequential and reciprocal interdependencies. The maintenance plans often require modification, which requires additional coordination and the adjustment of activities in the activity pattern. At the same time, because the OW relies on the support of external partners, the activity pattern also involves the activity structures of those firms. For all of those reasons, in the activity links involving the OW and its partners, sequential and reciprocal interdependencies are inevitable. The activities performed by the partners have to be coordinated with the activities performed by the OW, as well as with the tasks managed by the hauliers and bus operators.

In the resource collection of the OW, all means required for the maintenance services offered to its customers are included: e.g., facilities, workshop bays, technicians, tools, spare parts and other staff required for various operations. Many of the resources are specifically adapted to each other as well as to the vehicles being maintained; for example, the technicians are often trained in using specialised tools. As a result, the resource collection of the OW and the resource collections of its customers are connected through resource ties and, in turn, form a resource constellation. Resource ties between the OW and its customers also pertain to the sale of spare parts in the case that customers perform maintenance themselves. Furthermore, for the maintenance of the specific systems of its customers' vehicles, the OW relies on the support of external partners that offer specialised services for those systems. Owing to the resource ties embedded in the business relationships of the OW with its partners, the resource constellation also includes the resource collections of those partners.

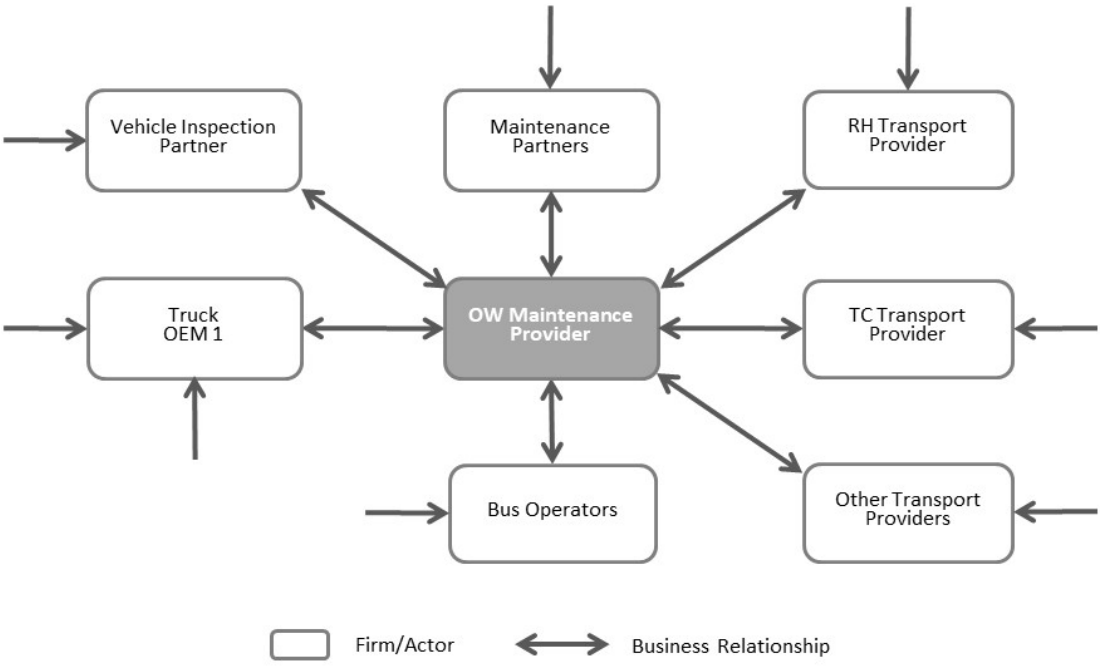

Figure 4.2: The workshop (OW) of Truck OEM 1 and its key business relationships

4.2.3 The Timber Haulier (TH)

Firm-level description

Although the TH plays two roles of particular interest in the case studied, this description and analysis focus on its role as a maintenance provider. The possibilities of reducing maintenance costs and avoiding the 1-hour drive to the nearest workshop have been key drivers for the TH's decision to operate an internal workshop, as have the possibilities of using preventive maintenance to avoid unnecessary problems and being able to repair vehicles as soon as any problem arises. At the workshop, which encompasses two bays and a vehicle-cleaning facility, the TH's three technicians spend half of their time on maintaining the firm's vehicles and the other half on servicing the heavy vehicles and passenger cars of external firms and private owners. However, the time allotted to providing maintenance services for external customers is adapted to prioritise the maintenance-related needs of the TH's vehicles.

For the vehicles used by the TH, the internal workshop manages most of the preventive and corrective maintenance, including wheel alignment, the maintenance of tyres, brake systems, load-locking systems, and the hydraulics for timber cranes. Only maintenance

concerning “the most inner parts of engine and gearbox” is assigned to external maintenance providers, typically the nearest workshop, a dealer within the network of the IW Company Group (IWCG; see also Section 4.2.4). For the maintenance performed internally at the TH, the TH also purchases spare parts from a third-party supplier.

The timber trucks of the TH require lubrication once or twice per week. When lubricating each timber crane and vehicle, the technician also performs a brief routine inspection that, as part of preventive maintenance program, saves on costs, according to the TH’s representative. In keeping with a strict preventive strategy, it is important to closely monitor the status of each vehicle, which can be difficult in large fleets, the representative explains. To avoid unplanned stops, the TH also performs oil changes more often than recommended by the OEM as well as a complete overhaul of the brakes twice a year.

Because the TH maintains complicated systems for brakes, timber cranes and load-locking systems, for example, its business relationships with system suppliers are important. In the maintenance of load-locking systems, the TH has accumulated extensive experience and even acts as an extension of the system supplier when it comes to providing support and service for companies that use the systems.

For the TH, the internal workshop is a long-term business commitment that requires obtaining knowledge and skills concerning the products and their maintenance. Therefore, the TH’s business relationship with the OEM is important. Cooperation with the OEM allows the workshop not only to develop competence and skills but could possibly also allow the TH to become an actor that can provide long-term support for the OEM. The TH could, for example, supplement the OEM’s operations and perform maintenance on the products that it sells to customers operating in the vicinity of the TH’s workshop, the TH’s representative argues.

Firm-level analysis

Figure 4.3 depicts the key business relationships mentioned by the TH’s representative. For the TH, external customers represent a key set of business relationships, because the business of its workshop partly relies upon its time allocated to the maintenance of external vehicles. However, because the maintenance of vehicles owned by the TH takes priority, the work on external vehicles is deferred to when time is available. Consequently, the interaction enabled by business relationships involving customers presumably has to allow

for the flexibility required. A second set of key business relationships represents firms required by the TH to perform maintenance on internal and external vehicles. In one such relationship, a workshop within the IWCG plays a key role as the provider of specialised maintenance beyond the scope of the TH's internal workshop. Moreover, the supplier of the load-locking system establishes an important business relationship for TH., which acts as an extension of the equipment supplier's organisation in an arrangement that mutually benefits both parties in the dyad. On top of that, for the TH, it is paramount to develop and retain its staff's skills and knowledge required for maintaining the vehicles purchased from OEMs. To that end, the TH strives to further develop its business relationship with the OEM that provides its vehicles, namely the Truck OEM 1. The TH representative even suggests that the TH's workshop could act as an extension of the OEM. For the IWCG, as an independent maintenance provider, such a business relationship could present a source of competition.

Overall, the activity structure of the TH encompasses two principal areas: the transport of timber and the maintenance of vehicles. The maintenance of vehicles owned and operated by the TH, occupying approximately half of the time available for all maintenance, is closely related to the transport performed by the firm. Preventive maintenance is performed when the vehicles are available and, together with the activities involved in timber transport, form both sequential and reciprocal interdependencies. Because the workshop also performs maintenance on vehicles belonging to external customers, the activity pattern involves the activity structure of the TH as well as the activity structures of external customers. Due to issues related to planning, that activity pattern could be expected to involve coordination and adjustment. Some of the specialised maintenance required for the vehicles of the TH is outsourced; thus, the activity pattern also includes the activity structure of the preferred workshop, i.e., the workshop of IWCG. As for the preventive maintenance performed internally by the TH, the maintenance managed by the workshop of IWCG has to be adjusted with respect to the transport performed by the vehicles of the TH. For those reasons, sequential and reciprocal interdependencies between the activities of the TH and the workshop of IWCG can be expected as well.

For the workshop facilities of the TH, the two workshop bays, the equipment and tools required for maintenance, along with the two technicians, represent the key resources of the TH's resource collection. The resources are mutually adapted but also adapted to the resources being maintained—that is, the vehicles. Due to the adaptation and investments

made, the resource collection could be expected to show signs of heaviness. Some of the equipment and skills required for maintenance, for example, are specific for the vehicles and systems maintained. The TH's ambition to act as an extension of the OEM's organisation could thus also be seen as a way to leverage the investments made. Because the TH also offers its services to external customers, the wider resource constellation additionally involves the vehicles owned by those customers. At the same time, for the maintenance of the vehicles, replacement parts are required, meaning that the parts provided by external partners become part of the resource constellation as well.

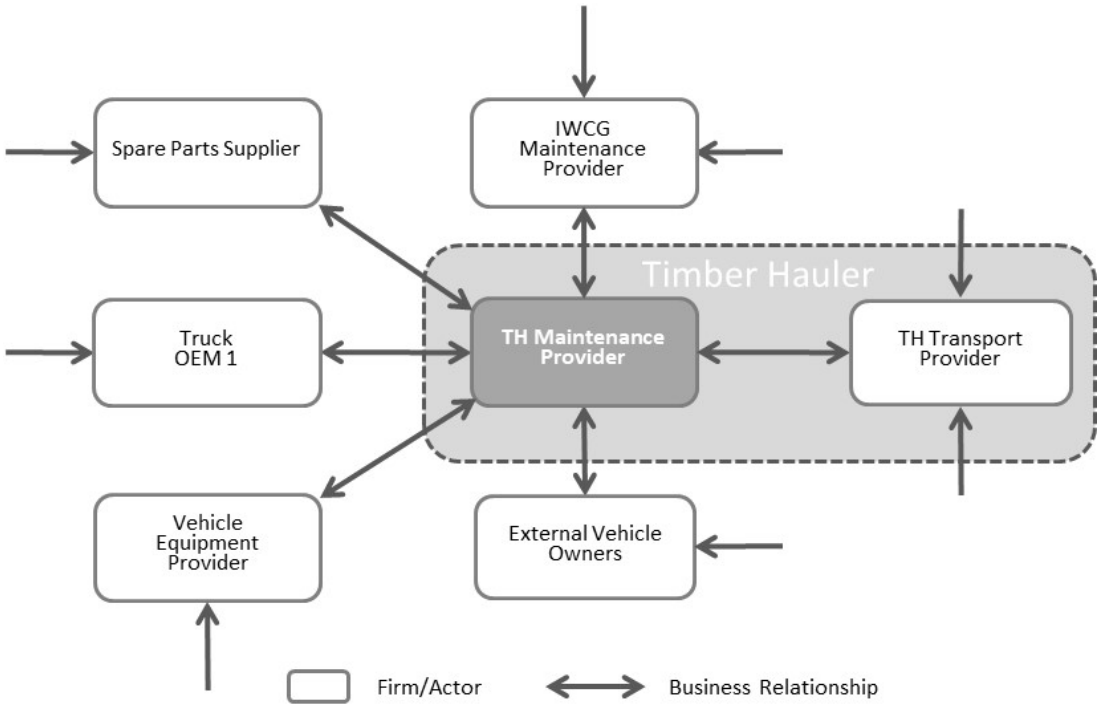

Figure 4.3: The Timber Haulier (TH) and its key business relationships related to the workshop operations

4.2.4 The Independent Workshop (IW)

Firm-level description

The IW, an independent, third-party workshop, forms part of the IWCG (IW Company Group), a group of dealers and workshops that provide services for customers that own heavy vehicles and specialise in vehicles produced by the Truck OEM 1. At the IW, the

workshop's operation is distinct from the department that sells new and used vehicles, in an arrangement that is common in the industry. The group of regular customers totals approximately 150, although other customers also use the workshop from time to time. The workshop is open 5 days a week, from 7:00 a.m. to 4:00 p.m., but also occasionally open on evenings or weekends when requested by customers. The ambition of the workshop is to offer a one-stop service that addresses all of the maintenance-related needs of customers. Similar many of the workshops belonging to the IWCG, however, the workshop does not offer tyre-related jobs or paint jobs in-house but instead cooperates with partners for those services. Amongst the workshop's customers, some hauliers choose to sign maintenance contracts for their vehicles. At the IW, these contracts are sold by the dealer's sales organisation.

Most of the IW's customers are timber hauliers (50%), followed by long-distance transport firms (30%), construction companies (15%) and specialised transport firms (5%). Independent of their sector, hauliers generally expects the workshop to keep their vehicles operational and available for transport assignments. According to the IW's representative, timber hauliers generally understand the importance of maintenance and are thus accustomed to its cost. In addition, hauliers involved in long-distance transport, as firms that typically face deadlines and delivery windows, are aware of the importance and cost of maintenance. The construction companies, by contrast, seem to have less understanding of that cost, according to the IW' representative.

Geographical proximity matters to the IW's customers. Hauliers favour short distances to their preferred workshops, and for some customers, even a distance of 50 kilometres is considered too long. Additionally, many customers prefer to have maintenance performed at a workshop where they know the staff. For healthy customer relationships, the competence of the workshop's staff is important, the representative adds, because customers know their vehicles and require efficient, high-quality support. Professional relationships with customers, both personal in nature and oriented towards business, are pivotal for customers as well as the workshop's business. As the representative of the firm explains, it is important never to take a customer for granted; the workshop–customer relationship has to be based on respect and professionalism.

Our customers are different from the ones that buy mobile phone subscriptions. The knowledge, quality and efficiency of the workshop are critical; customers have to feel that they are getting value for their money when their vehicles are maintained.

Manager at the IW

The IW relies on an internal planning process encompassing tasks, workshop bays and technicians. Although the workshop strives to maintain a 3-week planning horizon, the horizon frequently extends for only a week, if not less. For pre-planned jobs, the workshop aims to reserve a workshop bay for the date and time, and because technicians may have different, specific skills, planning at the IW also involves allocating technicians to specific jobs. At the same time, technicians have to remain available to perform emergency maintenance when customers experience unforeseen problems. To that end, near time planning made by the workshop´s customer receptionist has to be adjusted according to the current situation in the workshop. Although the IW strives to complete emergency maintenance quickly, the customer may have to wait until the following day, most often because the replacement part is out of stock at the workshop.

The IW's operations are monitored according to five parameters: the sale of workshop hours, efficiency, the utilisation of technicians, the number of ongoing jobs not yet invoiced and the amount of spare parts sold per workshop hour. Concerning those parameters, the IW aims to improve the sale of workshop hours, to achieve a high utilisation rate for technicians and to complete and invoice jobs as rapidly as possible. An important enabler for good business is proactivity—that is, supporting customers by having a long-term overview of the maintenance that needs to be performed. For that purpose, the role of the customer receptionist is essential to the firm. Together with the parts salesperson, the customer receptionist represents a significant interface with customers, along with being responsible for contact with customers, drivers and the workshop's technicians. Over time, customers become familiar with the receptionist, and some customers therefore choose only to communicate with that person at the workshop. Even if proactivity is preferred by the IW, initial contact prior to maintenance is often made by the customer seeking maintenance service.

Preventive maintenance offered by the IW occurs on two levels: base service and full service. Whereas base service takes half a day to complete, full service requires a few hours beyond that. One reason why some jobs take longer time is that the operation requires the

engine to be cold. Although some customers request maintenance to be split between two or more occasions, the workshop does not prefer such an arrangement but will accommodate the customer's request nonetheless. Most often, customers drop off their vehicles at the IW for pickup at a later time. If the service requires half a day or less, then some customers, mostly owner–operators, wait at the workshop until the work is completed. Even if such arrangements disrupt the flow of daily activities, the workshop considers the resulting dialogue with customers to be vital. At other times, to meet the demands of customers, the IW has performed the maintenance of vehicles at a haulier's facility. According to the workshop´s representative, such services may become more common in the future and may provide the firm a competitive edge.

According to the IW's representative, some hauliers operate internal workshops for the sake of around-the-clock availability and proximity. However, as the introduction of new technology and the special skills required for new kinds of maintenance drive changes, not all will be able to finance, for instance, the purchase of special tools and the training required. For the IW, know-how regarding new technology will thus become critical, as will be training provided by the OEM. In the future, the IW's representative predicts, fewer company groups will serve larger geographical areas with more workshop locations. Due to the cost structure, it will be important for the firm to realise synergistic effects with investments and operating costs, and having a larger organisation would allow the firm to offer better services to customers.

Firm-level analysis

For the IW, the business relationships with entities within the wider IWCG Company Group are of high importance. Additionally, the business relationships with the Truck OEM 1 and all of its customers are pivotal (see Figure 4.4). In particular, the business relationship between the IW (and IWCG) and the vehicle OEM is critical for both firms and represents a long-term collaborative commitment to cooperating in order to support customers. To be able to offer efficient, high-quality services to customers, the workshop requires the OEM's support with training, parts, tools, guidelines and administrative systems, amongst other things. The business relationship is bidirectional, however, and from the IW, the OEM receives feedback about the use and maintenance of vehicles. To allow for a wider range of services, the IW also cooperates with external partners for tyres and paint jobs, for instance. Therefore, for the IW and its customers, those business relationships also form an important

part of the business network. For the workshop´s customers, the uptime and reliability of their vehicles depend upon support from the IW as their preferred workshop. Therefore, both for the IW and its customers, the business relationships that develop between them are crucial. Specifically, hauliers and the customer receptionist of the IW develop actor bonds that facilitate dialogue as well as planning.

For the IW, the activity structure primarily involves activities related to the sales, performance and invoicing of maintenance services. Often following step-by-step guidelines from vehicle OEMs, maintenance activities exhibit sequential interdependencies and require thorough coordination through planning. Frequently, the planning of maintenance activities also has to address the need for and availability of specific resources such as vehicle bays, tools and technicians. The planning required concerns not only the internal activity structure of the workshop, however. After all, the IW's customers want to use their vehicles as necessary and to the greatest extent possible as well as the need arises; thus, the maintenance of their vehicles should be planned with their needs and reciprocal interdependencies in mind. Coordination thus also preferably involves the activity structures of the IW's customers. Because hauliers cannot use their vehicles during maintenance, the planning for the vehicles, drivers and the transport of the hauliers have to be adjusted. As a result, interdependencies between the activities of the workshop and the activities of the hauliers develop. The plans of hauliers and the workshop may suddenly change, however, in the case of an unplanned event (e.g. breakdown). On such occasions, the workshop strives to adjust its internal activities in order to help the haulier with getting the vehicle back in operation as quickly as possible. In addition to the activities of the IW and its customers, the specialised activities performed by external partners of the IW form part of the wider activity pattern. Therefore, the coordination managed by the IW should also take the work performed by its partners into account. Last, reflecting the operations of the IWCG, the activity structure of the IW is also linked to the activities of the company group.

The workshop's facility, the spare parts kept in stock, the staff and the equipment, all key tangible resources within the IW's resource collection, are critical for the firm, as are intangible resources such as knowledge and skills. By extension, the resources within the resource collection are adapted to the IW's offerings (i.e. vehicle maintenance and related services) and operational needs. At the same time, and reflecting a degree of heaviness, many of the IW's resources are connected and specifically adapted to the vehicles being maintained. Taken together, those resource ties result in technical interfaces and a resource

constellation involving the IW and the vehicles of their customers. The resource constellation, however, also comprises the resources owned and operated by the IW's partners, the IWCG, as well as resources managed by the vehicle OEM.

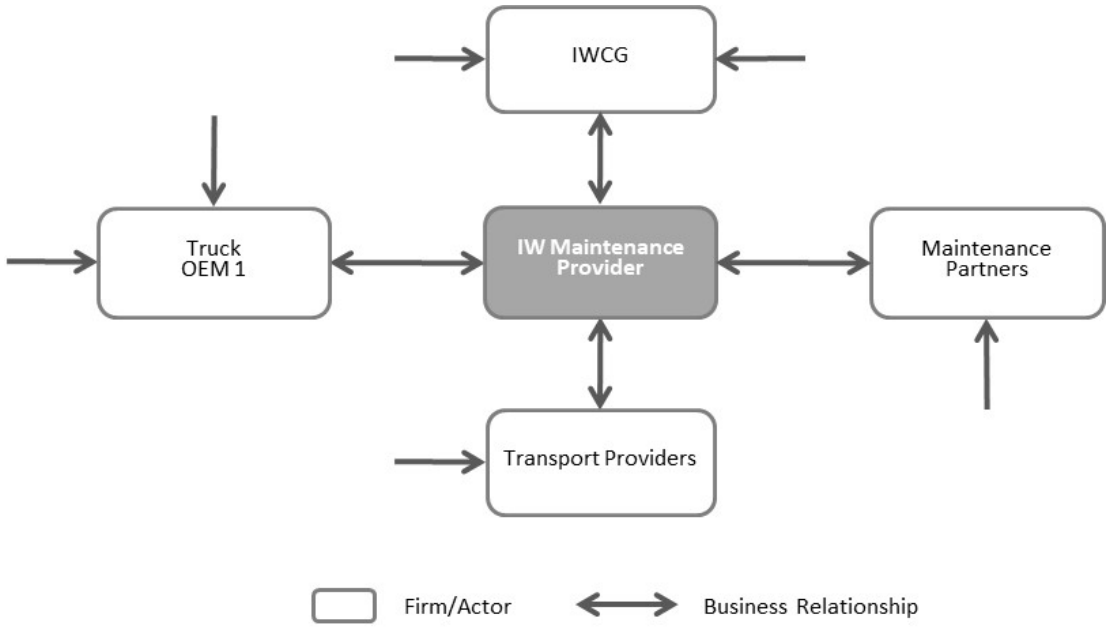

Figure 4.4: The Independent Workshop (IW) and its key business relationships

4.3 Transport providers

4.3.1 Introduction

The transport providers, also called "hauliers", provide transport services for their customers. As the following examples show, a transport provider can provide services to multiple customers and may also subcontract transport services to other firms. For the thesis, four empirical examples of transport providers have been selected from the case study: the Transport Contractor (TC), the Refuse Haulier (RH), the Timber Haulier (TH), and, not previously mentioned in this chapter, the Milk Haulier (MH).

4.3.2 The Transport Contractor (TC)

Firm-level description

The TC is a family-owned firm with more than 50 years of experience in the transport business. The company operates 90 vehicles through the TC and another 135 in two

subsidiaries. The TC performs the distribution and haulage of general cargo for a single customer, a large logistics service provider (LSP) with multinational presence. The TC's representative described the firm's contract with its sole customer as long term. Because the TC also manages the planning for transport performed on behalf of its customer, both firms have established a close business relationship over time. The goods to be distributed, including groceries, refrigerated goods, waste and dangerous goods (e.g. ADR goods), are loaded onto trucks in the morning and distributed throughout the day.

For the TC, refrigerated transport, which requires extreme reliability, is the most critical service offered. Because the reliability of transport is generally a major demand, the TC's customers constantly monitor the firm's performance in delivering the correct goods on time. In recent years, an increasing amount of the senders and receivers of goods have imposed strict requirements regarding time windows for deliveries or pickups, if not both. If several of those customers have goods loaded on the same vehicle, which requires the driver to manage multiple time windows on the same route, then meeting those requirements can be challenging. To address the overarching demand for reliability and robustness, and be able to complete the transport even when unforeseen problems arise, the TC maintains overcapacity with respect to drivers and vehicles. Such additional capacity also comes in handy when vehicles are due for maintenance and thus have to be removed from operation.

Each of the TC's drivers is typically affiliated with a specific geographical district and a specific vehicle. In the TC's experience, wear for vehicles is less with one driver than with many. Because the TC's vehicles perform urban and regional distribution that does not require travelling long distances, the firm's vehicles are kept for up to 12 or 13 years. In that time, they cover an average distance of approximately 25,000 kilometres a year.

The TC does not maintain an in-house vehicle workshop, primarily because, as the firm's representative explains, the vehicles used by the firm tend to contain advanced electrical systems whose maintenance requires costly tools. Instead, the TC prefers to focus on its transport operations. Therefore, all of its maintenance work is outsourced to the workshops of the respective OEMs, including the Truck OEM 1's workshop, the OW. Maintenance is planned by a fleet manager at the TC, who devises a rough plan for each year with the aim to distribute maintenance and inspections for the vehicles throughout the year. In that way, the TC avoids having several vehicles due for maintenance or inspection at the same time. Often, the TC's drivers leave vehicles at the workshop for maintenance and pick them up

later. The TC prefers to schedule vehicle maintenance for evenings, which usually suits the schedules of all involved. For annual vehicle inspections, however, an additional half day of servicing may be required.

Firm-level analysis

Based upon input from the TC's representative, Figure 4.5 displays a simplified business network with the TC's key business relationships. According to the representative, the firm's business relationship with its sole customer, the LSP, is long term. The TC manages the transport planning on behalf of its customer, and the interactions within that dyad have presumably become routinised over time. Another important business relationship for the TC involves the workshop that performs maintenance on its vehicles. Because reliability, delivery time and delivery precision are paramount for the LSP as well as the customers of the LSP, the TC's business relationship with the maintenance provider is pivotal. Additionally, because each of the firm's drivers is typically affiliated with a specific district, the drivers likely develop personal relationships and actor bonds with the staff responsible for sending and receiving goods.

The activity structure of the TC primarily involves activities related to the transport of goods (e.g., loading, transporting and unloading), all of which exhibit sequential interdependencies and require coordination. In addition to transport-related activities, the TC performs transport planning on behalf of its customer, as well as the planning of drivers' schedules and the maintenance of vehicles. The TC's planning activities respond to the needs defined by the LSP, which reflect the requirements of the senders or receivers of the goods, if not both. Therefore, the activity pattern involves activities performed by the TC, its customer LSP and customers of the LSP. The demands concerning delivery windows indicate that the activities of the firms need to be mutually adjusted and, moreover, that coordination amongst the firms is pivotal. The maintenance planning performed by the TC not only has to be adjusted in accordance to the demands set by the transport plans but also depends upon coordination with a maintenance solution provider—that is, the workshop. The transport performed by the TC and the maintenance performed by the workshop exhibit reciprocal interdependence and, in turn, require mutual adjustment.

To perform the transport required by customers, the TC owns and manages vehicles as well as employs drivers. On top of that, the TC employs staff responsible for managing and

planning the firm's operations. The resource collection of the firm thus encompasses resources mutually adapted in response to the firm's operations and business needs. Because the TC, on behalf of its customer, performs the transport of goods for senders and receivers, those firms also form part of the wider resource constellation. In some cases—for instance, in transporting refrigerated and ADR goods—the TC's vehicles are specifically adapted to carry the types of goods transported. By extension, it is probable that the TC's vehicles and the loading/unloading facilities at the LSP and its customers are mutually adapted.

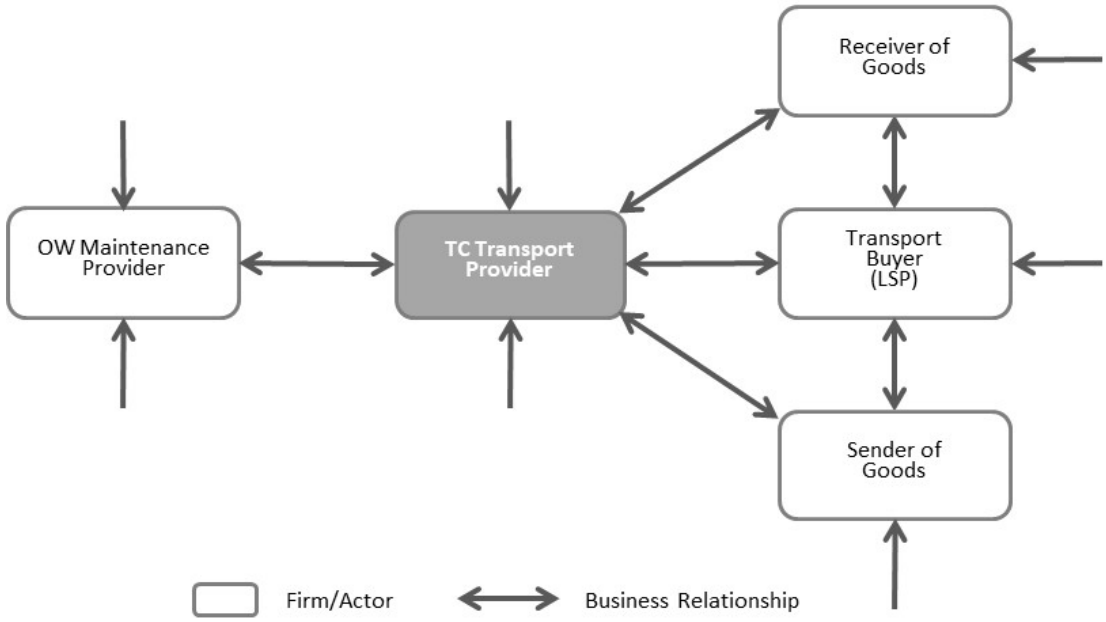

Figure 4.5: The Transport Contractor (TC) and its key business relationships

4.3.3 The Refuse Haulier (RH)

Firm-level description

The transport provider RH is a publicly owned company managing the operation of the collection and disposal of waste and garbage from households and commercial entities. Amongst the firm's principal customers are municipalities, construction companies and industries. Although 10 municipalities in Sweden own the RH, because they are governed by the rules for public procurement, they are not obliged to choose the RH as their respective municipality's service provider. In addition to the operations for waste collection and

disposal, the firm owns and operates several facilities for the disposal, treatment and burning of waste. The RH can also support its customers with services for cleaning as well as with the follow-up and reporting of waste management and environmental targets. The firm's ambition, the RH's representative explains, is to offer customers a comprehensive set of services that ensure the best transport, the best waste management and the best reporting. Along with its current offerings, the RH has begun to offer new services, including waste management for construction sites and waste sorting for apartment complexes. Altogether, the RH's offerings and operations depend heavily upon the use of trucks, and for that reason, its business relationships with vehicle OEMs and maintenance providers are important to the firm. At the same time, due to the nature of RH's operations, its relationships with (so called) "bodybuilders" designing and selling waste management systems, along with container suppliers, fuel suppliers and tyre suppliers, are important as well.

The RH retains a staff of approximately 750 employees as well as owns and operates more than 200 trucks along with another 100 light vehicles. To meet the demands for transport and to match fluctuations in the capacity required, the RH also purchases transport capacity services in an amount of approximately 20 vehicles daily. The vehicles used are equipped differently depending upon the type of waste to be collected and transported. Because city regulations limit the operations of garbage trucks in urban areas to the period between 6:30 a.m. and 6:30 p.m., most vehicles for urban and regional waste transport are used only during the daytime. However, a few of the RH's vehicles, used for longer-distance inter-regional haulage, are occupied between 5:00 a.m. and midnight. In all operations, the RH's transport plans are established a day in advance.

The costs of a vehicle and its equipment amounts to between SEK 2 and 2.5 million, and it is not financially sustainable to have a vehicle out of operation. To reduce operating costs, the RH strives to improve the internal efficiency and increase the use of its vehicles. Using the firm's resources in two shifts has proven costly, however, often because the additional shift of drivers lowers productivity and accelerates the wear and tear of the equipment. The RH depends on that their vehicles are operational and may even have to pay penalties (SEK 5000 per day) to its customers if waste collection is delayed. To prevent such risks, the firm requires spare capacity. Nevertheless, according to the RH's representative, it is difficult to find such specialised vehicles outside the company, and for that reason, the firm retains eight spare vehicles in its fleet.

For the RH, most vehicle repairs (e.g. of chassis) and routine maintenance are outsourced to workshops managed by each vehicle's respective OEM. By contrast, the RH perform the maintenance of vehicles and equipment (e.g. hydraulics) that does not require special tools, primarily because doing so affords greater flexibility in planning and because in-house work is less expensive. For such tasks, RH owns an internal workshop, staffed by more than 50 employees and open from 6:00 a.m. to 10:00 p.m.. The RH orders the spare parts required for maintenance of vehicles from the OEMs online. If the parts are ordered in the evening, then they can be picked up the morning after. In addition to the work related to RH's vehicles, the RH also offers maintenance services to external customers, including the OW (see Section 4.2.2).

Maintenance of RH's vehicles is planned internally, typically with reference to the OEM's guidelines. Because the yearly driving distance for most vehicles is limited, maintenance planning is thus based on the recommendations with respect to time between service stops. In general, regular maintenance is performed 4 times annually, and of those 4 times, the one for most extensive maintenance lasts approximately 2 days. To not disrupt transport operations, maintenance is mostly performed in the evenings.

Only in a few cases does the RH sign maintenance contracts for its vehicles. According to the RH's representative, maintenance work may cost less in-house than when outsourced, and the firm avoids maintenance contracts for that reason. However, as the representative explains, another reason is that external maintenance contracts require the RH to assign a staff member to drive the vehicle to and from the out-of-house workshop.

Firm-level analysis

Even if the network representing the key business relationships identified by the RH´s representative is simplified, as in Figure 4.6, it nevertheless involves some complexity. The RH's operations rely heavily upon interactions with multiple actors in the network, several of which have dual roles. For one, the 10 municipalities that collectively own the RH also occasionally act as customers. Similarly, the OW not only acts as a maintenance provider for the RH's vehicles but also acts as a buyer of maintenance services from the RH. Construction firms, industries and property owners add to the set of the RH's business relationships involving customers. For its part, the RH is a customer of equipment, services and solutions from several suppliers that thus support the firm in managing its operations.

For transport operations in particular, the RH purchases transport capacity from external hauliers, and for its vehicle fleet, its purchases vehicles and equipment. Because many of the vehicles are specialised, the firm's business relationships with OEMs, bodybuilders and equipment suppliers are critical. For its daily operations, the RH also relies upon business relationships with tyre and fuel suppliers.

Waste management, collection and disposal involve various activities that have to be thoroughly coordinated. For the RH, such coordination typically concerns the activities within its internal activity structure. To meet the demands of customers, however, the RH has to take the activities managed by several additional stakeholders in account during the coordination process. To transport waste from industries and apartment complexes, for instance, the firm has to collect and occasionally sort the waste before its trucks can be loaded. Therefore, the activity pattern involves numerous instances of sequential as well as reciprocal interdependencies that require the coordination amongst the actors. Also with respect to maintenance, coordination of activities is an important task for the RH. After all, even if the firm performs maintenance planning internally, the maintenance has to be coordinated with the transport being performed and address the limitations imposed by the driving restrictions enforced in local communities. On top of that, maintenance has to be planned together with the workshop that will perform the work—that is, the internal workshop or the external maintenance provider. For those reasons, sequential and reciprocal interdependencies thus develop, and the coordination has to address the needs of multiple actors. Adding to the complexity for the RH's internal workshop, coordination also has to meet the needs of external customers.

The RH's resource collection ranges widely, from facilities for the disposal, treatment and burning of waste to vehicles and auxiliary equipment such as containers. The vehicles are specialised for and adapted to the type of waste transport and management performed by the RH; however, due to such specialisation, it is difficult to find replacement vehicles when garbage trucks break down. Also with respect to the auxiliary equipment, interdependencies can be observed. The design of garbage bins and the lifting system of the vehicles, for instance, are mutually adapted. Hence, the adaptation of resources also involves resources managed by other actors in the business network. More broadly, to ensure the collection, transport and disposal of waste, the resource constellation contains several examples of technical and organisational resource interfaces.

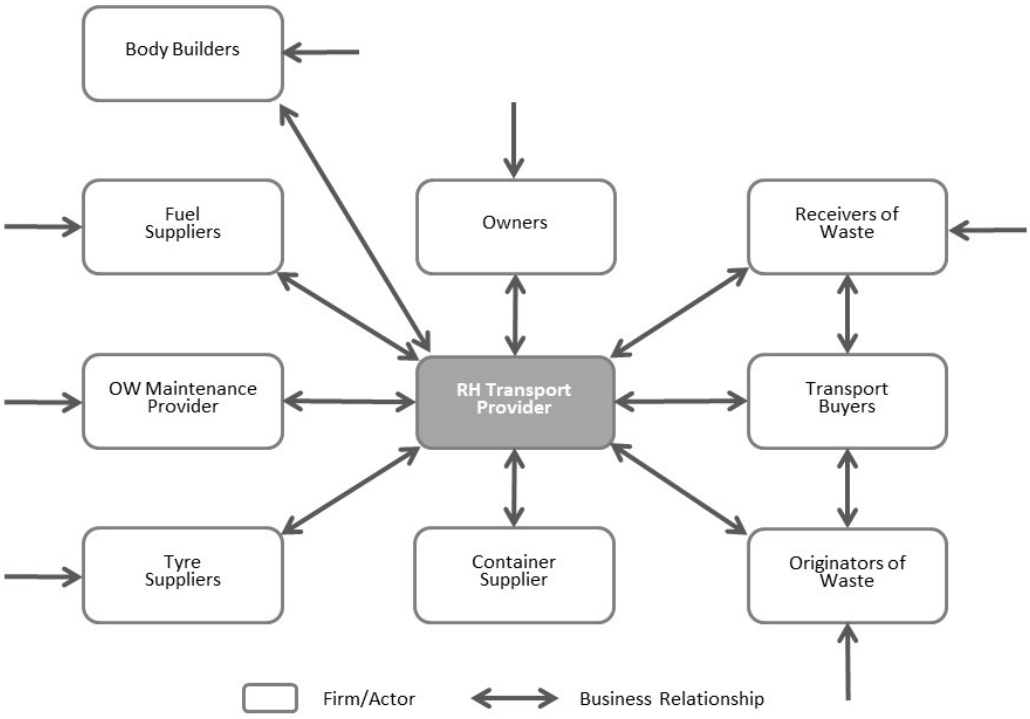

Figure 4.6: The Refuse Haulier (RH) and its key business relationships

4.3.4 The Milk Haulier (MH)

Firm-level description

The operations of the haulier MH revolve around milk collection for a single customer: Dairy Products (DP; Section 4.4.3). Even if the contracts between DP and its transport providers are short term, their business relationships are often long term. The MH retains only three trucks, all manufactured by the Truck OEM 2, a different vehicle OEM from the one presented below in this chapter, and each of the trucks has three drivers who work in shifts. In their arrangement, the MH and DP have agreed that the haulier owns the trucks but that DP owns the trailers and bulk tanks mounted on the trailers and trucks.

The MH collects fresh milk from farmers in the region every 48 hours, which amounts to four rounds of milking at each farm. For each cycle of milk collection, the MH and DP cooperate in planning the route, and upon completing the cycle and filling the bulk tanks of the truck and trailer, the driver takes the vehicle to a DP-owned dairy for weighing and unloading. Once every 24 hours, the bulk tanks must be cleaned, which is done at one of the

dairies by the driver during one of the stops. In the recent years, the demand for organic milk has grown amongst consumers; however, because organic milk cannot be mixed with regular milk, separate milk collection cycles, as well as special handling at the dairy, have become necessary.

Because the MH's vehicles are in operation 23 hours a day, 7 days a week, the hauliers contracted work solely for DP. As demand for efficiency has increased and fewer vehicles have to cover a wider geographical area than in the past, the vehicles cover vast distances every year. As a result, each of the MH's vehicles covers approximately 310,000 kilometres on average in a year's time. Consequently, maintenance has to be performed often. As an upshot, such frequent maintenance improves the reliability of the vehicles, which is crucial for the transport so sensitive to disruptions.

For a more comprehensive overview of the maintenance costs to expect and plan for, the MH has signed maintenance contracts with the OEM of its vehicles—that is, the Truck OEM 2. Because the long distances covered by the vehicles, the trucks of MH have to be replaced every 2.5 to 3 years. Hence, the MH's business relationship with the Truck OEM 2's dealer is important and has lasted for a considerable time. To follow up on the use of the vehicles, as well as to support time reporting and salary administration, the MH uses a system provided by a company offering fleet management systems.

When maintenance is due, the haulier calls the workshop from a few days to a week in advance in order to schedule an appointment. For less time-consuming maintenance tasks requiring only up to 1 hour, the haulier adapts its transport to the workshop's schedule. Although the workshop that the MH uses also offers maintenance during the evenings and weekends, the MH has so far not needed using such extended services. The maintenance is sometimes performed at the workshop on the route to or from the dairy, and the driver, usually an owner of the MH, stays with the vehicle. If more extensive, more time-consuming maintenance is required, then the MH normally requests to split the maintenance into several steps in an effort to avoid having to arrange for a replacement vehicle. Flexibility with maintenance and a short time horizon for scheduling it are highly valued by the MH. After all, several circumstances influence transport plans, and it is preferable to adjust maintenance planning in accordance with the current situation.

Apart from the workshop, the tyre service company is an important suppler for the MH. The firm that the MH contracts has to be able to provide support both day and night as well as meet wherever and whenever one of the MH's vehicles experiences a tyre-related problem. Reflecting the split ownership between the MH and DP, the maintenance of trailers and bulk tanks is the responsibility of DP. Therefore, DP also has to ensure that the maintenance of trailers and bulk tanks is planned and performed. When the trailers are being maintained, DP lends the MH a replacement trailer.

Firm-level analysis

The MH and its key business relationships are depicted in Figure 4.7. Because the MH has only one customer—DP, its transport buyer—its relationship with DP is paramount. At the same time, because the milk is collected every 48 hours, the farmers and the MH have forged business relationships involving, for instance, planning and reporting concerning the volume and quality of milk collected. The supplier of the fleet management systems used by the MH represents another of the MH's business relationships. For DP's operations, the reliability and punctuality of milk collection and transport are key criteria; therefore, vehicle uptime and maintenance are major concerns for the MH. For such maintenance, the maintenance provider of the Truck OEM 2 thus represents a key supplier for the MH. Last, for the uptime and availability of the MH's vehicles, the tyre supplier also represents another key business partner.

The collection, transport and unloading of fresh milk are three of the key activities of the activity structure of the MH. Furthermore, in being linked to each other, those activities exhibit sequential interdependencies. By extension, because the activities performed by the MH also are linked to the activities performed by DP, its sole customer, the activity structures of both firms are connected. For that reason, the coordination of activities is critical for both firms. However, the joint activity pattern also involves other stakeholders such as the farmers and the maintenance provider. The milk collection performed by the MH has to be coordinated with and adjusted to the milking performed by the farmers. Similarly, the maintenance of the MH's vehicles has to be planned and coordinated with other activities to accommodate the transport of milk. Consequently, maintenance is sometimes performed on the route to or from the dairy, meaning that providing required maintenance can interrupt with transport. The transport and maintenance performed thus exhibit both sequential and reciprocal interdependencies. Because DP is responsible for the

maintenance of the trailers and bulk tanks, those activities also become part of the activity pattern and need to be adjusted to accommodate the transport performed by the MH.

The key resources of the MH encompass the trucks and the drivers. On the trucks, a bulk tank is mounted that, along with supplementary trailers with their own bulk tanks, are owned by DP, the customer. The resources of that joint resource constellation are mutually adapted as well as specific to the purpose of the transport. The vehicles used are thus adapted to the goods being transported—that is, fresh milk, a resource of the farmers. Moreover, to allow for the unloading of milk at the dairies of DP, the vehicles and the dairies' facilities are also mutually adapted. As a result, technical interfaces have developed between the farmer's facilities, the goods transported, the vehicles and the facilities at DP's dairies. On top of that, as a result of interaction concerning planning, organisational interfaces have developed between MH, DP, and the farmers.

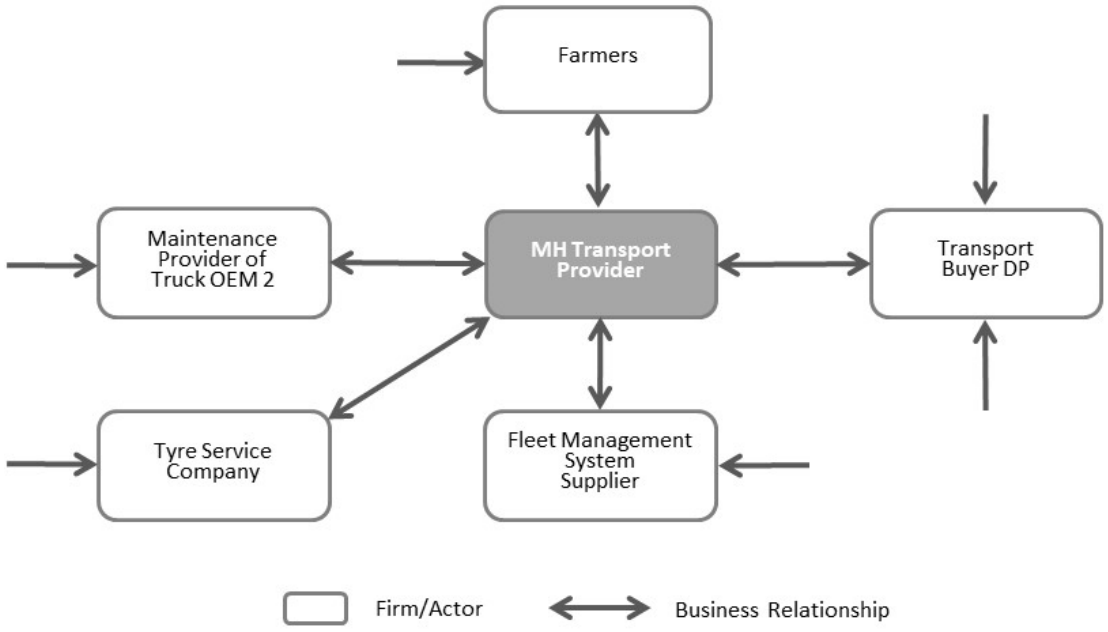

Figure 4.7: The Milk Haulier (MH) and its key business relationships

4.3.5 The Timber Haulier (TH)

Firm-level description

As previously explained, the TH owns two roles of specific interest to the case: that of a maintenance provider, as previously discussed in Section 4.2.3, and that of a transport

provider, as in focus here. The TH is also a family-owned business that started in the 1930s by the current manager's grandfather. Although the firm's operations initially involved various areas, since the 1970s the firm has focused exclusively on transport to sawmills and paper mills. The TH sells most of its transport services to one customer only: the Forest Company (FC), a large forest owner in Sweden that produces timber and forest-based products. To meet its customer's transport demands, the TH owns and operates eight timber trucks but also subcontracts transport to external hauliers, each of which is often small and typically owns only one or two vehicles. Beyond that, the TH cooperates with another timber haulier, and to improve their efficiency and flexibility, both hauliers exchange loads when feasible. When the FC, as the TH's sole customer, wants to increase the transport capacity purchased, the TH needs to expand accordingly. As the contracts in the business have become increasingly short-term—today, they last from 18 to 24 months, and less than the time required to complete the instalments for a vehicle—the TH would prefer longer contracts that allow for a longer planning and investment horizon.

Based on weekly quotas received from the FC, one of the TH's managers establish a transport plan for the company. Thereafter, the information required by the drivers is relayed to the vehicles' on-board terminals; such information concerns, for example, the place for loading, the identification of the timber and the receiving industry. If the production plans of the receiving industries change, then the transport plan has to be adapted to the new circumstances. To cope with such changes, the haulier has to be flexible, able to adjust its operations and rely on the possibility of purchasing external capacity. Even if the TH uses subcontracted hauliers, however, it is impossible to count on support with additional capacity as necessary if the planning horizon is too short.

The TH performs transport 5 days a week, from early Monday morning to Friday evening. Each day, the vehicles are used from 5 a.m. until after midnight, which requires the drivers to work in two shifts. The empty vehicle is driven to the loading site, which is typically a roadside storage (i.e. pile) for timber or other forest products. If the storage site is large, then the driver may have to return several times to fetch all of the products. If the volume is small, by contrast, then the driver may have to visit additional roadside storage sites. Having completed loading, the driver takes the vehicle to the receiving industry, and upon arrival but prior to unloading, the volume or weight of the load is measured. In turn, such measurements are used as input in the reimbursement system.

The TH's vehicles are kept for 5 to 7 years and cover long distances—on average, 150,000 kilometres—per year, although the average annual distance covered has increased over the years. Due to difficult driving conditions (e.g. rough forest roads) and the long distances completed, maintenance is a top concern for the TH. The drivers continuously check their vehicles during the day, and greasing is needed every week. To manage the maintenance required and enable a quick response to problems detected, the TH has operated an internal workshop since 1982, as described in Section 4.2.3. For the TH, an acceptable distance to a workshop is no more than 30 or 40 kilometres.

> *Our customers demand quick responses from us, and we also have to get a quick response from the dealer. Maybe a solution for the future could be a denser network of smaller specialised workshops that work closer with their customers …*
>
> Manager of the TH

For the TH, the long-term perspective of its business relationship with the truck OEM matters far more than the basis of its business—that is, the trucks—and whether the trucks are owned by the company. Moreover, to get the most out of the vehicles, long-term cooperation with the truck OEM is required. Today's vehicles are advanced, and the haulier needs the support of OEMs in order to learn how to use the vehicles economically. In the future, for the TH, the business relationship with the truck OEM may become more important than the one with the dealer or workshop. At the same time, however, closer cooperation between the dealer's workshops and the workshops of hauliers would be preferred.

Firm-level analysis

Because the TH sells it transport services to one customer—the FC—its business relationship with the FC is crucial. To allow for flexibility, the TH purchases additional transport capacity from external hauliers, and those business relationships are also critical to the TH's operations. By virtue of those business relationships, the TH can cope with shifting demands and better tailor its solutions to its customer. Moreover, to improve the efficiency of its operations, the TH also cooperates with another timber haulier. As a result of that business relationship, the two firms can coordinate their plans and exchange loads when favourable. The TH has also developed an important business relationship with the

OEM of its trucks, the Truck OEM 1. Hence, even if the TH nurture a business relationship with a workshop of the IWCG (see Section 4.2.3), it also collaborate directly with the OEM. Last, because the TH transports timber from roadside storage sites to mills requiring raw material as input, the firm's relationships with those mills are also important. Figure 4.8 presents the TH's key business relationships in its role as a transport provider.

Timber transport is the TH's most important activity, one that entails loading, transport to mills and unloading, all of which exhibit sequential interdependencies that require coordination. To manage interdependencies amongst the activities of its activity structure, the TH has established a transport plan based on the demands and activities of the mills. Therefore, the activity structures of the TH and its customer, the FC, are connected via activity links. As a result, the two firms have to collaborate in order to coordinate their operations. The activity pattern also involves activities managed by other firms, and because the TH outsources part of the transport performed for the FC and collaborates with a partner haulier, the firms concerned form part of a comprehensive activity pattern. For the joint operations of the firms involved, the planning and coordination of activities become critical tasks. Moreover, maintenance planning, which to a large extent is performed by the TH, has to be made with the transport assignments in mind, and the activities involved exhibit reciprocal interdependencies that necessitate coordination.

For the TH's haulage operations, the vehicles, the drivers and all additional staff at the firm represent key resources. The vehicles are specifically adapted to timber transport and equipped with, for example, timber cranes, load-locking systems and on-board terminals. The vehicles thus involve several types of resources mutually adapted to allow for the use intended by the TH. By way of their business relationships, the TH's resource collection is tied to the resources of its customer, including the mills. In that resource constellation, the timber, which is transported by the TH and processed by the FC, stands as a central resource that forms part of several technical interfaces. Because the coordination of activities appears to be a critical joint challenge for the TH, the FC and external hauliers, the organisational interfaces are pivotal to their joint operations.

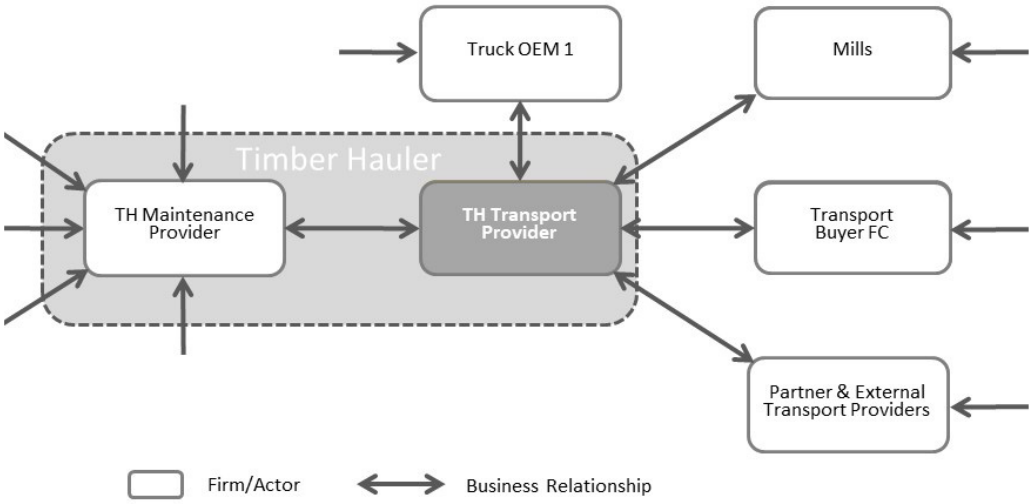

Figure 4.8: The Timber Haulier (TH) and its key business relationships related to timber haulage

4.4 Transport buyers

4.4.1 Introduction

Transport buyers purchase transport services from transport providers. Even though the operations of each of the four transport buyers presented below depend heavily upon transport, the firms exhibit variety in their transport context, goods to be transported and way in which transport capacity is secured. For the thesis, to provide insights into a range of operations and demands, four transport buyers were selected—Medical Supplies (MS), Dairy Products (DP), the Construction Company (CC) and General Cargo (GC)—each of which is described and analysed in the following sections from a firm-level perspective.

4.4.2 Medical Supplies (MS)

Firm-level description

Medical Supplies (MS), owned by a European investment firm, operates in 10 countries in northern and central Europe. Established approximately 10 years ago, the firm is a wholesaler that supplies pharmaceutical and healthcare products to customers. Although MS purchases, imports, stores, sells and distributes products such as medicine, it has also established a few house brands for mature products such as plastic gloves. The customers of MS represent five segments—home care providers, elderly care providers, primary care providers, hospitals and retailers—each with different needs. Home care providers, for

instance, require small deliveries of low-value products, whereas hospitals require frequent deliveries in high volumes.

MS operates warehouses where the products are stored, picked according to orders and packaged. Additionally, for some hospitals, MS offers on-site logistics solutions in which goods are sorted, packed and delivered on load carriers. MS's warehouse in Gothenburg, for example, manages a considerable volume of products; each day, three to four containers are received from Asia at the port of Gothenburg, and distribution from the warehouse amounts to approximately 1000 pallets per day.

MS's distribution is outsourced to an external LSPs and transport providers, and the firm divides its services purchases as either the distribution of parcels or the distribution of pallets. For the distribution of parcels, the firm General Cargo is the selected provider (GC, see Section 4.4.5), and MS is its second largest customer, who ships approximately 18,000 parcels via GC every day. Resembling a partnership, the collaboration of MS and GC has spanned 4 years, and MS's representative explains that for parcel deliveries such solutions requires taking a long-term perspective. Meanwhile, for the distribution of pallets, MS has contracted another logistics and transport provider. In those activities—for example, the transport of pallets from A to B—the need for long-term strategic approaches is not required, the representative argues. Although the transport and logistics services are re-sourced approximately every other year, approximately half of the cases do not involve any change in the supplier.

Because MS's customers require reliable, prompt deliveries, MS in turn requires reliability and punctuality from the LSPs and transport providers employed, and to follow up on their performance, MS requires detailed information on delivery reliability and promptness from them. However, a problem for MS in that activity is acquiring high-quality data from the suppliers. Apart from demands concerning deliveries, MS's customers also pose demands concerning the environmental aspects of transport. As a result, MS also imposes demands concerning environmental sustainability and fuels used when selecting LSPs and transport providers.

Firm-level analysis

MS's business network from the firm's perspective is depicted in Figure 4.9. For MS, as a wholesaler, its business relationships with the suppliers of pharmaceutical and healthcare

products are critical. Beyond that, all customers in their various segments (i.e. home care providers, elderly care providers, primary care providers, hospitals and retailers) engage in business relationships that are pivotal for MS. Because the needs of the customer segments differ, MS has to adapt to their requirements. For some hospitals, for instance, MS offers on-site services and can thus be seen as a part of the hospitals' organisations. Furthermore, with respect to distribution, MS is involved in important business relationships with the LSPs and transport providers to which it outsources distribution: some for the distribution of parcels, some for the transport of pallets. The business relationship between MS and GC, the supplier of parcel services, appears to be a close partnership, whereas MS's business relationships with suppliers of pallet services appear to be less close and deep.

MS's activity structure primarily involves activities related to the import and sale of products, warehouse operations and shipping. Reflecting the customers' demands for promptness and reliability, the coordination of those activities is equally important to MS, and the activities related to picking and shipping particularly exhibit sequential interdependencies and have to be carefully planned. At the same time, the firm's activity structure is linked to the activities performed by the transport providers and LSPs as well as the activities managed by the customers, who often require and plan for shipments to arrive at specific times. The need for coordination thus also applies to the wider activity pattern. Moreover, for the hospitals to which MS provides on-site logistics solutions, the activities managed by MS form part of the activity structure of the customers.

Compared to some of the transport providers discussed, MS does not manage the same amount and variety of resources. For example, the firm outsources the transport of goods. The resource collection of MS primarily comprises the products, staff, warehouses and equipment required for storage and packaging. The resources are mutually adapted to enable the operations and offerings of MS. By way of importing, warehousing and shipping products, however, MS maintains a resource collection connected to the resource collections of suppliers, transport providers, LSPs and customers. In the case of MS's on-site services for hospitals in particular, the firm's resources are embedded in the resource collection of the hospital.

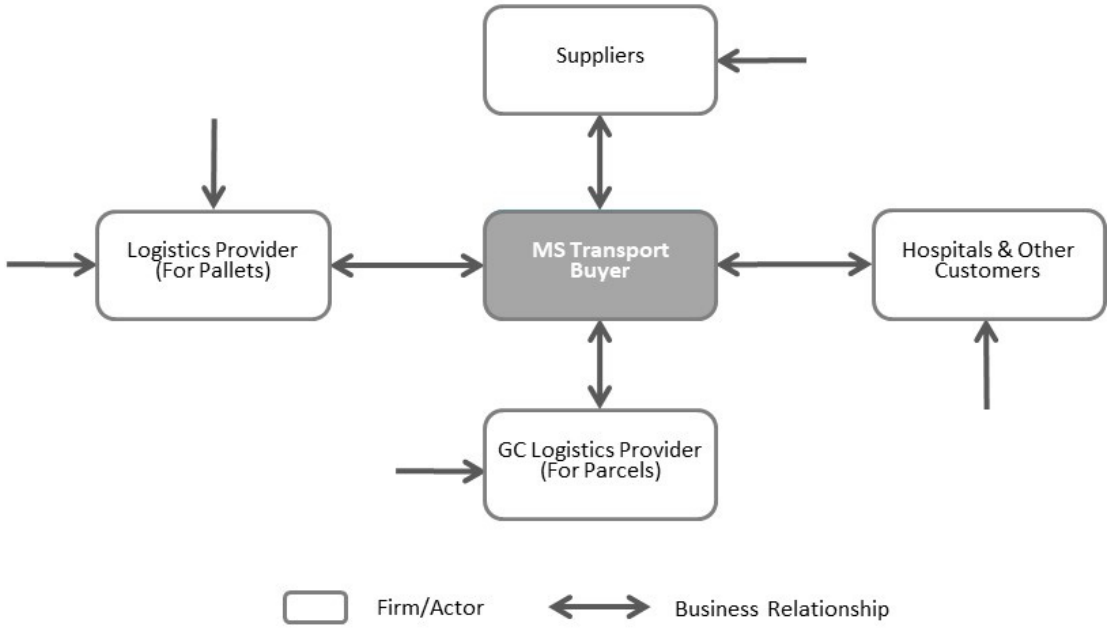

Figure 4.9: Medical Supplies (MH) and its key business relationships

4.4.3 Dairy Products (DP)

Firm-level description

Owned by farmers in Sweden and part of an international company group, DP is a cooperative that connects more than 3000 farmers and is responsible for roughly two thirds of all milk production in Sweden. For the production of milk and milk-based products, DP owns and operates several dairies specialising in different types of products. The company's transport operations are divided in two parts: one involving the inbound transport of fresh milk and the transport of unpackaged products between DP's dairies, the other part encompassing the outbound transport to customers. For DP's firm-level description and analysis in the thesis, its operations in and demand for inbound transport are in focus.

The fresh milk—that is, the product upon which DP's production is based—is produced by the farmers' cows around the clock. Because the milk supplied has to be processed shortly after collection, the continuous supply of fresh milk factors into the operations of the dairies. Customers' orders direct which products have to be produced by DP and thus also which dairy requires fresh milk as input. Therefore, even if the supply is continuous, the transport plan changes depending on DP's production plans. DP's operations are thus governed by two key parameters, the continuous inflow of fresh milk and, the demands based on

customers' orders. DP's customers include not only large retailers and small shops but also public organisations and companies such as kindergartens, schools and hospitals. Customers place their orders for next day's deliveries up until 5:00 p.m., and based upon those orders, picking begins in the warehouses of DP's dairies. Having completed picking, the load carriers bearing the customers' orders are loaded onto trucks for distribution between 6:00 a.m. and 2:00 p.m. on the following day.

DP outsources the collection of fresh milk to approximately 30 external hauliers. Owning only up to seven vehicles, most of the hauliers are small firms, one of which is the Milk Haulier (MH; see Section 4.3.4). As DP's representative explains, the firm prefers to purchase transport services from smaller hauliers, which are considered to be more efficient and flexible than larger firms. Currently, nearly 70 vehicles are used for the collection of DP's milk in Sweden. The hauliers working for DP own and manage the trucks used for milk collection, whereas DP owns and manages the bulk tanks and trailers. Although transport planning is managed by a team at DP, the process also relies upon input from the hauliers that perform the transport. Because a target for DP's planning team is to minimise the number of vehicles required, ensuring a high utilisation rate of the hauliers that provide the transport services is important. The contracts between DP and the hauliers last for 8 months, and DP constantly reviews the need for transport capacity. Even though the contracts are short term, DP aims at keeping the business relationships stable and long term. As a result, changes in companies in the group of hauliers working for DP seldom occur. Although DP does not impose any specific demands concerning the maintenance of the hauliers' trucks, DP's representative explains that its demands for reliability and efficiency mean that maintenance is thus a critical matter for the hauliers to manage.

Put succinctly, milk is a sensitive product. Because the farmers' cows continuously provide more milk to be collected, the inbound flow of fresh milk is highly sensitive and can never stop. As backup for the transport capacity provided by external hauliers, DP currently owns 20 spare vehicles, all from Truck OEM 3, for use when the hauliers experience emergencies or by the hauliers themselves when their primary vehicles are receiving maintenance at a workshop. Reflecting the split ownership of trucks, trailers and bulk tanks, the hauliers manage the maintenance and replacement of the trucks, whereas DP is responsible for maintaining and replacing trailers, bulk tanks and the 20 spare vehicles.

From suppliers, DP purchases vehicles, trailers and bulk tanks, all of which require maintenance that DP outsources to external maintenance providers. The firm also sources tyres and fuel from suppliers. The fuel, stored in tanks at DP's dairies, is also made available to the hauliers at a fee. Additionally, DP offers tyres to them under the contract negotiated by DP with the tyre suppliers.

Firm-level analysis

DP is owned by a large group of farmers who also produce the fresh milk processed at DP's dairies. Therefore, for DP, the business relationships with those farmers are vital. Whereas the farmers supply the input to DP's dairies, its customers impose demands that influence production plans and distribution. Therefore, apart from the farmers, the customers, especially large retailers, also represents crucial business relationships for DP. Because DP outsources inbound transport to external transport providers, its relationships with those hauliers are also key. Although the contracts are short term, the business relationships are often far longer-lasting. Additionally, because the hauliers specialise in the collection of milk, are often small and work only for DP, the firm and the hauliers over time have cultivated close business relationships that influence how the activities and resources involved are organised. At the same time, because DP outsources the maintenance of vehicles, trailers and bulk tanks, as well as purchases fuel and tyres from external suppliers, its business relationships with all of the other firms involved were highlighted by DP's representative as being important as well. Figure 4.10 depicts DP's key business relationships as identified by the representative.

The activities occurring at its dairies, where fresh milk is transformed into various dairy-based products establish a crucial part of DP's activity structure. Once the products are packaged, they are stored in warehouses, picked and placed onto load carriers, loaded onto vehicles and distributed. DP's activity structure thus comprises a wide range of activities exhibiting pooled as well as sequential interdependencies. Because the operations at the dairies relate closely to the demands of customers and in turn, consumers, coordination is crucial. For the same reason, the activities performed at the dairies are continually adjusted to enhance production plans. Via the distribution of products, DP's activity structure is linked to the activities of its customers. For one, the deliveries of DP's products have to be coordinated with the operations of the receiving retailers, shops and companies. Moreover, the operations of the dairies, as well as the inbound transport, are influenced by the

continuous inbound flow of fresh milk. The cows continuously produce milk that has to be collected at regular intervals and processed within a short period; therefore, for farmers, DP and the hauliers who perform the inbound transport, coordinating and adjusting the joint activity pattern are pivotal tasks. The specialisation of those actors is reflected in the division of labour and results in an activity pattern involving multiple forms of interdependencies. For DP, it also influences the maintenance of the vehicles, trailers and bulk tanks owned by the firm. Ultimately, to minimise disruptions in the collection and transport of fresh milk, the activities performed by external maintenance providers need to be coordinated with the transport performed by external hauliers.

Amongst DP's resources, its dairies are essential. Such resources entail an array of equipment and systems required for receiving and processing fresh milk, producing and storing products and planning operations and transport. DP's internal resource collection also exhibits several forms of resource adaptation. For one, the systems required for production of milk-based products are adapted to the specific products of the dairies. Additionally, the load carriers used for picking customers' orders, as well as the packaging of the milk-based products, are adapted to each other. Because many retailers and stores use the same load carriers for displaying the products to consumers, those carriers and the facilities of the stores are subject to mutual adaptation as well. In addition to the facilities for processing, production and warehousing, DP owns and manages trailers and bulk tanks used for the collection of fresh milk, along with a few backup vehicles. Together with the resources of hauliers used for inbound transport, DP's resource collection forms part of a complex resource constellation. Therein, the trailers owned by DP are combined with the trucks owned by the hauliers, resulting in resource adaptation and resource interfaces. Likewise, the bulk tanks owned by DP are mounted onto the trailers as well as the hauliers' trucks; thus, those different resources also have to be mutually adapted. Due to the multiple interfaces amongst the resources of DP and the hauliers, as well as the long-term business relationships between them, the resource constellation is assumed to involve signs of heaviness.

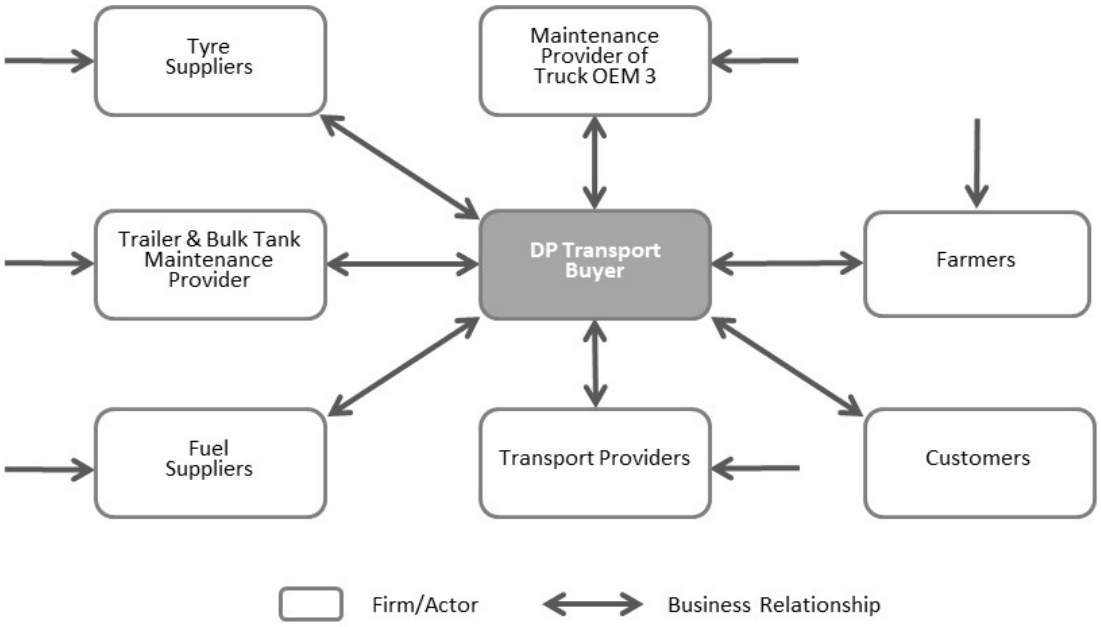

Figure 4.10: Dairy Products (DP) and its key business relationships

4.4.4 The Construction Company (CC)

Firm-level description

The CC's operations are organised in three divisions: one for construction, one for (infrastructure) maintenance and one for asphalting. On behalf of its customers, the CC performs construction as well as transport services, all primarily related to the development and maintenance of the road network in Sweden. In the last few years, however, the CC has also entered the market for concreting the foundations of buildings. The CC's largest customer is the Swedish Transport Administration, work for which largely concerns maintenance, especially road maintenance. Additionally, municipalities around Sweden establish important customers of CC.

According to the CC's representative, external suppliers manage and operate the equipment required for some of its services (e.g. transport) better than the CC. Consequently, instead of binding up capital in equipment, the firm prefers to purchase the majority of its logistics, transport and construction services from external suppliers. The transport services include the shipping of construction material, the ploughing of snow and the spreading of de-icer, whereas the construction services regards excavation, as example. In its (infrastructure) maintenance division, the CC's internal equipment contributes to only approximately 10%

of the required capacity, while its construction division contributes only approximately 1%. The equipment owned by the CC thus serves as backup resources and enables the firm to better understand its suppliers' situation with respect to the costs involved in owning and operating vehicles and machines.

In coordinating the purchase of transport, logistics and construction services, the CC seeks to hire as few suppliers as possible while continuing to remain competitive. With fewer suppliers, as the CC's representative explains, the possibilities for developing closer, longer-term cooperation expand, as do possibilities for developing joint processes and sharing knowledge with other firms. Although the services that the CC purchases from suppliers typically involve short assignments at multiple locations, they occasionally involve long-term projects.

According to the CC's representative, the firm has become increasingly aware of the importance of taking holistic perspectives on transport that envision the entire process of transport purchase and consider, for example, a supplier's stability and long-term resilience, not merely the amount of material to be transported or the time that transport requires. For the market to function, it is necessary for firms such as hauliers that make investments to profit as well as their customers. Reflecting the same line of thought, in the past few years, interest amongst hauliers in forging long-term business relationships has grown. A major reason for that trend is that hauliers seeking financing for new vehicles face tougher demands from banks, and longer-term contracts can be leveraged to secure such financing. In its case, the CC continues to follow routines involving requests for quotations (RFQ) and tenders supplied by competing firms. For some of its suppliers, however, the CC has cultivated business relationships, which has enabled the firm to involve suppliers earlier in the procurement process.

The CC's customers require that the services and solutions purchased from the firm are performed as agreed, and in the case of deviations, the CC may have to pay penalties. To better ensure that the services will be performed as promised, the CC's suppliers have to commit to the number of vehicles and machines operating on the CC's behalf, as well as their specifications. The availability of capacity is thus defined indirectly as a number of vehicles or units. As the CC's representative reports, neither buyers nor hauliers have reached the maturity required for defining services in measures of capacity instead of the number of vehicles or units. To mitigate the risks of disruptions due to the unavailability of

vehicles and units, the CC, together with the suppliers, strives to estimate the risk of problems and to identify means for solving them when they occur.

To improve the efficiency of the transport services purchased, the CC and the suppliers have considered various measures, including one involving the loading and unloading of material. To even out the supply, reduce waste with respect to transport capacity and shorten queues for loading and unloading, the CC would like to implement planning in which each delivery is allocated to a time interval (e.g. 15 minutes). At the same time, for transport in general, as well as the transport of asphalt for road surface construction in particular, ensuring uptime and reliability is critical. Because the asphalt needs to have a certain minimum temperature when applied to roads, once loaded with hot asphalt the vehicles have to reach the delivery location, typically within 80 kilometres, and begin unloading within a narrow time frame. Moreover, to avoid joints (i.e. seams) in road surfaces, the flow of asphalt has to be even and within specified limits. Therefore, it is also important that the asphalt is provided in a steady pace without disruption. For other types of transport involving, for instance, the use of snow ploughs or lifting cranes, observing the specifications of the vehicles is pivotal.

Firm-level analysis

A simplified business network involving the CC and its key business relationships is illustrated in Figure 4.11. Of the CC's customers, the Swedish Transport Administration represents a key business relationship; and a large part of the work performed by the CC relates to construction and maintenance of Sweden's road network. Beyond that, its supplementary business relationships with municipalities in Sweden are also important to the firm. As the CC's representative claims, because external suppliers better manage the equipment required for the firm's offerings, the CC purchases most of its logistics, transport and construction services from other firms. Most of the hauliers that the CC contracts own fewer than 10 vehicles, and it could thus be expected that the business of those firms relies heavily upon the work outsourced by the CC. In the past, the contracts between the CC and its service providers have been short term; nowadays, however, the business relationships are more often close and long-term.

For the CC, the key activities within its activity structure relate to the construction and maintenance of roads. However, because the CC outsources a majority of that work to firms

specialising in different activities, the firm focuses on managing, planning and coordinating the required activities. Moreover, in having outsourced transport and construction services, the solutions that CC offers rely heavily upon the linking its internal activity structure and the activity structures of its suppliers. Reflecting the type of work performed by the CC and its suppliers, the activity pattern involves a high degree of interdependencies that require coordination. An assignment involving the laying of asphalt, for example, involves activities with sequential and reciprocal interdependencies and thus requires coordination through planning and adjustment.

Because the CC owns only a small portion of the equipment required to meet its needed capacity, the firm's resource collection is limited. The wider resource constellation, also including the resources of CC's suppliers, however, involves an array of resources required for the completion of construction and maintenance tasks. Such equipment is specialised for the various tasks involved in the CC's offerings and thus adapted to the goods transported as well as to the objectives of the activities performed. The transport of gravel, for instance, requires a specific type of vehicle. Additionally, an asphalt layer is adapted to the specific characteristics of the asphalt, as is the vehicle used for transport from the asphalt production site to the road construction site. The vehicle and asphalt layer, moreover, have to be mutually adapted in order to ensure an efficient process and satisfactory result. Due to specialisation and adaptation of resources involved in the CC's offerings and its suppliers, it could be expected that the resource constellation exhibits heaviness.

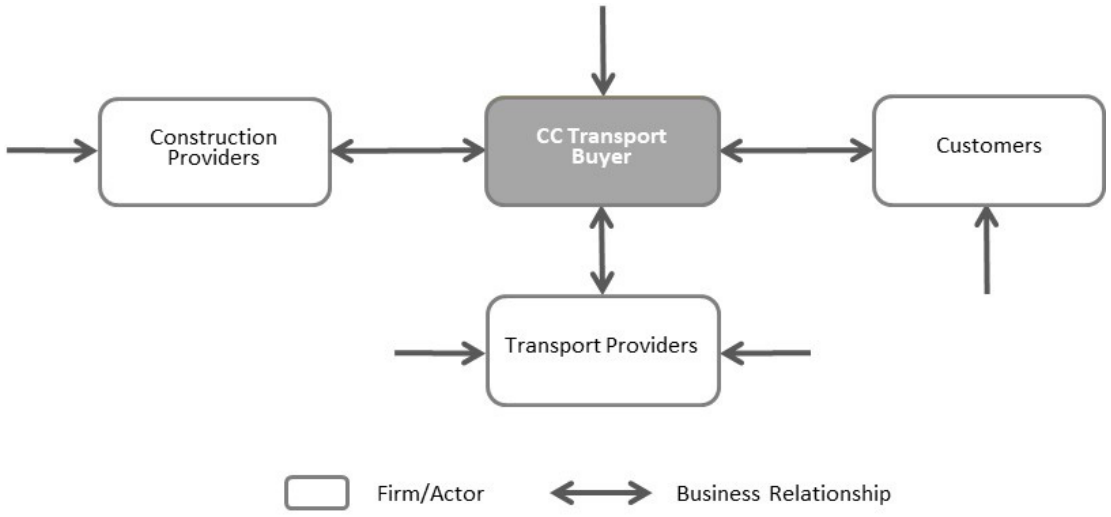

Figure 4.11: The Construction Company (CC) and its key business relationships

4.4.5 General Cargo (GC)

Firm-level description

For GC, a logistics and transport provider, the transport and distribution of mail and packages form the core of operations, supplemented by the transport of refrigerated goods. The customers of GC include firms, public organisations and the general public. The transport managed by GC is divided into three areas: distribution, regional haul and long haul. Trains, boats, aircrafts and trucks are used for the firm's long-haul transport, whereas its regional transport is performed exclusively by trucks, and its distribution involves the use of trucks as well as vans.

For its transport operations, GC mobilises both an internal fleet and purchases transport capacity from external suppliers. In all, GC's internal fleet encompasses approximately 1200 trucks and 800 vans. For long-haul transport, the internal capacity (i.e. trucks with three axles) represents approximately 20% of the required capacity; for distribution, by contrast, for which external capacity is more expensive than for long haul, approximately 80% of capacity is provided by trucks with two axles and vans, all owned by GC. In addition to those vehicles, GC own trailers, dollies and swap bodies. According to the firm's representative, the top reason for owning such equipment is that the productivity of GC's operations is improved. Having full access to trailers and swap bodies, for instance, allows the firm to load goods before trucks arrive at the warehouse to pick them up.

As implied, the purchase of external transport capacity for GC is pivotal. For distribution and regional haul, each of GC's six regions of operation is responsible for procurement, whereas the purchase of capacity for long haul and refrigerated transport is centrally managed. For the procurement of transport services, GC has developed a standardised contract format that is adaptable to the type of transport service purchased. GC strives to maintain a fixed platform for 70% to 80% of the required capacity. Adding to this, GC also purchase additional capacity when so required, which allows adjusting transport capacity in response to seasonal fluctuations. Because GC is responsible for the overall planning of transport, external hauliers have limited influence on that activity, whereas they are fully responsible for planning involving vehicles and drivers.

In deliveries, precision and punctuality is paramount for GC's customers, which are liable to impose penalties if errors or delays occur. Retailers seldom have any local storage space

and, for that reason, depend on goods to be delivered at the time requested. Also, for deliveries of food and refrigerated goods, receiving stores have defined precise delivery windows, and to meet the demands of GC's customers, the hauliers working for GC have to ensure the precision of deliveries as defined in their contracts. The contracts involve two levels of precision—namely, ±5 minutes and ±15 minutes—and which level applies to a specific assignment depends on the type of transport performed. For deliveries of clothes to retailers, for example, the delivery window is often ±15 minutes. If a deviation occurs that exceeds that window, then GC pays the haulier less. According to GC, the cost of transport does not increase, however, if the precision requested for a delivery increases.

The hauliers contracted by GC include small firms with four to five vehicles as well as larger firms. The size of the firms contracted depends upon which type of transport services is involved and where in the country the service is procured. For local transport, small firms may be considered, whereas for long haul, only large firms are preferred. The contracts for transport service suppliers often span an initial 3 years with the possibility for extension by one year for a maximum of 2 additional years (i.e. 3+1+1).

Over time, as productivity at firms has become increasingly important, GC has had to respond by enhancing its planning. Both LSPs and hauliers work in an industry with low margins that afford increasingly fewer possibilities to acquire buffer or spare capacity in order to meet unforeseen events. Coordination is thus a key enabler of GC's operations. For example, if a letter is sent from southern to northern Sweden, then the southern, northern and central regions of GC's transport operations (i.e. terminal to terminal) are involved. To ensure profitability, GC has set targets for the use of trucks owned. For a long-haul truck, an average of at least 65 or 70 hours per week is the target, whereas a corresponding target for a truck used for distribution is 40 hours. With the overarching target of reducing the cost of transport purchased, GC also strives to help external hauliers by improving the usage rate of its vehicles, for instance, by combining the collection of goods, a long-haul transport, followed by a distribution cycle.

For GC, interaction with the truck OEMs is key when purchasing new vehicles and for vehicle maintenance. Together, GC and each OEM establish maintenance contracts that support the operations of both parties. The maintenance contracts have resulted in lower monthly maintenance costs for GC, while for the OEM, such contracts have led to that more of GC's vehicles use the OEM's dealer network for maintenance, the representative of GC

argues. Given the amount of vehicles used by GC, tyre suppliers are key partners for its operations, as are fuel suppliers. To help subcontracted hauliers, GC offers them the same deals that GC has negotiated with the fuel suppliers.

Firm-level analysis

GC maintains key business relationships with customers, vehicle OEMs and transport suppliers. Amongst its customers, ones requiring the largest volumes of capacity are the most important, followed by ones who send the most commercial packages, the shipping of which generates more profit for GC. Also important to GC's customer base are retailers who have signed long-term contracts with the firm, including MS (see Section 4.4.2). No matter the type of customer, however, it has become increasingly important for GC to offer efficient and reliable services at competitive prices amidst increasing competition in its industry. Aside from customers, the truck OEMs and their workshops also maintain pivotal business relationships with GC, which owns numerous vehicles whose cost to purchase, operate and maintain is of strategic importance. Moreover, the vehicles have to be operational, which GC's maintenance contracts with OEMs aim to support. Given the large volume of transport that it purchases, GC's business relationships with firms that supply external transport capacity are also critical. With some of the largest transport service suppliers, GC's interactions have developed into long-term business relationships. Figure 4.12 depicts GC's key business relationships as described by one of GC's managers.

GC's activity structure entails two types of activities: ones involved in managing and planning transport services sold to customers and ones involved in managing vehicles used for transport. Reflecting the needs of GC's customers, the transport activities have to be linked to and coordinated with activities of the customers' activity structures. Collecting letters and parcels, cross-docking at warehouses and unloading at customers are examples of sequentially interdependent activities in the activity pattern, whose coordination and adjustment require the joint efforts of GC and its customers. Meanwhile, GC plans all transport, whether performed with its own vehicles or by external suppliers. Therefore, activities performed by GC's transport providers also form part of the wider activity pattern and require effort with respect to coordination. Last, because the vehicles owned by GC require maintenance, the maintenance planning performed by GC also has to address the needs and preconditions of the maintenance providers as well as the plans for transport to be performed.

The staff, warehouses, trucks, trailers, dollies, swap bodies and vans represent key resources within GC's resource collection. The vehicles and equipment used for transports, as well as the equipment and facilities at the warehouses owned by GC, are adapted to the mail and packages transported by GC and its transport suppliers. Because the vehicles of external transport service providers are combined with the trailers and swap bodies owned by GC, the resource constellation entails the resources of GC as well as of its transport suppliers. Other important resources for transport are the load carriers, a kind of cage on wheels, which GC, transport providers and customers are all involved in handling. Last, because the vehicles and the loading and unloading facilities at customers' facilities have to be mutually compatible, the customers also form part of the wider resource collection.

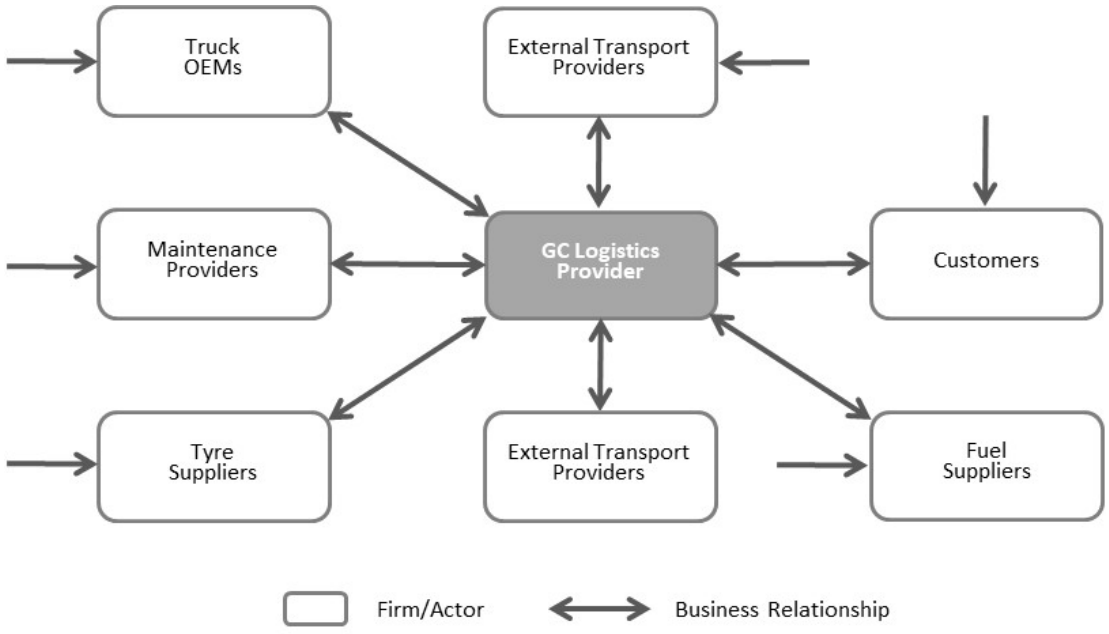

Figure 4.12: General Cargo (GC) and its key business relationships

4.5 The Truck Original Equipment Manufacturer 1 (OEM)

4.5.1 Introduction

The Truck OEM 1—in this section, referred to simply as "the OEM"—forms part of a large international company group that develops, produces and sells trucks, construction vehicles, busses and engines. The company group is divided into units with different functions and

responsibilities, including product development, service development, manufacturing, information technology (IT) and sales and aftermarket. In particular, the group's business for trucks is structured as a portfolio of different truck brands. One of those brands is represented by the OEM, whose offerings pertain to trucks and related services for customers in Europe, Asia, Africa and South America.

The following firm-level description and, in turn, firm-level analysis focus on the OEM's operations. Figure 4.13 depicts key units of the OEM together with the internal and external actors identified by the OEM's managers as especially important for the operations of the OEM. Thus, the figure does not provide a complete overview of all the actors involved, instead it reflects the managers' ideas concerning the most important stakeholders. Because the OEM's various units and the company group sometimes operate according to different business logics, their interactions often resemble the interactions of separate firms. Therefore, for the figure as well as the description and analysis, the interaction between the units of the OEM as well as between the OEM and the units of the company group, are discussed as business relationships.

4.5.2 Firm-level description

General overview

The OEM's organisation is divided into multiple departments with different responsibilities (see Figure 4.13). Some departments manage shared functions (e.g., marketing, business planning and strategy, the development of services for customers, business processes, business systems and IT, warranties and quality), whereas others manage the operations and business of specific sales areas, which focus on the bundling and sale of offerings and interactions with customers. Because each sales area includes several markets, each area also includes several departments with specific responsibilities for the operations governing a specific market. Therefore, the OEM's sales areas involve the key interface with markets, whereas the markets involve the key interface with customers.

Shared functions: The headquarters (HQ) organisation

The entity of the OEM that handles its shared functions, sometimes referred to as the "headquarters (HQ) organisation", develops systems and processes required for the OEM's sales operations, as well as operates a customer call centre shared amongst the sales areas.

The HQ organisation is responsible for handling issues related to customer quality, warranties and the maintenance and quality of systems and services supporting the sales areas. The organisation is additionally responsible for developing some of the elements required for the OEM's bundled offerings, including services for customers who use the vehicles: driver coaching for fuel efficiency and fleet management, to name two. As part of its responsibilities, the HQ organisation is also responsible for the initial bundling of some offerings—for example, the two principal elements of maintenance contracts (e.g. workshop hours and the spare parts required)—which also now frequently include a connectivity service to ensure the possibility to read data from the vehicle. Based on the initial bundling done by the HQ organisation, each sales area performs the final bundling and adaptation of those building blocks in accordance with the specific needs of its various markets and customers.

The sales area

In the OEM, each sales area is responsible for the sale of vehicles, supplementary products (e.g. spare parts) and services, as well as for the implementation and market adaptation of offerings developed by the HQ organisation. Apart from the customer interface in the call centre managed by the HQ organisation, interaction with customers primarily occurs at the dealers and workshops within the sales area. For some markets of the sales area, external private importers govern imports. Responsible for Europe, the sales area studied for the thesis consists of a dealer network encompassing more than a thousand dealers and workshops. For Sweden, as an example, the OEM owns part of the dealer network, whereas the rest is divided amongst 18 external firms. The departments responsible for each individual market form a large part of the sale area's organisation. Apart from those market-related departments, the organisation of the sales area also includes departments responsible for shared functions such as business planning and development, vehicle sales, the service market and retail network development.

The department for retail development, as a shared function of the sales area, supports the dealer network of the markets included in the area. Encompassing the OEM (-owned) dealers as well as external private dealers, the network receives support with training, business systems, qualitative requirements for the operations of dealers and workshops and standards for dealers, workshop layout and operations. For internal (OEM-owned) dealers, support also includes business case calculations and financing for investments within the

dealer network. In addition, the department plans the structure of the dealer network, including the locations of dealers. Amongst the stakeholders that the department for retail network development cooperates with, the IT department of the company group is key.

For a sales area, business relationships with private importers as well as dealers, whether owned or external, are important, as are ones with third-party suppliers of elements required for offerings. The most important customers for the overall sales area, however, are transport providers that purchase its products and services. As a manager of the OEM explains, customers seldom buy "just a truck" but instead invest in a relationship for their "peace of mind". According to the OEM, it appears that such business relationships have become closer and longer-lasting in recent years.

The OEM's offerings

The OEM's offerings include vehicles, spare parts, software, maintenance contracts and extended coverage, which is similar to a warranty. In addition, the OEM offers services aimed at affording additional value for customers that purchase and use its products (e.g., driver coaching, ways of improving productivity and ways of improving fuel efficiency). By contrast, each dealer's vehicle sales organisation is responsible for the sale of leasing and rental services. By further contrast, whereas the service market organisation of workshops manages active maintenance contracts, the contracts are often sold by the organisation for vehicle sales in conjunction to the sale of trucks. In sum, the bundling of products and services results in solutions offered to customers. For the OEM, a manager claims, products have been and partly remain in focus, although the firm is currently shifting from being a "mechanical firm" to one that offers services as well as solutions. Such increasingly complex offerings, however, require that salespersons as well as technicians receive qualified training in selling and maintaining the solutions offered. They also imply that the importance of external partners able to provide knowledge, technology, services and skills will increase.

> *We've been a company of engineers in which the pricing of products and services relates to variants, options and so on. But [for solutions] we could develop new pricing models that instead focus on the value of solutions.*
>
> Manager at the OEM

To succeed with developing such services and solutions, the OEM stress the importance of understanding its customers, their businesses and their needs, to which end involving customers in the definition, development and evaluation of new offerings will become increasingly important. As one manager explains, the stronger the OEM's focus on services and solutions, the more that it will need to understand which problems of customers should be targeted. For maintenance solutions, for example, it is critical to understand the needs of the customers using the trucks, and such solutions should be adaptable to the customer's specific needs with respect to, for instance, the scope, place and time of maintenance. Customers also seek maintenance solutions adapted to each vehicle as a whole—that is, ones that consider additional equipment such as cranes, locking mechanisms or rear loading ramps. To that purpose, however, possible challenges are the differences in the profiles and needs of customers. As a case in point, the needs of hauliers performing long haulage and of hauliers transporting asphalt for road construction differ. Also, the size of hauliers' operations vary. In Sweden, the OEM distinguishes three key customer profiles: hauliers with only one or a few trucks, hauliers with 10 to 30 trucks and hauliers with 100 or more trucks. Another difference concerns the profitability of haulage, because, after all, the profit margins for hauliers are typically slim. A haulier involved in long hauls, for example, often anticipates a margin of only approximately 3%.

Aside from those challenges, knowledge transfer about customers within the OEM and the company group also faces obstacles. Due to the organisational structure, as more than one OEM manager argue, there are too many "layers" between a customer and an organisation such as the one responsible for product development. Additionally, as one manager claims, it is often difficult to find the right people, and one has to develop your own interfaces within the organisation.

For the development of new offerings, or the improvement of existing ones, the service market organisation collects feedback from customers that, in turn, has been gathered by dealers and workshops. The feedback aggregated by the service market organisation is forwarded to the central and shared functions of the OEM—that is, the HQ organisation. Based on the input from markets and customers (i.e. customer pull), combined with knowledge regarding new technologies (i.e. technology push), the central functions of the OEM involve developing strategies and roadmaps for each specific area, uptime, as an example. The HQ organisation embodies the interface between the sales areas and the company group's organisations that are developing products and services, as well as the

organisation managing the IT infrastructure. As part of its responsibilities, the HQ organisation thus establishes requirements for new development projects and transfers those requirements to the organisations concerned with product and service development. Such requirements concern topics such as product cost, performance, maintainability and spare parts. As a receiver for the requirements from the HQ organisation, the product planners and the project managers of the product development organisation establish key interfaces.

> *Looking at the current situation, you might think that we're somewhat tied down by heavy investments made in the dealer network. Our customers probably expect to be able to use our services when and where it suit them the best, not when it suits our plans. A dealer's opening hours is one potential source of such inconvenience.*
>
> Manager at the OEM

The OEM's development of new offerings and business models bears a strong influence on the structure and operations of the sales area. Furthermore, not only will new technology such as electromobility and automation influence the scope of new maintenance solutions, but the operations of a dealer or workshop are also influenced by new offerings, whose related processes, tools and skills have to support new demands. Therefore, questions regarding investments in the dealer network, for example, become even more challenging to manage. When investing in a new workshop, the time span considered stretches up to 50 years, and several critical, long-term decisions regarding the layout, scope and operations of the workshop have to be made upfront. At the same time, the pace of development has increased dramatically in recent years. Cooperation with other stakeholders is thus important to not only forming a better understanding of the changing prerequisites but also gaining access to knowledge, technology and systems required for offering complete solutions that meet the needs of customers.

4.5.3 Firm-level analysis

The OEM is involved in business relationships with actors within the company group and with external firms (see Figure 4.13), and all of those business relationships serve different purposes. Business relationships between the OEM and units within the company group, including IT, Purchasing, Product Development, Service Development and Vehicle Production, concern the design and development of products and services required for the OEM's offerings. The HQ organisation embodies the interface between the customer-facing

organisation established by the sales areas and the "internal" organisation of the company group. Therefore, the interaction within those business relationships, primarily governed by the OEM's HQ organisation, reflects the functional division of labour performed within the company group. In addition, as the HQ organisation also operates the OEM's customer call centre, the HQ organisation of the OEM is also involved in business relationships with hauliers. Departments in the sales areas focus on the sale of products, services and integrated offerings; thus, business relationships with importers, dealers and workshops are key. In particular, business relationships with dealers and workshops concern both the OEM-owned and external private dealers or workshops within the dealer network. In the sales area, however, interaction with dealers and workshops owned by the OEM involve a wider range of topics and support. After all, the business relationships managed by the sales areas focus on matters related to the sales of products, services and solutions.

For the OEM, the activity structure primarily involves activities such as planning, project management, internal and external communication, strategising and organising. The OEM also manages activities that are part of the customer call centre's operations. Via customer–OEM interaction managed by the call centre, the activity structures of the OEM and its customers—that is, the hauliers—are connected. To solve problems faced by hauliers, the OEM and customers have to coordinate and adjust their activities. A result of the "inwards-facing" interfaces of the HQ organisation is that the activity structure of the OEM also becomes part of the wide set of activities managed by the various functions of the company group: the company group's activity structure. The activities linked through those business relationships primarily concern the design, development and manufacture of elements for the OEM's offerings (e.g. products and services). Therefore, reflecting project-oriented development processes, the interdependencies amongst activities of that joint activity structure require coordination supported by plans and roadmaps. The planning and preparation of services that form part of the integrated offerings, for example, require the coordination of activities managed by the sales areas, the HQ organisation and the service development organisation. For the definition, development and implementation of the integrated offerings, the OEM also has to coordinate its activities with the activities managed by other organisational units of the company group, the product development unit or the IT unit, for example. For the sale of products, services and solutions, however, the OEM also collaborates with external actors such as importers and dealers or workshops. Activities involved in the preparation of new offerings, the management of current offerings

or the management of problems faced by the workshops or their customers result in that the OEM's activity structure and the activity structures of importers, dealers, workshops and customers are connected. To manage the interdependencies amongst activities that are part of that wide activity pattern, coordination involving routines, planning and adjustment is required.

The key resources in the OEM's resource collection include its personnel and the personnel's competence together with data concerning customers and the products sold. The OEM's operations are labour-intensive but do not generally involve any machinery or equipment. The call centre, by contrast, stands as an important tangible resource part of the OEM. The intangible part of the offerings provided by the OEM concerns strategies, roadmaps, systems, processes, standards, guidelines and customer- or user-oriented services of various sorts. The tangible resources sold by the organisation, such as vehicles and spare parts, are sourced or manufactured by other parts of the company group or external suppliers and partners. The intangible resources that support the OEM's offerings are often adapted to the user's or buyer's needs, and by combining these with the tangible resources, customisation can be achieved. It is clear that the resource collection of the OEM is but part of a much wider resource constellation. The resources of other units within the company group are used in the production and transfer of resources later on bundled by the OEM before providing offerings to partners and customers. Moreover, the resources of dealers and workshops are adapted to the OEM's offerings. Above and beyond that, the operations of the dealers and workshops rely on the systems developed and provided by the OEM.

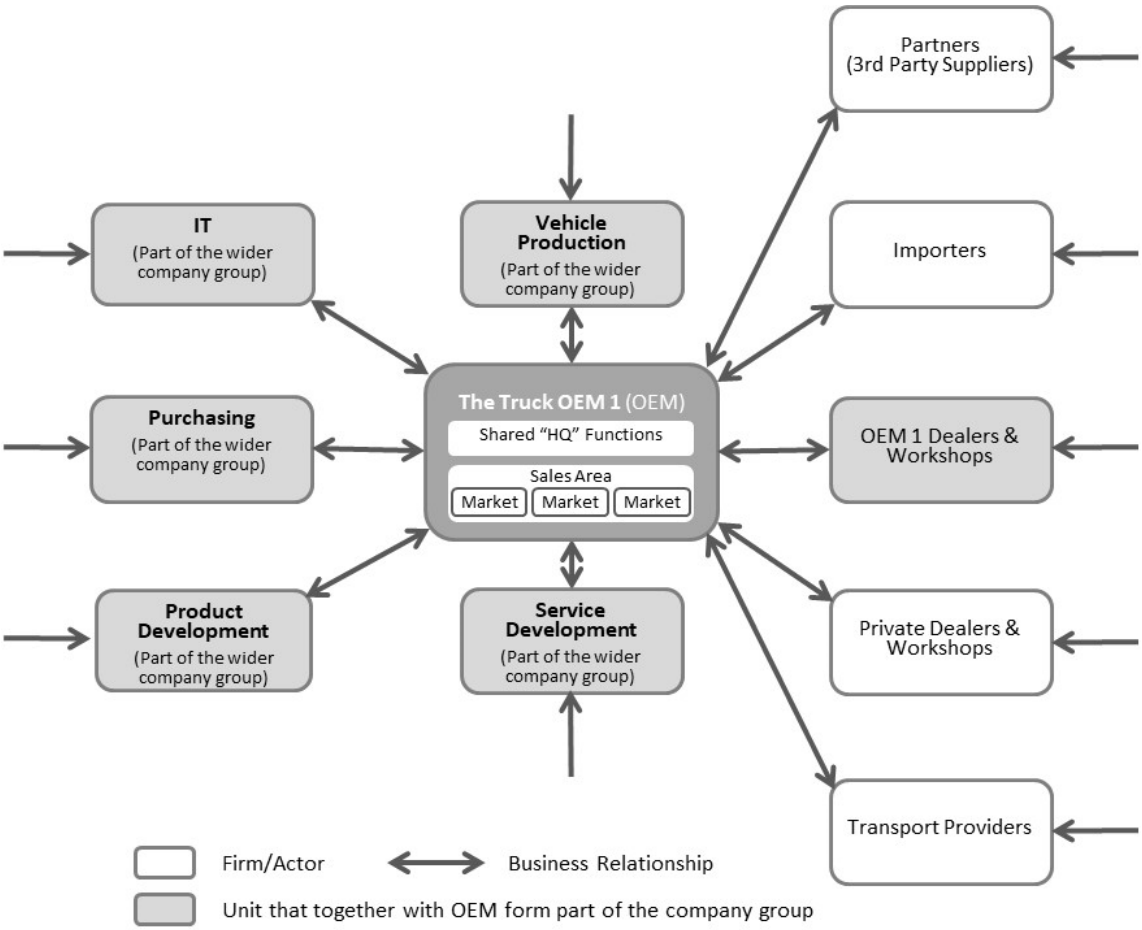

Figure 4.13: The Truck Original Equipment Manufacturer 1 (OEM) and its key business relationships within and outside the company group

5. THE CASE STUDY: A NETWORK-LEVEL PERSPECTIVE

5.1 Introduction

At the outset of Chapter 4, a simplified business network (see Figure 5.1) is presented to identify the key actor categories that influence and are influenced by the maintenance of heavy vehicles used for transporting goods in the case studied. In the sections thereafter, Chapter 4 describes and analyses a set of firms, each of them associated with one or more of the four categories of actors identified: maintenance providers, transport providers, transport buyers and vehicle original equipment manufacturers (OEM).

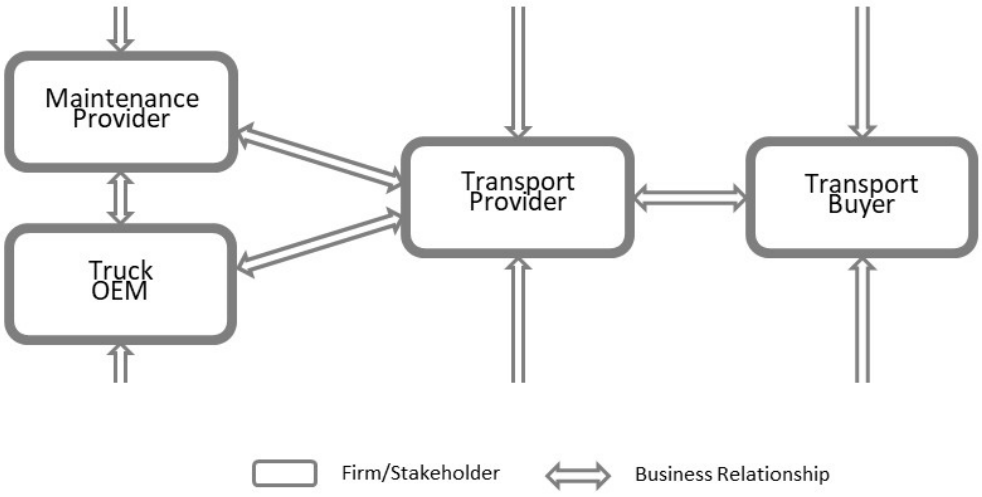

Figure 5.1: The simplified business network adopted in Chapter 4

The firm-level analysis and the simplified business networks presented as *sub-networks* show how the firms and their operations thoroughly depend upon the interaction with multiple other actors. By way of the business relationships connecting firms, the firms interact and influence each other. Beyond that, on a more detailed level, the solutions sold and purchased by firms involves the joint organising of activities and resources.

For each sub-network, the links and interdependencies of activities are highlighted. For the activity pattern of the sub-network involving the Refuse Haulier (RH; see Section 4.3.3 and Figure 4.6), for example, activities for waste management at the sites of customers, for the collection and transport of waste and for waste disposal are linked and exhibit both sequential and reciprocal interdependencies. Likewise, in the sub-network involving the Transport Contractor (TC; see Section 4.3.2 and Figure 4.5), activities for loading, transporting and unloading goods are adjusted to accommodate the activities managed by

the senders or receivers. Additionally, for the TC, the activities involved in transport planning, driver utilisation and maintenance exhibit pooled as well as reciprocal interdependencies.

For the resource layer, the interaction and adaptation amongst resources within the resource constellations of sub-networks can be observed. The firm-level analysis of the sub-network involving a transport buyer, the Construction Company (CC; see Section 4.4.4 and Figure 4.11), as an example, show how the machine used for asphalt coating and the vehicles used for transporting asphalt are adapted to each other. By extension, those two resources are adapted to the characteristics of the resource being transported—that is, the asphalt. Another example concerned the sub-network involving the Refuse Haulier (RH, see Section 4.3.3 and Figure 4.6), whose resource constellation encompasses several resources adapted to the waste produced by external firms, including vehicles specialised for the type of waste collected and transported.

Additionally, the firm-level perspective applied for the analysis in Chapter 4 highlights that the focal firms described influence and are influenced by several other actors. The sub-networks visualise how each firm is connected to a number of other firms through business relationships. Above and beyond that, the interaction enabled by business relationships result in activity patterns and resource constellations, all of which demonstrate interdependencies. Hence, the firm-level analysis underscores the embeddedness and connectedness of firms, activities and resources in each sub-network. Additionally, the firm-level descriptions and corresponding analyses point to how the connectedness of firms´ operations and processes has implications for the solutions developed and used by firms.

5.2 From a firm-level perspective to a network-level perspective

The sub-networks presented in Chapter 4 indicate that a simplified, limited network such as the one in Figure 5.1 does not capture the complexity of the context in which the firms and their solutions are embedded. First, the sub-networks presented involve additional actor categories supplementary to the four key categories of Figure 5.1. Second, several of the focal firms described and analysed are interconnected, either directly or indirectly, meaning that the sub-networks are interconnected as well. For instance, the sub-network involving the transport buyer Dairy Products (DP; Figure 4.10) is connected to the sub-network involving the Milk Haulier (MH; Figure 4.7). Therefore, by connecting the sub-networks,

shifting from a firm-level perspective to a *network-level perspective,* the interconnectedness of firms and their activities, resources and solutions come to the fore.

Figure 5.2 portrays how the sub-networks presented in Figures 4.2–4.13 are connected to each other. As explained, the figures in Chapter 4 portraying the sub-networks derive from a firm-level perspective and reflect the perspectives of the managers interviewed. Consequently, the sub-networks do not represent a complete overview of the business relationships of each firm but only the way in which the actors perceive their environments. Thus, the consolidated overview in Figure 5.2 also does not represent a complete summary of the firms, their suppliers, partners, customers or business relationships but an aggregated network based on the perspectives of the interviewees.

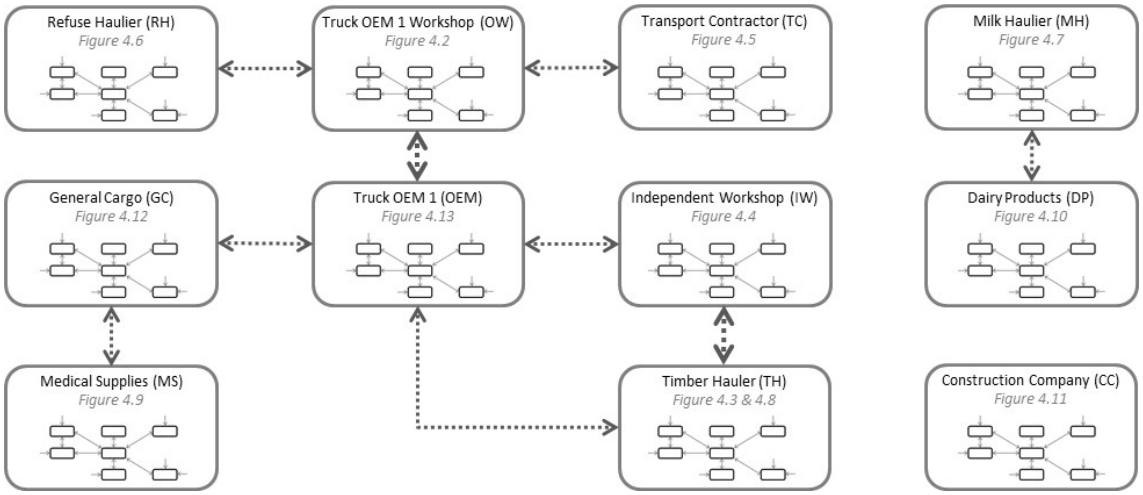

Figure 5.2: An aggregated overview showing how the sub-networks of Chapter 4 are connected

The overview in Figure 5.2 shows how the sub-networks presented in Chapter 4 are connected to each other by way of business relationships. Because the business relationships cross the boundaries of the sub-networks, the focal firms become part of a far wider web of actors. Moreover, the overview suggests that the activity pattern and the resource constellation cross the boundaries of the firms and the sub-networks. Even then, however, the actor web, the activity pattern and the resource constellation of the aggregated overview merely represent part of the business network that ventures beyond the scope of Figure 5.2.

Returning to the maintenance of heavy vehicles, Figure 5.2 also showcases the embeddedness of the maintenance providers and the maintenance solutions. By way of the business relationships connecting firms, the maintenance providers also influence and are

influenced by actors embedded in the wider context of the aggregated view in Figure 5.2. Thus, to further illuminate how vehicle maintenance influences and is influenced by other actors, an approach that considers a wider context than the limited scope of the sub-networks should be applied.

Therefore, to answer the call for a more comprehensive, profound understanding of the embeddedness of maintenance providers and maintenance activities, some of the sub-networks discussed in Chapter 4 are analysed again in Section 5.3. However, the new analysis applies a *network-level* perspective and draws upon the ideas pictured in the aggregated overview presented in Figure 5.2. To highlight the implications of taking a network-level perspective with respect to interaction and interdependencies, two specific examples are discussed (see Figure 5.3), each including maintenance providers embedded in the business network. Example 1, titled "Milk collection and dairy products", combines the sub-networks of MH and DP (Figures 4.7 and 4.10), whereas Example 2, titled "Timber transport and forest products", combines the sub-networks of the TH and IW (Figures 4.3, 4.4 and 4.8). Taken together, the two examples aim to highlight the embeddedness of maintenance providers and maintenance solutions, as well as the connection between actor webs, activity patterns and resource constellations.

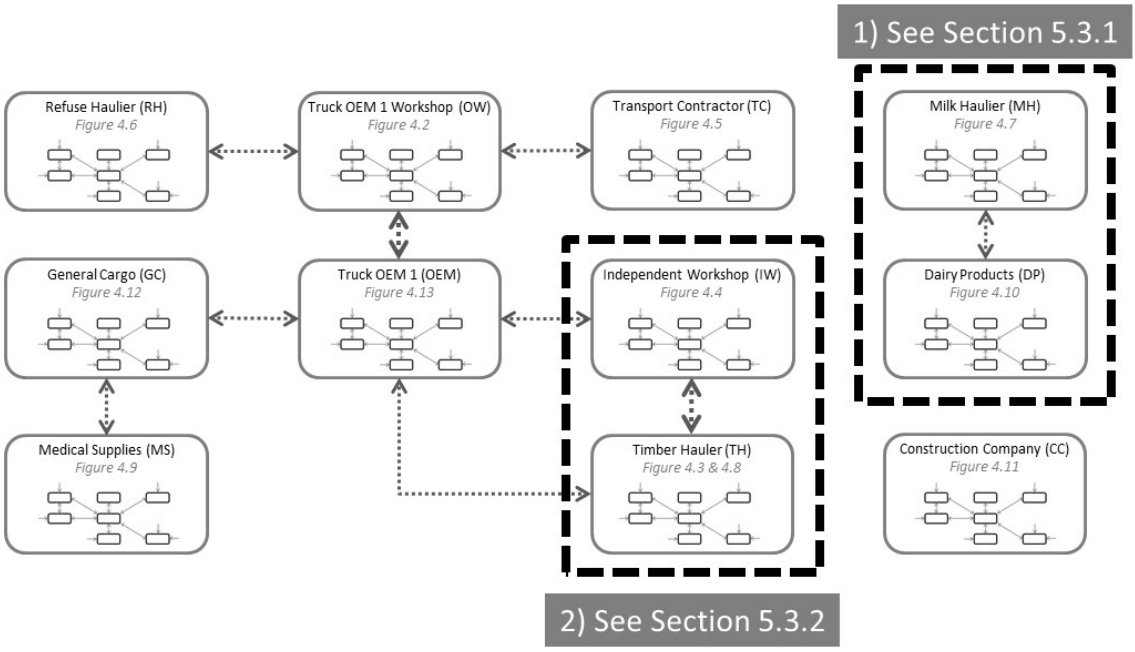

Figure 5.3: Overview encompassing the interconnected sub-networks and the two selected examples

The objective of the network-level analysis in Section 5.3 is not to provide a complete or extensive description of the structure and dynamics of the business network but to highlight some key implications of the interdependencies amongst actors, activities, resources and offerings. Together with the firm-level analysis performed in Chapter 4, the results of the network-level analysis inform a discussion on solutions in business networks, as presented in Section 5.4, and the discussion in Chapter 6.

5.3 Applying a network-level perspective: Two examples

5.3.1 Example 1: Milk collection and dairy products

DP, a cooperative owned by farmers in Sweden (see Section 4.4.3) produces dairy-based products for customers. Although DP owns and operates dairies where milk is processed and turned into various products, it outsources the collection of fresh milk to external transport providers such as the MH (see Section 4.3.4). The MH is a small, family-owned business that operates with three trucks. A simplified business network was drawn for the MH and DP, as shown in Figures 4.7 and 4.10, respectively. Each of those figures depicts a sub-network involving the focal firm and the key business relationships identified by the managers interviewed. Once a network-level perspective is applied and the two sub-networks are combined to reflect the business relationship between DP and its transport provider, the MH, the result is an aggregated network, as presented in Figure 5.4. The following discussion in Section 5.3.1, involving a specific focus on the maintenance of vehicles, refers to Figure 5.4 and the business relationships interconnecting the firms.

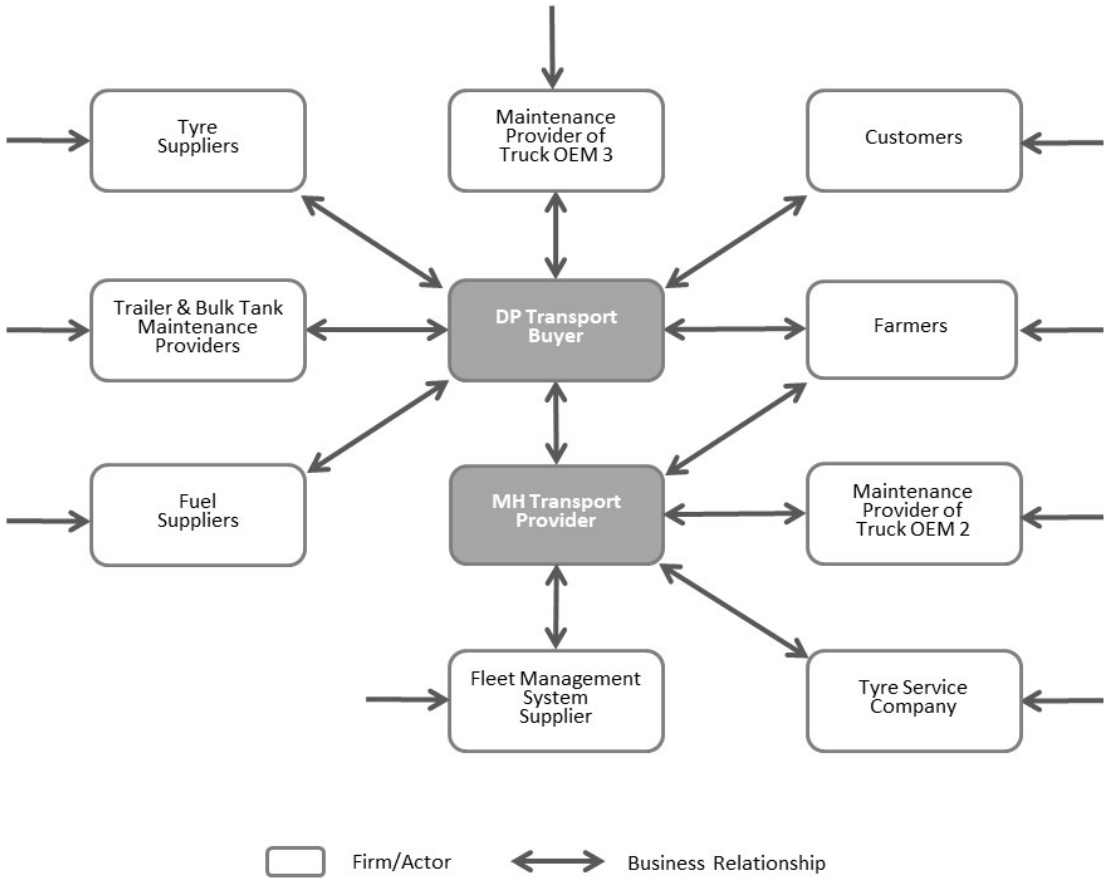

Figure 5.4: A business network based on the connected sub-networks of Dairy Products (DP) and the Milk Haulier (MH)

Maintenance and the web of actors

DP and the MH are connected to each other, as depicted in Figure 5.4, and maintain business relationships involving a variety of other firms. Figure 5.5 depicts an actor web based on the network shown in Figure 5.4. The number of actors in that actor web has been reduced in comparison to Figure 5.4, reflecting a focus on the actors that are perceived to be the ones most strongly influencing, or influenced by, the maintenance performed. The web of actors points to the bonds that the owners of DP (i.e. the dairy farmers) have with both DP and the MH. With DP, the actor bond concerns the ownership of the cooperative, the joint planning of milk collection and the reimbursement for milk provided, while the actor bond connecting the MH and the farmers concerns the activities involved in the collection of fresh milk. The milk produced by the dairy farmers is collected by hauliers such as the MH, transported to a dairy, processed and packaged by DP and distributed to DP's customers. Therefore, by

way of the actor bonds spanning the limited business network (see Figure 5.4), the farmers and the MH are indirectly connected to the customers of DP.

To enable the operations of DP and the MH, both DP and the MH require the services of maintenance providers. For DP, the maintenance is needed for backup vehicles from Truck OEM 3, the trailers and the bulk tanks, whereas the MH requires maintenance for its own vehicles, supplied by Truck OEM 2. However, because the maintenance of bulk tanks and trailers concerns the (combined) vehicles that the hauliers operate, the hauliers and those maintenance providers could be expected to develop actor bonds over time. In addition, several firms provide products and services required for the operations. For DP, fuel suppliers and tyre suppliers, for instance, provide resources required for transport, whereas for the MH, the fleet management system supplier, for instance, provides a system used for monitoring and follow-up.

Altogether, as the network depicted in Figure 5.4 highlights, the core operations of DP and the MH—the collection, transport and processing of milk and the distribution of dairy-based products—require the involvement of a wide range of firms. At the same time, the maintenance provided by DP and the MH's suppliers is critical to their operations. Therefore, even if the maintenance providers often are perceived to provide non-core offerings, the services that they provide have implications for the transport performed by hauliers.

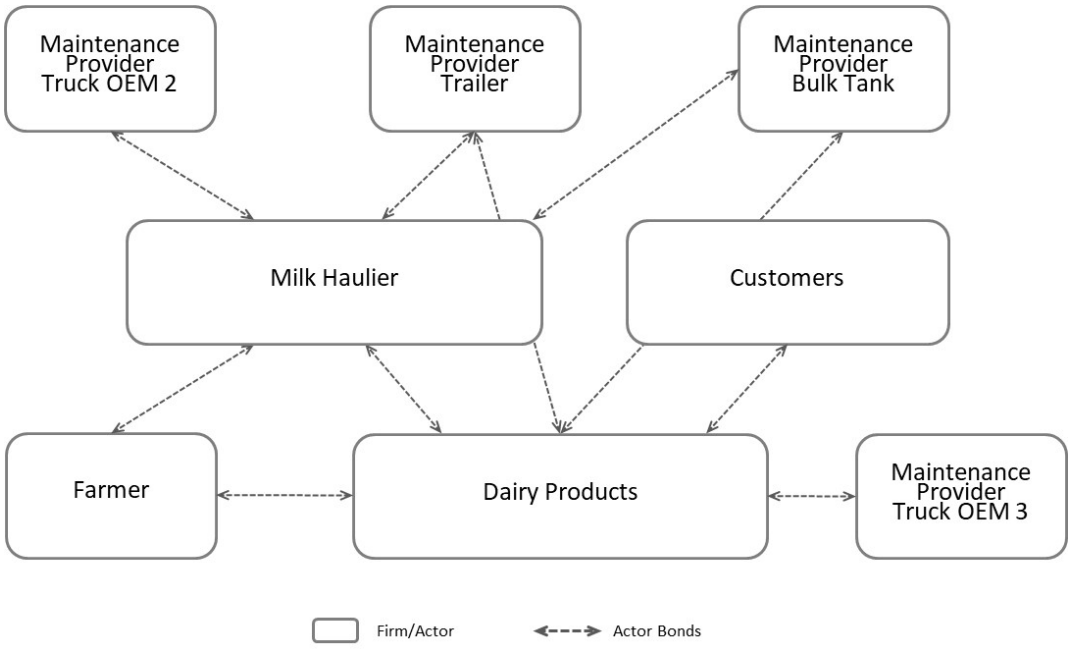

Figure 5.5: A web of actors involving key firms and business relationships with focus on the transport and processing of milk and the maintenance of vehicles

Maintenance and the activity pattern

The firm-level analysis concerning the MH has revealed that the activity structures of farmers, including the milking of cows, are linked to and interdependent with the activities performed by the hauliers that collect and transport the milk. Moreover, the activities for transporting and unloading milk performed by hauliers are linked to and interdependent with the activities involved in processing and production performed at the dairies of DP. Because the activities have to be performed in a specific order, the activities also exhibit sequential interdependencies requiring coordination between the farmers, hauliers and DP. On top of that, because the picking of customer orders and subsequent distribution performed by DP are linked to the activities of its customers—for example, the receiving of goods—the need for coordination also involves the customers of DP. The maintenance of vehicles, trailers and bulk tanks exemplifies a set of activities involving reciprocal interdependencies. The aim of maintenance is to support the core operations of the firms, and all actors involved strive to minimise disruptions. Regarding the reciprocal interdependencies, the coordination of activities thus also involves the maintenance providers of DP and the MH. Maintenance should be performed at a time and place that minimises disruptions to the core operations of the farmers, the MH and DP. Figure 5.6

illustrates some of the key activities of actors in the business network shown in Figure 5.4 and how they are linked to each other.

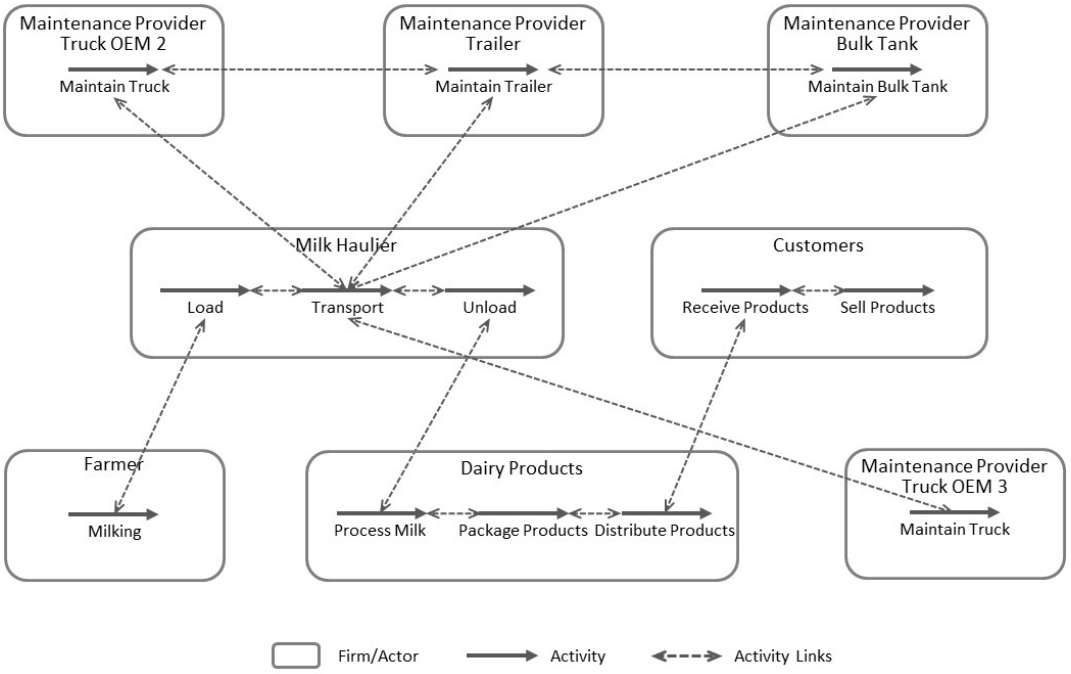

Figure 5.6: Key activities and activity links with a focus on the transport and processing of milk and the maintenance of vehicles

Maintenance and the resource constellation

For DP, the dairies, equipment and systems required for receiving and processing fresh milk, producing and storing products and planning operations and transport are key resources of its resource collection. The resources are mutually adapted in order to improve the performance of the operations and the quality of the products. Additionally, DP manages backup vehicles, trailers and bulk tanks, the latter two of which involve technical resource interfaces related to the MH's key resources (i.e. trucks). Encompassing a truck of the MH with a trailer and two bulk tanks from DP, the combined resource is adapted for the fresh milk transported. Moreover, for the loading and unloading of fresh milk, the bulk tanks of the vehicles are adapted to the tank equipment at the farmers' facilities and the equipment for unloading at DP's dairies. For the distribution of dairy-based products, DP uses specially designed load carriers that store the products picked at the warehouse and facilitate

transport. The same load carriers are also often used for storing and displaying the products at retailers. For that reason, the resource constellation enabling the distribution of DP's products also includes resources that are subject to mutual adaptation. With respect to maintenance, DP, the MH and the maintenance providers together form a resource constellation encompassing resources that require mutual adaptation. The resources of the workshop—tools and parts, for instance—are adapted to the vehicles and equipment being maintained. Figure 5.7 displays key resources of the resource constellation related to the business network shown in Figure 5.4. The figure illustrates how different actors manage different resources and how the various resources are tied together. The resource ties thus also point to the adaptation required to secure the joint operations of the actors concerned.

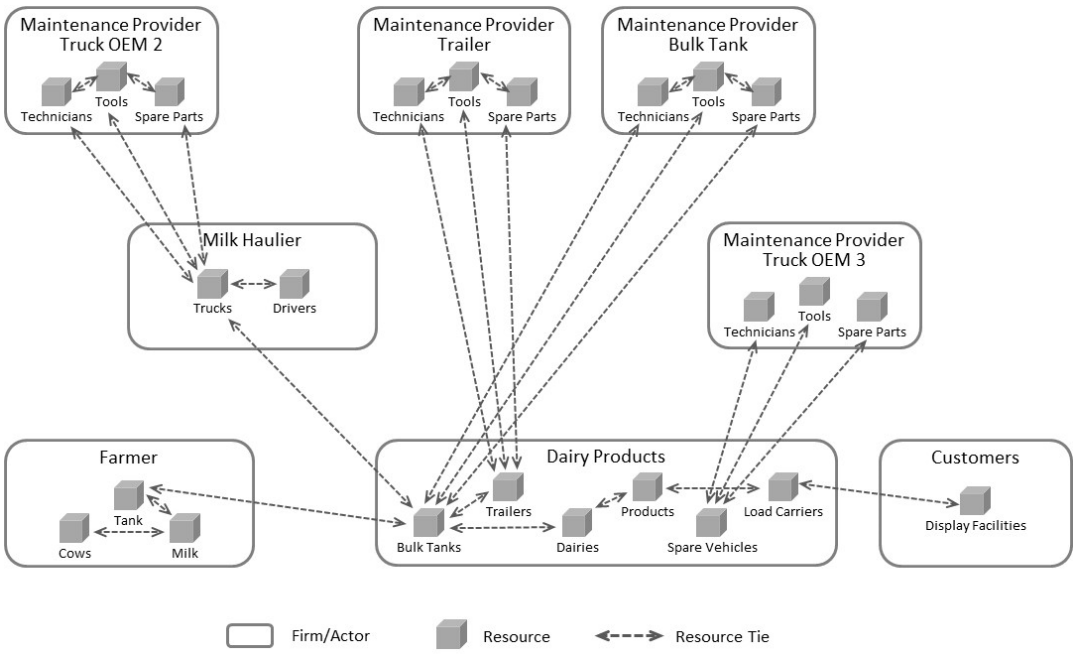

Figure 5.7: Key resources and resource ties with a focus on the transport and processing of milk and the maintenance of vehicles

The offerings of firms: A network-level perspective

The MH, a transport provider, offers a transport solution to DP, a transport buyer. As a result of DP's purchase of the MH's services, the activity structures of the two firms are linked, and their resource collections are tied together. Additionally, owing to the resource ties and activity links connecting the DP with its customers, the solutions offered by the DP to the

customers becomes interconnected with the solution offered by the MH. For the sake of efficiency and to ensure the quality of the milk collected, planning and coordination of activities are key concerns for the farmers, the MH and DP. Moreover, since the MH outsources the maintenance of its vehicles, the solution offered by the maintenance provider becomes interconnected with the transport service offered by the MH to DP. Thus, striving for improved efficiency of the transport services provided by the MH necessitates the coordination of the transport solution offered by the MH and the maintenance solution provided by the Truck OEM 2's workshop.

Owing to the interaction amongst the firms over time, interdependencies between activities within the activity pattern develop. The transport performed by the MH and the processing managed by DP, as examples, involves sequential interdependencies requiring coordination. Additionally, the transport managed by the MH and the maintenance performed by the maintenance provider involves sequential and reciprocal interdependencies. As a result of the interdependencies involving activities and resources, the solutions being sold and purchased by firms become interconnected and interdependent. Over and beyond that, as an implication of changing demands and the interdependencies between solutions, the solutions sold and bought will need to be continuously adapted. The demands of the MH concerning the time and place for vehicle maintenance, for instance, will change as the transport planning of DP changes to accommodate production plans and the milk production of farmers.

5.3.2 Example 2: Timber transport and forest products

The Timber Haulier (TH) is a small, family-owned transport provider that sells its services to customers requiring the transport of timber. Two of the TH's roles are presented in Chapter 4: that of a maintenance provider (see Section 4.2.3) and that of a transport provider (see Section 4.3.5). Even though the TH performs most of the maintenance for its vehicles, a maintenance provider part of the IW Company Group (IWCG; see Section 4.2.4) occasionally provides its services to the haulier. Combining the sub-networks of the TH (see Figures 4.3 and 4.8) and the IW (see Figure 4.4) results in the aggregated network shown in Figure 5.8. The simplified network displayed in Figure 5.8 indicates how the sub-networks are connected by business relationships involving the IWCG and the Truck OEM 1.

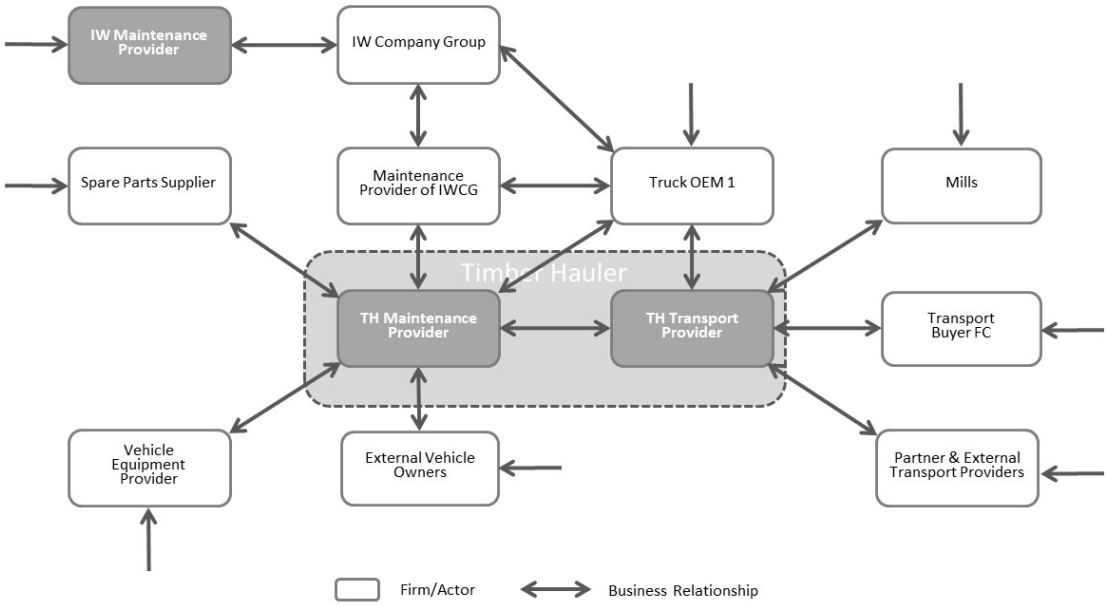

Figure 5.8: A business network based combining on the connected sub-networks of the Timber Haulier (TH) and the Independent Workshop (IW)

Maintenance and the web of actors

Figure 5.9 illustrates the web of key actors based on the network depicted in Figure 5.8. As with the previous example, discussed in Section 5.3.1, this network-level analysis also includes a limited number of actors and reflects a focus on the actors that are perceived to be the ones most strongly influencing, or influenced by, the maintenance performed. In that web of actors, the TH performs two roles, for which the key actor bonds differ. As a transport provider (see Section 4.3.5), the TH assumes a focus on the transport of timber, in which case the key customer, the Forest Company (FC), is crucial for the TH. Based on the production plans of the mills receiving timber, the FC estimates the transport capacity required from the TH. To cope with changing demands for transport and to even out fluctuations, the TH cooperates with a partner and subcontracts transport to other hauliers. Therefore, for the TH's operations, collaborating with other transport providers is essential. At the same time, the hauliers with which the TH cooperates have other customers as well. Consequently, for the management of transport, the joint coordination of vehicle utilisation becomes important. The part of the network shown on the right-hand side of Figure 5.8 thus relates to the transport of timber, the key objective for the FC, the mills, the TH and its suppliers and partners.

For the TH as a maintenance provider, however, the web of actors assumes a different shape. For the maintenance of its vehicles, the TH occasionally outsources work to an external maintenance provider that is part of the IWCG. The maintenance performed by the external workshop concerns advanced maintenance work involving engines and gearboxes, whereas the TH's internal workshop performs most of the maintenance required for its timber trucks. At the same time, the TH sells maintenance services to external customers, which thus represent a way for the TH to support its investments required for establishing and operating the in-house workshop. For the TH's workshop, a parts supplier and systems suppliers also represent key actors, and both replacement parts and knowledge are required for the maintenance performed. In particular, the TH has invested in a partnership involving a supplier of load-locking systems. As shown in Figure 5.8, the Truck OEM 1 is an important actor for both the TH and the IWCG; both firms rely on the OEM as a key source for know-how, training, tools and spare parts. For the TH's transport operations, the know-how provided by the OEM is critical as well. In its role as a transport provider, however, the TH's needs relate more to the utilisation of the vehicles purchased from the OEM. Therefore, depending on the two roles of the TH, the scope and purpose of the interaction with the OEM differs.

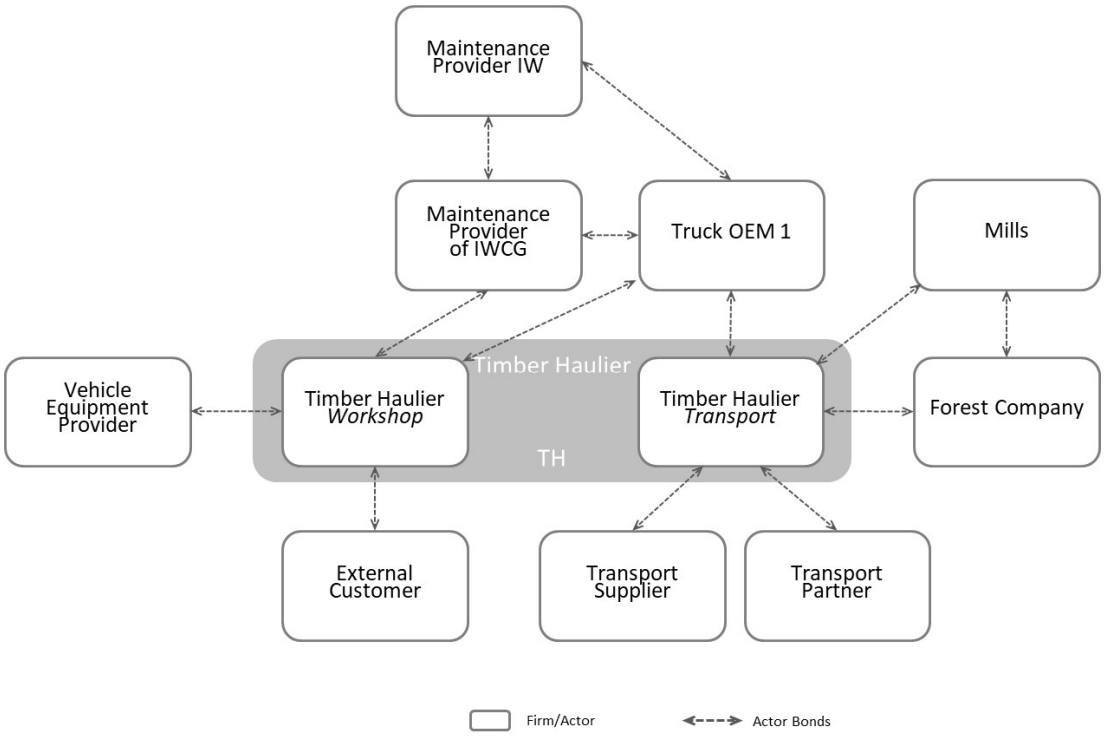

Figure 5.9: A web of actors involving key firms and business relationships with a focus on timber transport and the maintenance of vehicles

Maintenance and the activity pattern

Figure 5.10 depicts a simplified activity pattern involving some of the key activities performed by actors in the business network illustrated in Figure 5.8. The transport of timber represents a set of key activities in the activity structure of the TH. The firm's vehicles load timber at roadside storage sites, after which they transport and deliver the timber to mills. To coordinate those sequential activities, represented in Figure 5.10 as an aggregated activity called "timber transport", the TH has established a transport plan that aligns with the scheduling of drivers. The planning performed by the TH is based on the production plans of the mills, defined as a quota by the FC. Therefore, the activity structure of the TH is linked to the activities performed by the FC and the mills. At the same time, because the TH collaborates with another haulier and also outsources parts of the timber transport performed for the FC, the activity pattern also includes the activities managed by those additional transport providers. Overall, the combined needs of the TH's customers and its partner have to be considered when the hauliers plan for the division of labour and the utilisation of their combined fleet of vehicles.

Even though the transport of timber is the core operation of the TH, vehicle maintenance is also a key concern. By virtue of such maintenance, the vehicles are kept operational and ready to use for the transport required. The maintenance of the TH's vehicles is either performed by the TH's in-house workshop or at an external workshop belonging to the IWCG. In either case, the maintenance has to be coordinated with the utilisation of the vehicles. Therefore, to address those reciprocal interdependencies, adjustment of the activities involved is required. In order to secure the capacity required by the transport buyers, such coordination also has to reflect the joint transport plan of the TH, the transport supplier and the transport partner. For the TH's internal workshop, it is also essential to plan the work in relation to the needs of external customers, whose activities thus also form part of the activity pattern. All told, the transport of timber requires coordination amongst the hauliers as well as between hauliers and their customers. In addition, to ensure the reliability and efficiency of transport, the maintenance performed has to be managed with needs of the transport buyers in mind.

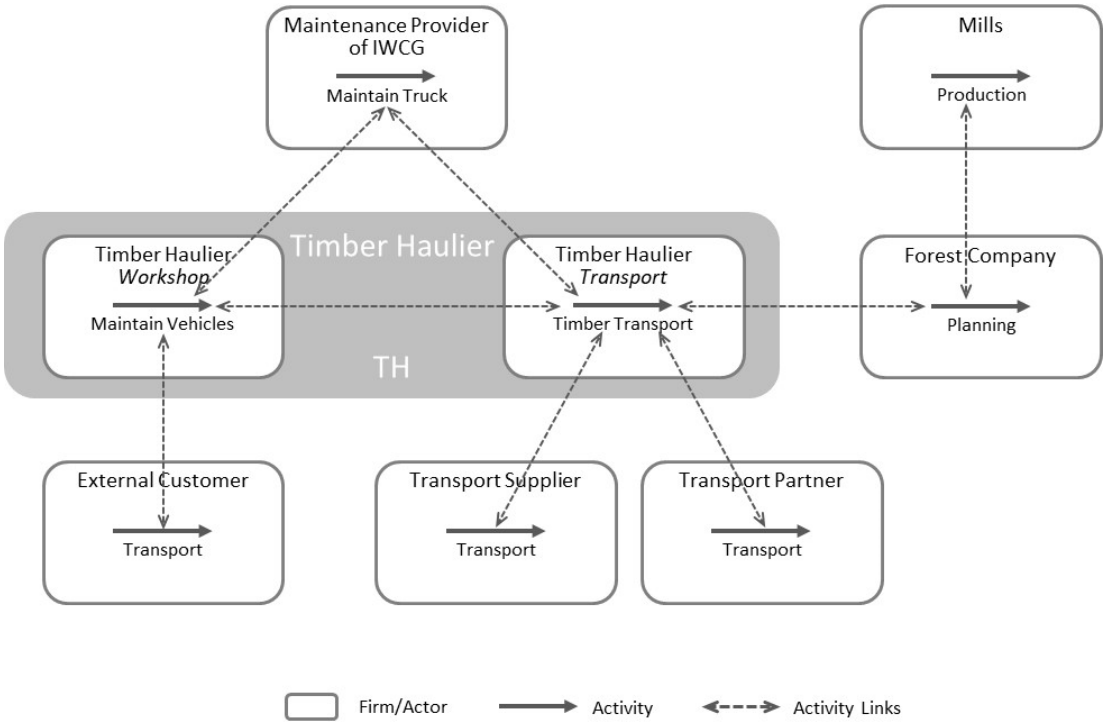

Figure 5.10: Key activities and activity links with a focus on timber transport and the maintenance of vehicles

Maintenance and the resource constellation

The resource constellation depicted in Figure 5.11 encompasses some of the key resources related to the business network shown in Figure 5.8. The figure depicts how different actors manage different resources and whether those resources are tied together and, if so, then how. As a result of the interaction amongst actors, the adaptation of the connected resources may be required. For the hauliers, the vehicles and their drivers stand as key elements of their respective resource collections. The vehicles involves a combination of a truck produced by an OEM and the equipment provided by equipment specialists. Moreover, the vehicles are adapted to the resource being transported—that is, timber. Because the transport of timber is different from other types of transport, the knowledge and training of the driver are often specific to the vehicles and equipment used. Therefore, in the transport of timber, the resource constellation comprises the resources of the hauliers, the FC, the mills, OEMs and vehicle equipment specialists. The resources are specifically adapted to the timber transported and processed, and as a result, the resource constellation exhibits heaviness. The resource constellation in Figure 5.9 also encompasses the resources involved in the maintenance of vehicles. Because specialised equipment requires specialised maintenance,

the resources managed by the maintenance providers are adapted to the make, technical specifications and uses of the vehicles and systems involved in the timber transport. Additionally, some of the maintenance operations and tools require specific knowledge. The resource collections of maintenance providers thus involve adaptation between technicians and tools. In sum, the resource constellation displayed in Figure 5.11 showcases the ties amongst the resources of multiple actors that are required for the transport operations and maintenance of vehicles in the case.

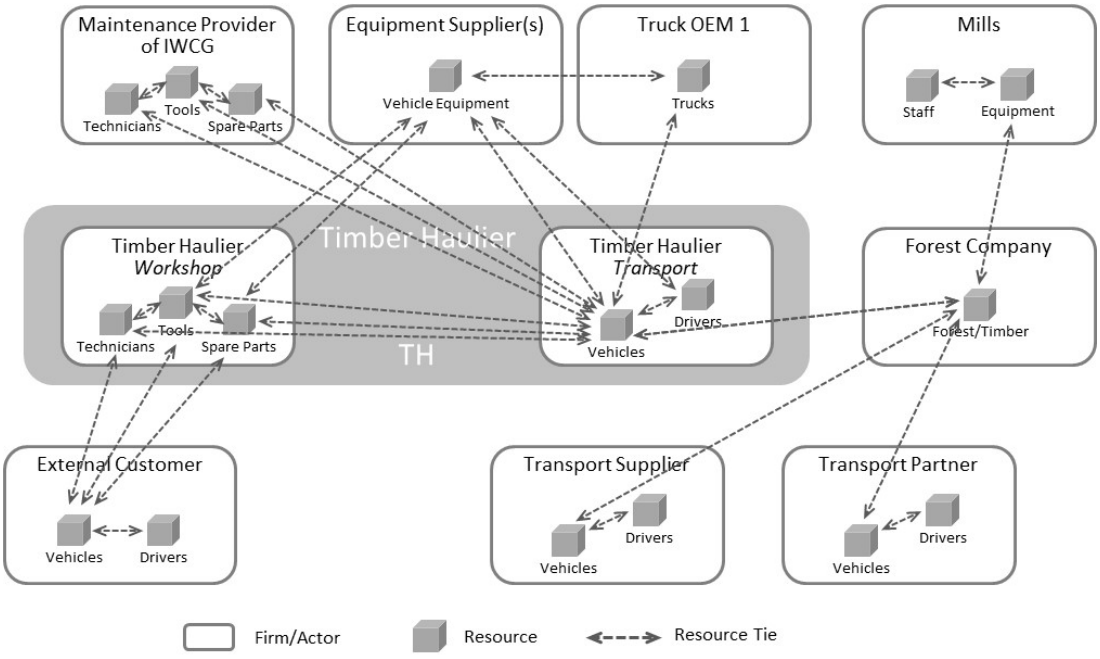

Figure 5.11: Key resources and resource ties with a focus on timber transport and maintenance of vehicles

The offerings of firms: A network-level perspective

Also in this example, the connectedness and interdependencies amongst actors, activities and resources reveal how the solutions offered and purchased by firms become interconnected and interdependent. The focal transport provider, the TH, offers a transport solution to the FC. This solution closely relates to the production performed at the mills of FC, which, in turn, depend on the FC's offerings to customers who require timber-based products. Moreover, the transport capacity purchased by the FC sometimes requires support from additional hauliers, from which the TH therefore purchases transport services. Beyond

that, to improve efficiency, the TH exchanges transport services with a partner in a business arrangement that—for the sake of coordination—also requires the involvement of the partner's customers.

The connection between offerings additionally involves the sale and purchase of maintenance solutions. For example, when the TH purchases maintenance from the external maintenance provider belonging to the IWCG, joint coordination has to ensure that the maintenance does not compromise the transports performed for the TH's customers. Additionally, because the TH offers maintenance solutions to external customers, those solutions become connected to the solutions offered by these customers to other firms.

5.4 Solutions: A network-level perspective

The aggregated overview shown in Figure 5.2 depicts connected sub-networks identified in the empirical material discussed in Chapter 4. Even though the overview represents a simplified view that excludes many of the business relationships that concerns firms within the network, its complexity makes a network-level analysis challenging nonetheless. As shown in the examples described in Sections 5.3.1 and 5.3.2, the actor webs, activity patterns and resource constellations involves complex structures and interdependencies. Therefore, to facilitate a discussion about solutions in business networks that draws on the analysis of the empirical material, a more generic business network derived from the case is introduced.

In the principal network depicted in Figure 5.12, the key actor categories discussed in Chapter 4 are represented. At the same time, the network encompasses additional actors involved in, or concerned by, the transport, the development of the OEMs' offerings and the vehicle maintenance performed by the maintenance provider.

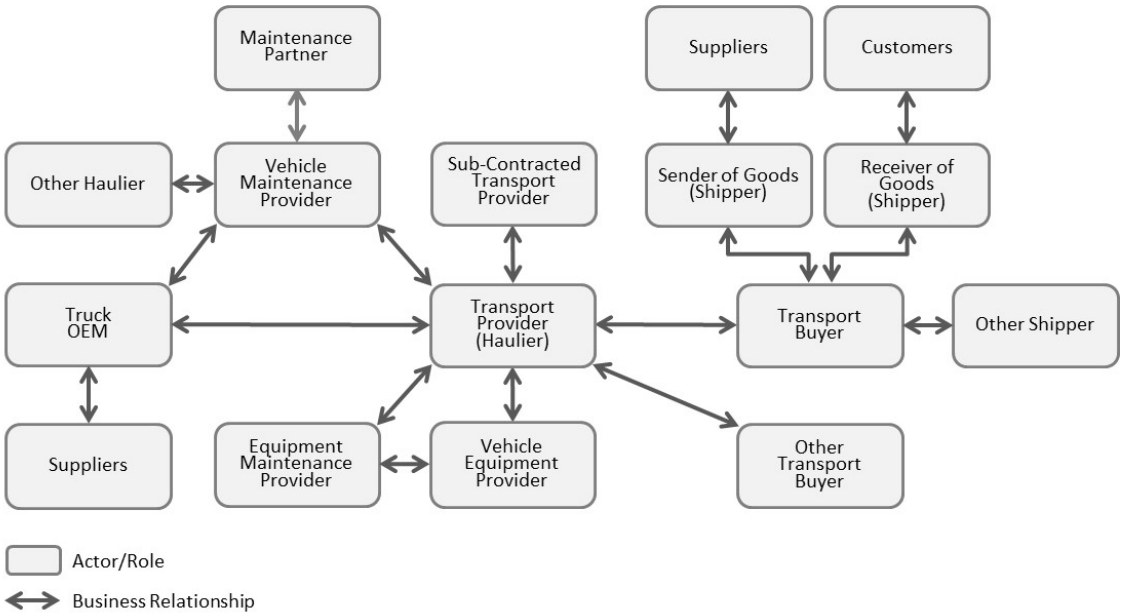

Figure 5.12: A principal business network in which heavy vehicle maintenance solutions are embedded

The analysis of the combined sub-networks discussed in Sections 5.3.1 and 5.3.2 highlights the embeddedness and connectedness of firms and their offerings. The network-level analysis of actors (see Figures 5.5 and 5.9), of activities (see Figures 5.6 and 5.10) and of resources (see Figures 5.7 and 5.11), highlights how the firms influence each other and how the solutions supplied and bought are connected and interdependent. Consequently, vehicle maintenance should not only be understood as a solution embedded in a wider network but also as only one of the solutions embedded in that network. Hence, to better understand how vehicle maintenance influences and is influenced by actors operating in the business network, the maintenance offering has to be viewed as a solution embedded in a context in which actors interact in developing, selling and purchasing other, interconnected, offerings. In Figure 5.13, to illustrate the connectedness and interdependencies of solutions, the principal network of Figure 5.12 has been developed by highlighting a few of the connected solutions previously discussed in Chapter 5.

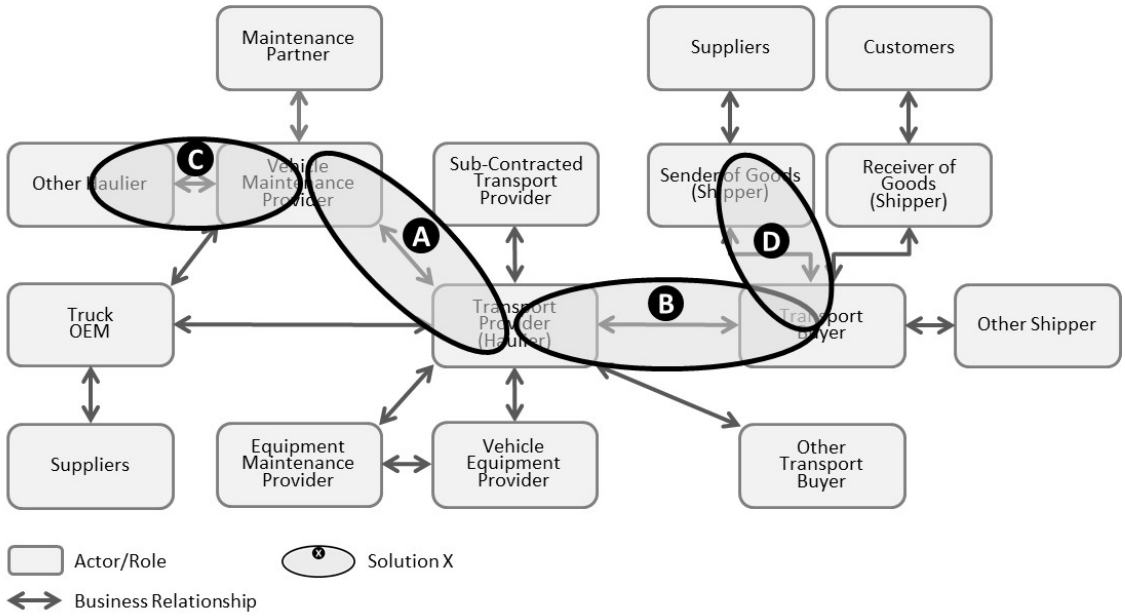

Figure 5.13: A principal business network illustrating the interconnectedness of offerings

In Figure 5.13, the maintenance solution involving a transport provider and a maintenance provider is depicted in Oval A. In the case studied, an example of such arrangement is when the maintenance provider OW supply the TC with a maintenance solution adapted to the haulier´s needs. Likewise, the transport solution purchased by the transport buyer and supplied by the transport provider is depicted in Oval B. For the haulier TC, as an example, the key customer, an LSP, is the transport buyer purchasing its services. Also, in the figure, Oval C represents the maintenance solution purchased by another haulier and provided by the same maintenance provider. In the case studied, the maintenance provider OW provides customer-adapted maintenance solutions for both the TC and the RH. Last, Oval D represents a logistics solution bought by a shipper—in this case, the sender—and provided by the transport buyer, for example the customers of the LSP discussed in the sub-network concerning the TC. Thus, firms such as the transport provider, as Figure 5.13 highlights, are involved in simultaneously purchasing, if not also using, the maintenance solution in Oval A and providing the transport solution in Oval B. At the same time, as discussed in relation to the OW, the maintenance provider could be involved in maintenance solutions provided to other customers, possibly with different needs, as exemplified in Oval C.

As highlighted by the discussion above, firms could be involved in buying and supplying different solutions at the same time. Consequently, this result in that the various solutions

influence each other. As the examples in Sections 5.3.1 and 5.3.2 underscore, planning and performing vehicle maintenance influence and are influenced by other activities performed in the business network. The transport of goods performed for the transport buyer, for instance, influence the use patterns of the vehicles and the time available for maintenance. Similarly, because the maintenance provider has only a limited range of resources available, the planning of maintenance for vehicles operated by the transport provider has to be performed in relation to maintenance also performed on vehicles operated by other hauliers. Therefore, vehicle maintenance should be conceived as not only embedded in the network but also involving interdependencies in relation to other solutions embedded therein as well. As a result of such interdependencies, changes to one solution could result in that other, connected and interdependent, solutions must be modified, sometimes even as an immediate response. In the case study, it could be seen how changes to one solution lead to a "chain reaction" with implications for the coordination of activities and use of resources.

For the firm-level analysis in Chapter 4, as well as for the network-level analysis in Chapter 5, the actors–resources–activities lens (the ARA model) of the Industrial Network Approach has been applied to afford a comprehensive understanding of the interaction between firms and the interconnectedness and interdependencies amongst actors, activities and resources. Moreover, specifically related to the focus of the thesis, the analysis has highlighted issues related to the solutions sold and purchased by firms. For the following chapter, the Industrial Network Approach and the ARA model are used in an attempt to conceptualise solutions in business networks.

6. SOLUTIONS IN BUSINESS NETWORKS

6.1 Introduction

Building upon the firm-level analysis performed in Chapter 4 and the subsequent network-level analysis performed in Chapter 5, this chapter focuses on the conceptualisation of solutions in business networks. To set the stage for that discussion, Section 6.2 focuses on what the Industrial Network Approach (INA) implies for how solutions are understood. Next, Section 6.3 draws upon the conclusions articulated in Section 6.2 and, based on the INA and its actors–resources–activities (ARA) model develops a conceptualisation of solutions in business networks. The section also discusses some of the key implications resulting from the suggested conceptualisation and responds to the three research questions developed in Section 2.7.

6.2 Solutions: An INA perspective

The case analysis in Chapters 4 and 5 contains numerous examples of how firms provide offerings to their customers. The truck OEM sells heavy vehicles to the hauliers, spare parts required for maintenance, and driver training in order to enable more efficient use of the vehicles. The maintenance providers, in turn, offer maintenance solutions to the transport providers who provide transport solutions to the transport buyers.

The customers also frequently require solutions to be adapted to their specific needs. The case analysis showed how transport buyers require maintenance solutions to be adapted to the technical specifications and uses of their vehicles. From the case analysis, it also becomes evident that customers require particular features of products and services to meet their specific needs. Transport providers, for example, require the trucks to be adapted to the characteristics of the goods transported, as in the case of the milk haulier MH where the vehicles with their bulk tanks and pumping equipment are adapted to the transport of milk, the milk tanks at farmers, and the unloading equipment at the dairies of Dairy Products.

Because each customer has specific needs, the solutions required to meeting those needs have to be adapted to the specific customer. For one customer, a truck in itself may be the solution to meet its needs, whereas another customer may require services such as training of technicians or drivers. In the case analysis, examples of different types of solutions have been observed. The spare parts supplied by the truck OEM represent a solution for the

maintenance provider IW, while the transport buyer DP view the transport offered by the haulier MH as a solution meeting its needs for the inbound transport of milk. Therefore, in addition to the integrated and customised bundles that often are termed as solutions (Brax & Jonsson, 2009; Windahl & Lakemond, 2006), customers may also conceive a product or service as being a solution that meet its needs (cf., Kowalkowski et al., 2017; Kowalkowski et al., 2015; Raddats et al., 2019).

In Section 2.7, it is argued that the combining of resources is central to solutions (Cantù et al. 2012). According to the INA, resources represent tangible goods, physical and financial assets, services, and human assets such as knowledge (Bocconcelli et al., 2018; Håkansson, 1987; Håkansson & Waluszewski, 2002a). The case analysis of Chapters 4 and 5 contains a broad range of resource combinations that are identified as part of solutions. The vehicles used by the MH to transport goods, for example, encompass a truck owned by the MH that is combined with a trailer and two bulk tanks owned by the transport buyer, DP. Additionally, the maintenance performed by the maintenance provider IW relies on a combination of tools, spare parts, and technical knowledge provided by the technicians.

However, it becomes clear that also the activity layer of the business network is of significance for solutions. First, activities are required to create and develop the resources required for solutions (Håkansson, 1987). Second, activities are required for the combining (Cantù et al., 2012) and activation of resources involved in solutions. For vehicle maintenance, as an example, the tools and spare parts required are activated and combined by way of the maintenance activities performed by the technicians. Third, as is clear from the case analysis, the coordination of activities is often a prerequisite when adapting the solutions to the needs of customers and acting on the implications from interdependencies with other, connected, solutions.

The combining and adaptation of resources and the linking and adjustment of activities, however, requires the involvement of, and interaction between, actors. Interaction is crucial as it enables a provider to gather and interpret a customer's demands, ensure the customisation required for a solution, and for actors to jointly coordinate the combining of resources involved therein. As discussed in Chapter 2, interaction also matters from the relational perspective on solutions, which highlights how buyers of solutions emphasise the relational processes involved (Tuli et al., 2007) and underscore the need for inter-process

management and coordination (Töllner et al., 2011). Therefore, also from that perspective, the centrality of interaction becomes evident (Brax & Jonsson, 2009; Petri & Jacob, 2016).

From the arguments above it thus follows that a solution can be understood as the outcome of a (certain) set of actors linking and adjusting a (specific) set of activities and combining and adapting a (specific) set of resources.

In the following sections, those notions are further developed in conjunction with a conceptualisation of solutions grounded in the INA.

6.3 Towards a conceptualisation of solutions in business networks

6.3.1 A conceptual model for solutions in business networks

The development of the conceptual model takes its starting point in some of the core notions of the Industrial Network Approach. The INA conceptualises the business landscape as a business network involving firms connected by way of business relationships (Håkansson et al., 2009; Håkansson & Snehota, 1989, 2017b). The business network and the business relationships involved encompass three layers—the actor layer, the activity layer and the resource layer—together conceptualised as the ARA model (Håkansson & Snehota, 1995). Therefore, a network of connected firms as the set of actors depicted in the upper part of Figure 6.1 may be divided in three layers corresponding to a web of actors, an activity pattern and a resource constellation.

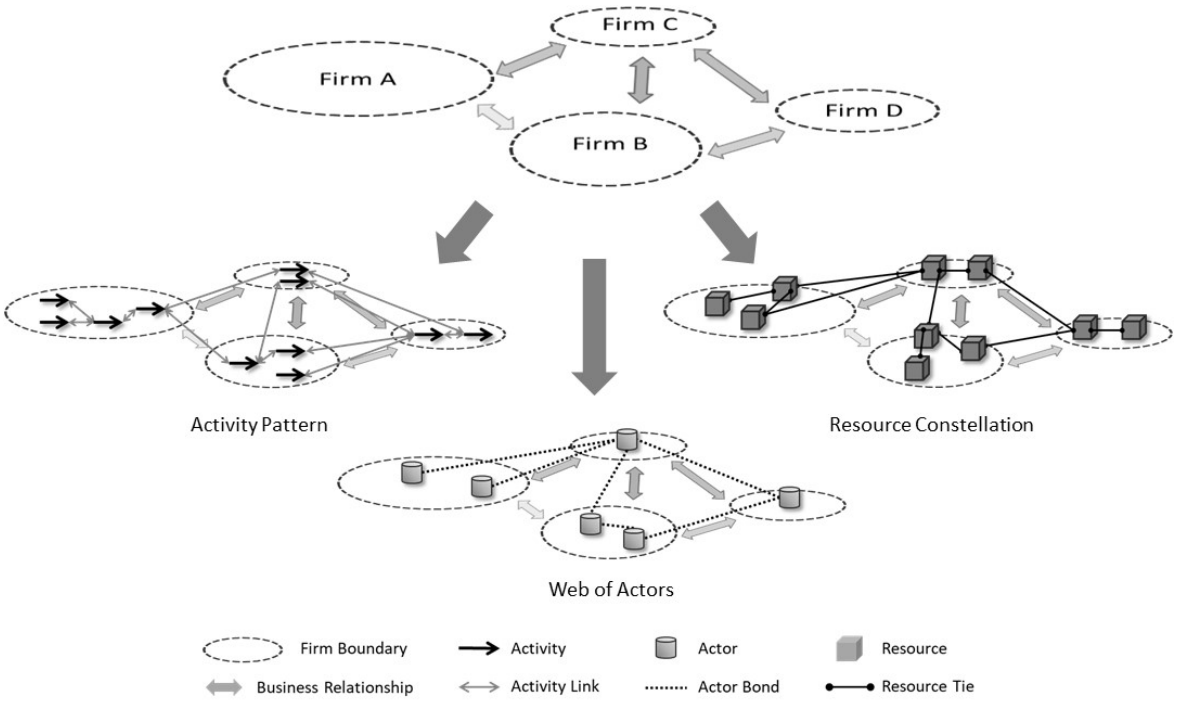

Figure 6.1: A business network divided in the three layers of the ARA model

However, as argued in Chapter 2, the three layers of the ARA model are not isolated or independent but interconnected and interdependent and thus influence each other (Håkansson et al., 2009, p. 33). Therefore, an alternative conceptualisation is suggested in Figure 6.2, which illustrates how the business network introduced in Figure 6.1 is conceptualised as having interconnected, interdependent layers of activities, actors and resources.

Figure 6.2 points to the interconnectedness and interdependencies amongst elements within layers (i.e. activities, actors or resources). As observed in Chapters 4 and 5, several examples of interconnectedness and interdependencies were identified when analysing the case. The haulier MH, for example, uses vehicles for its transport services that combines the trucks that it owns with trailers and bulk tanks owned by the transport buyer DP. Moreover, the core activities performed by the MH, i.e. activities related to the transport of goods, and the activities performed by its maintenance provider, are interconnected as well as interdependent.

Additionally, the case analysis displays examples of interdependencies between different layers, shown as the vertical arrows in-between layers in Figure 6.2. For example, the

technical features of the truck owned by the MH—that is, the features of the resource—affect the type of maintenance performed by the workshop responsible for maintenance—that is, a set of activities.

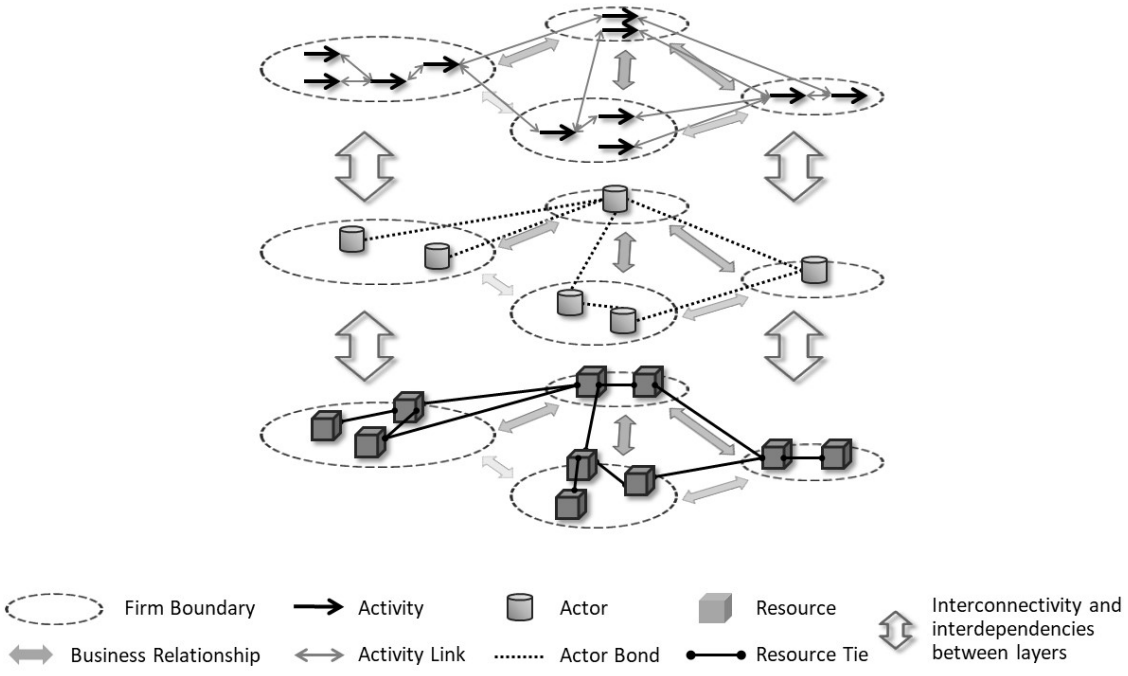

Figure 6.2: The three interconnected, interdependent layers of the business network of Figure 6.1

The case analysis in Chapters 4 and 5 also highlights the embeddedness of firms. First, each focal firm described and analysed in Chapter 4 is simultaneously engaged in several business relationships connecting it to a number of other firms. The transport provider TH, as an example, was engaged in business relationships involving the customer FC, the truck OEM, and several other hauliers. The simplified business networks established by each focal firm and its key business relationships were termed sub-networks in Chapter 4. Second, in Chapter 5, the network-level analysis showed that sub-networks are connected by way of business relationships spanning the boundaries of sub-networks. The sub-network involving the Refuse Haulier (RH) and the sub-network involving the Transport Contractor (TC), for example, were connected by way of business relationships involving the OW workshop. In addition to that, however, the case analysis revealed that the connected sub-networks formed part of an even wider business network. Thus, it can also be expected that the set of firms illustrated in Figure 6.3 are involved in business relationships involving

numerous other firms, resulting in that the small cluster of firms becomes embedded in a wider business network. In that light, the activities in Figure 6.2 form just a part of a far more extensive activity pattern, while the resources form part of a far more extensive resource constellation. Due to the connectedness and interdependencies amongst business relationships, the firms of the business network influence each other. Therefore, the set of firms in Figure 6.2 is also influenced by interaction and events taking place elsewhere in the business network in which it is embedded. To highlight those spatial aspects, Figure 6.3 depicts how the set of connected firms is influenced by events and actions occurring elsewhere.

As shown in the case analyses of Chapters 4 and 5, the temporal dimension is also of importance with respect to the interaction of firms. As the network-level analysis in Section 5.3.2 reveals, the haulier TH opts to cooperate with other hauliers in order to cope with the additional transport capacity sometimes required by the FC, its transport buyer. Moreover, the TH's maintenance operations limit the amount of work performed for external customers so that the firm can attend to the immediate needs of its in-house vehicles used for transporting timber. Both examples indicate how the TH chooses to interact with other actors based on previous experiences and expectations about the future. According to Håkansson et al. (2009), the past, the present and expectations for the future all pose implications for the interactions of firms. The interaction in one episode is influenced by the results and experiences of previous episodes as well as by the actors' expectations concerning future interaction. Drawing from Figure 2.6, Figure 6.2 can be developed to highlight the temporal aspects of interaction (cf., Håkansson et al., 2009, p. 35; Jahre et al., 2006, p. 54). As a result, Figure 6.3 illustrates how the interaction taking place in the business network is influenced by the results of past interaction and the actors´ expectations for the future.

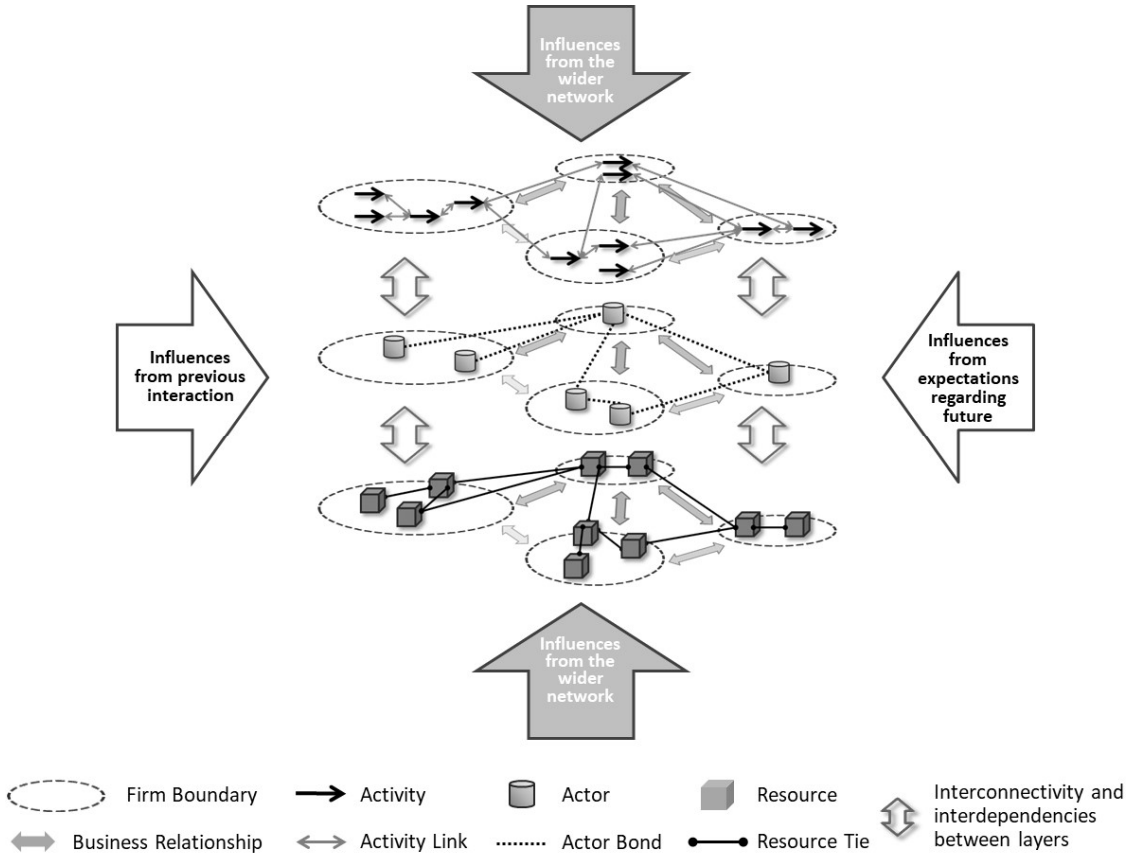

Figure 6.3: The temporal and spatial dimensions influencing the focal network

Figure 6.3 thus illustrates how the set of connected firms is subject to spatial and temporal embeddedness. The firms and their interaction are influenced by contemporary events and interaction taking place elsewhere in the network, by the outcome of previous interaction and by the actors' expectations for the future. Based on the model in Figure 6.3, a model that draws from the INA and its ARA model, the focus now turns to the notion of solutions in business networks.

Section 6.2 highlights that a solution can be understood as the outcome of a certain set of actors linking and adjusting a specific set of activities and combining and adapting a specific set of resources, whether the solutions are products, services or a combination of the two. If those notions are applied to the business network shown in Figure 6.3, then a solution could be visualised as shown in the drawing in Figure 6.4. Reflecting that the solution concerns only a certain set of actors organising a specific set of activities and a specific set of resources, in Figure 6.4, the activities, actors and resources directly involved in the solution appear in grey shading whereas the remaining activities, actors and resources appear without

shading. Furthermore, to highlight the scope of the solution in the figure below, the (focal) solution has been delimited by a "virtual boundary" shown as a dashed line.

The limited set of actors directly involved in the focal solution is embedded in a larger business network. Moreover, because business relationships are interconnected and involve interdependencies, events and actions elsewhere in that larger business network influence the actors involved in the solution. Business relationships and interdependencies are bi-directional, however, and firms thus simultaneously influence and are influenced by each other. Therefore, to reflect this, the arrows above and below the focal solution depicted in Figure 6.4 are drawn as bi-directional arrows.

Added to that, the actors involved in the focal solution are influenced by the outcomes and experiences of previous interactions, as well as by their expectations concerning future interaction. However, because the interaction and acts of actors involved in the focal solution in Figure 6.4 also have implications for the future, the corresponding arrow to the right of the solution indicates that duality.

The focal solution and its actors, activities and resources are embedded in a wider business network. Due to the business relationships spanning the virtual boundary of the focal solution, the actors´ organising of activities and resources both influence and are influenced by contemporary events and interaction occurring elsewhere in the business network. Similarly, the acts of actors are influenced by the outcomes and experiences of past events, and the actors' expectations about the future. At the same time, however, the outcome of the interaction and events resulting in the focal solution also influence future interaction and events.

The three-layered conceptualisation in Figure 6.4 poses several implications for future research on solutions and for managers involved in providing, buying and using solutions. Drawing on the preceding discussion and the conceptual model presented in Figure 6.4, the research questions articulated in Section 2.7 are addressed in the remaining three sections of the chapter.

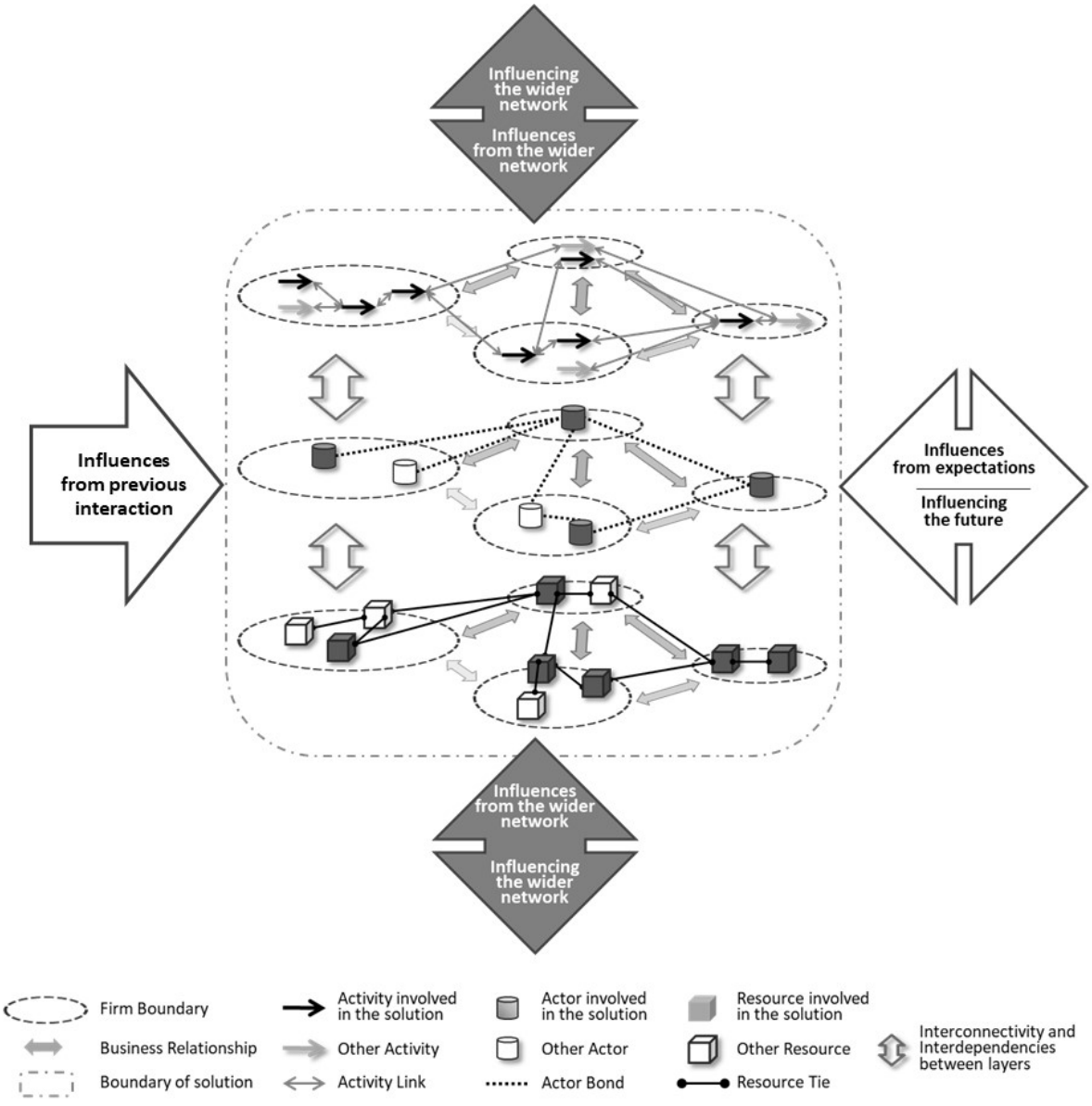

Figure 6.4: A conceptualisation of a solution embedded in a wider business network and subject to spatial and temporal influences

6.3.2 A conceptual model of solutions involving actors, activities and resources

This section addresses Research Question 1 articulated in Section 2.7.3—that is, *How can the Industrial Network Approach and the ARA model contribute to the understanding and conceptualisation of solutions?*

The conceptualisation developed in the previous section and summarised in Figure 6.4 expands current understandings of solutions in general, and solutions in business networks in particular. By applying the INA and the ARA model, the structures and dynamics often invisible in the "black-boxed" processes of solutions come to the fore.

A solution not only relies on the combining of resources but also involves activities and actors. More precisely, a solution involves activities linked to each other and resources that are combined, and to organise those activities and resources, the interaction between actors is required. In addition, as revealed in the case analysis, the elements of the three layers of the ARA model should be addressed jointly, not in isolation, because each influences the other two (Håkansson & Snehota, 1995). A change in one layer may therefore prompt the need for changes in one of the others, if not both. For instance, if a transport provider replaces a vehicle with a new model with different specifications, then the maintenance provider has to adjust the maintenance-related activities, and the transport buyer's transport plans may require adjustment in response to changes in the new vehicle's load capacity. By extension, for solutions, all three layers need to be addressed both individually and jointly in order to better understand—and address—the interdependencies within and between them.

Moreover, the case analysis and the conceptual model—both drawing on the ARA model—highlight that a solution should be considered as being embedded in, influencing, and influenced by, a wider business network of firms. Events and activities taking place elsewhere in that business network influence each solution by way of interdependencies that span the boundaries of firms and solutions. Because of the interdependencies, the solution also influence the business network in which it is embedded. Additionally, the outcomes of past interactions and actors' expectations for future ones influence the decisions and interactions of actors in the present. By extension, the interaction and acts of actors involved in the focal solution also influence the future interaction and actions of actors in the business network.

Corroborating what Windahl and Lakemond (2006) and Cantù et al. (2012) have argued, the findings highlight that solutions involve the combining of resources. In addition, however, the findings also point to that solutions require the linking of activities and the interaction between actors. Furthermore, the findings not only underscore that the interaction amongst actors involved in a specific solution is required (e.g., Storbacka, 2011; Tuli et al., 2007) but also emphasise the need for interaction involving other firms embedded in the same business network.

For actors engaged in solutions, it is crucial to recognise the aspects related to the spatial and temporal dimensions. Therefore, in the next section, Section 6.3.3, a spatial perspective on solutions in business networks is discussed, after which temporal aspects are discussed in Section 6.3.4.

6.3.3 Solutions in business networks: A spatial perspective

The penultimate section of this chapter responds to Research Question 2 articulated in Section 2.7.3: *What are the key implications of conceptualising a solution as being embedded in a business network?*

The network-level analysis in Chapter 5 highlights the interdependencies spanning the boundaries of firms. The operations of a transport provider, for example, depend heavily upon the scope of the transport services purchased by its customers. Therefore, the usage of the haulier's vehicles is also influenced by the requirements imposed by the transport buyer. Because transport providers prefer to have vehicle maintenance performed when vehicles are not being used for transport—during evenings or at weekends, for instance—the maintenance planning managed by transport providers in cooperation with maintenance providers is influenced by the demands of transport buyers. Those demands, in turn, reflect the activities performed by the customers of the transport buyers. Hence, the interdependencies amongst activities point to the embeddedness of, and interdependencies amongst, solutions.

The embeddedness of a solution also poses implications related to the resources of firms. As discussed, the vehicles of a haulier are often specifically adapted to the goods being transported—that is, resources that could be produced by one actor and bought by another. Moreover, the resources used by a maintenance provider have to be adapted to the technical

specifications and equipment of the haulier's vehicle. In that way, the spatial dimension also involves interdependencies amongst resources part of solutions.

Conceptualising solutions in business networks based on concepts from the INA and the ARA model adds to the understanding of how solutions are embedded in the business network and relate to each other. As revealed by the case analysis and as observed by Hedvall et al. (2019), solutions are connected and interdependent. The transport solution offered by the Timber Haulier (TH), for instance, is connected to the transport solutions offered by its subcontractors as well as the solutions offered by the Forest Company (FC) to customers. Figure 6.5 depicts how a solution is embedded in a network of other solutions.

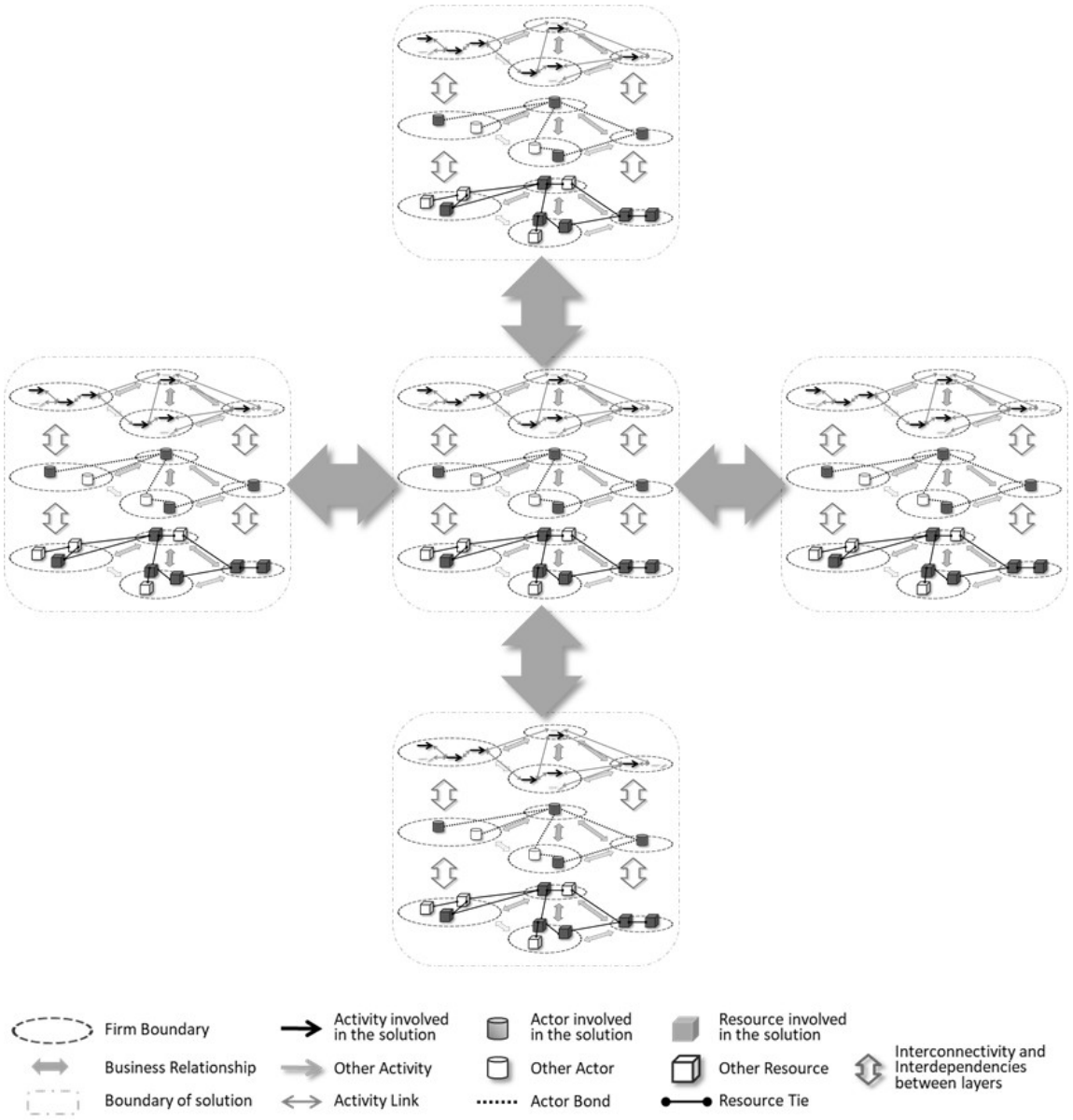

Figure 6.5: The interconnectedness of solutions embedded in a business network

In a business-to-business context, firms are often involved in several solutions at the same time, and the case studied contained several examples of such circumstances. For one, the workshop OW of the Original Equipment Manufacturer 1 simultaneously offers two different maintenance solutions for two of its customers: the Refuse Haulier (RH) and the Transport Contractor (TC). A key implication of the interconnectedness of solutions is that the firms involved may have to simultaneously address solutions with different scopes and different objectives. Therefore, while several authors have stressed the need of coordination amongst the firms and processes involved in providing a (single) solution (e.g., Aarikka-Stenroos & Jaakkola, 2012; Storbacka, 2011; Töllner et al., 2011), this thesis adds a network approach to solutions that suggests that the coordination amongst different solutions in a business network matters as well. For firms involved in solutions, this involves significant challenges. Solution providers, for instance, have to balance demands with respect to customisation and standardisation and address the specific and unique features of each solution, while, at the same time, they have to leverage economies of scale or scope (cf., Gadde & Håkansson, 2008, p. 43). For a maintenance provider, the need to simultaneously be able to maintain vehicles with countless different technical specifications and configurations of equipment results in challenges in improving the efficiency of internal processes, and securing access to a variety of necessary skills, tools and spare parts, for example.

The conceptual model in Figure 6.4 clearly points to how the INA, and the ARA model in particular, can be used to scrutinise the underlying structures of actors, activities and resources (cf., Törnroos et al., 2017). Because actors organise the activities and resources involved in the solution, those structures are highly significant to the development and deployment of solutions. Moreover, as clearly seen for many of the examples discussed above, structures are subject to change over time. Hence, for an improved understanding concerning solutions in business networks, the "dynamic dimension" of spatial embeddedness (Törnroos et al., 2017) is also of importance. To address this dynamic perspective, the temporal dimension of solutions in business networks should be investigated as well.

6.3.4 Solutions in business networks: A temporal perspective

The last section of this chapter, in addressing the temporal perspective of solutions in a business network, seeks to answer Research Question 3: *What are the key implications of conceptualising a solution as being embedded in time?*

In addition to the spatial dimension, the temporal dimension involves aspects that pose implications for firms involved in solutions. The outcomes of past interaction and actors' expectations for future ones both influence the actions and decisions of actors in the present. For a maintenance provider, the time allocated for the maintenance of a vehicle is based on experience with previous maintenance performed on the same or similar vehicles. It could also be expected that the maintenance provider's experience with interacting with a specific transport provider influences how the interaction is managed in the present. Similarly, a transport provider's expectations regarding future transport for a customer could influence its internal operations as well as its interaction with a maintenance provider. Similarly, the transport provider could make assumptions concerning the volume of goods to be transported for a customer in the following weeks. By extension, such an assumption could influence the use of subcontractors as well as the planning of vehicle maintenance.

Taken together, for the actors involved in a solution, it becomes essential to understand and address the temporal embeddedness. The actors involved have to jointly manage the effects from past interactions and from present events taking place elsewhere in the business network. Additionally, the actors also have to be observant of the effects from their expectations for the future. Therefore, while other scholars have highlighted various aspects of the interdependence of processes involved in providing individual solutions (Aarikka-Stenroos & Jaakkola, 2012; Töllner et al., 2011), this thesis highlights the importance of also paying attention to how actors are influenced by the outcomes of past interactions as well as their expectations regarding future ones.

Another aspect related to the temporal dimension concerns the scope of a solution over time. Solutions supplied and bought could be perceived as more or less stable over time, as in the case in which the Diary Products (DP) purchases transport services from the Milk Haulier (MH). The milk is collected from each farm every 48 hours, and the transport plans are comparably fixed. Additionally, the configuration of the vehicles used, in combining resources from the MH and the DP, remains the same for a considerable time. However, the

type of fresh milk collected by the haulier occasionally differs; therefore, from time to time, the MH is required to make changes in order to meet the demands related to transporting of ecological milk. Moreover, as consumers' purchasing patterns change over time, the milk has to be supplied to different dairies. Similarly, in the example concerning timber transport, the capacity required by the Forest Company (FC) fluctuates over time, which requires hauliers to cooperate and exchange services to meet the need for capacity. Under such conditions, the transport solution involving the transport provider and the transport buyer therefore has to be continuously adapted to changing circumstances.

The need for adaptation over time also concerns the maintenance of vehicles. Vehicle maintenance is required for the uptime of vehicles and the reliability of transport. At the same time, the maintenance performed should not impede the transport services bought by a haulier's customer. Therefore, a transport buyer's need for increased capacity from a haulier could influence when maintenance is possible to perform. The services provided by a maintenance provider thus have to be altered to accommodate changes induced by the demands of a transport buyer. The MH, as an example, strives to have a short planning horizon with respect to vehicle maintenance. Even if the transport assignment as such is comparably stable and repetitive, unforeseen issues could arise related to driver planning, amongst other changing circumstances.

Using the ARA model of the INA as a basis for the conceptual model in Figure 6.4 highlights the importance and implications of the temporal dimension. When applying an INA perspective to solutions in business networks it becomes clear why and how previous events and interaction could influence the actors involved in a solution. Moreover, the same INA concepts shed light on how the expectations of actors for the future also influence their acts in the present. Taken together, the conceptual model points to the temporal embeddedness of solutions in business networks.

Because a solution needs to meet the specific, unique demands of a customer (Davies, 2004; Sawhney, 2006; Storbacka, 2011), if the customer's demands change over time, then the solution also has to be modified in order to meet those new demands. That dynamic means that actors involved in the solution have to continuously interact in order to identify and address new or changed needs. Thus, as noted by Evanschitzky et al. (2011) and Grönroos and Voima (2013), amongst other scholars, solutions should be seen as a phenomenon

spanning over time. In that respect, the conceptual model developed can also be used to highlight the dynamic perspective of the structural changes over time.

Figure 6.6 illustrates the temporal aspects of a solution. At Time *n*, the solution has been developed based on the solution at Time *n* – 1 but also adapted to the influences from the wider network and the customer's specific needs at Time *n*. Additionally, the solution at Time *n* is influenced by expectations regarding the future (i.e. Time *n* + 1 and beyond).

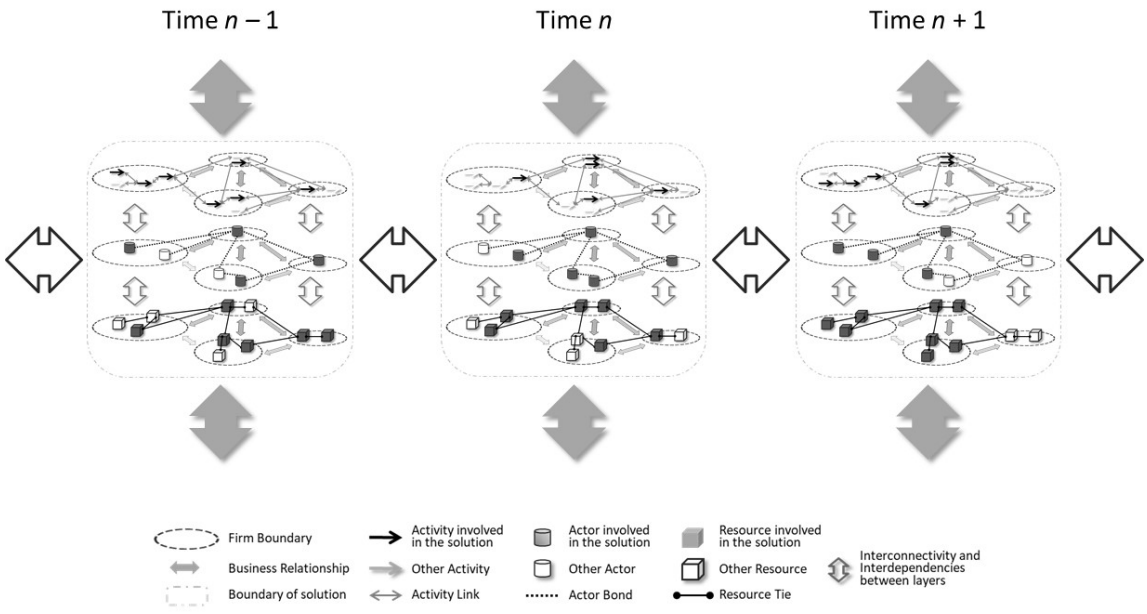

Figure 6.6: A solution in a temporal perspective

Depending on the perspective applied and the temporal boundary set, a solution could thus be viewed as a result of not only the interaction amongst firms with the objective of meeting a customer's need at a specific point in time but also the interaction amongst firms geared towards meeting the customer's demands over a longer time period. To address changes over time, the actors involved may have to reorganise their activities and replace or re-combine resources. The changes over time could also prompt actors to leave or join the set of actors involved in the solution. Consequently, the interaction amongst actors remains vital. Even then, whereas some authors have predominantly stressed the significance of supplier–buyer interaction (Cantù et al., 2012; Tuli et al., 2007), the discussion concerning the spatial and temporal embeddedness of a solution in business networks highlights the importance of ensuring the interaction between multiple actors within a wider business network setting as well.

7. CONCLUDING DISCUSSION & IMPLICATIONS

7.1 Key contributions of the thesis

The thesis has sought to problematise and conceptualise the notion of solutions in business networks. The thesis primarily aims to contribute to and further develop the processual approach to solutions based on the notions of the INA. Additionally, the thesis also extend the view on how solutions are conceptualised in an INA perspective.

Based on the outcomes of firm-level and network-level analyses of the case, and drawing from the Industrial Network Approach (INA) and its ARA model, a conceptual model for solutions in business networks has been developed. Drawing from this model, a set of key conclusions with significance for scholars and managers are articulated. Altogether, the conclusions and their implications add to the current understanding of solutions in business networks.

First, in line with Windahl and Lakemond (2006) and Cantù et al. (2012), the thesis shows that solutions rely on combining and adapting resources. Beyond that, it highlights that solutions also depend on the linking and adjustment of activities and the interaction of actors. For the organising of activities and resources involved in a solution, and to manage the interdependencies within solutions, interaction between actors is a prerequisite.

Second, as also highlighted by Hedvall et al. (2019), the thesis underscores that solutions in a business network are interconnected and interdependent. As a consequence, changes to one solution could have ramifications for other solutions, which may affect their perceived efficiency, effectiveness and value. Hence, also for managing the interdependencies between solutions, the interaction between actors is pivotal.

Third, as highlighted in the conceptual model of Figure 6.4, the thesis underscores the importance of the temporal and spatial dimensions to the embeddedness of solutions. Solutions are influenced by the actions of actors elsewhere in the business network, as well as by the results of previous interaction and actors' expectations for the future.

To manage—or cope with—the interdependencies within and amongst solutions, as well as the influences in the spatial and temporal dimensions, the interaction among actors is essential. Together, actors jointly have to organise and manage their activities and resources

over time as a means to enable the efficiency, effectiveness and value(s) of solutions from a short-term and long-term perspective. Cova and Salle (2008, p. 272) note that "*firms increasingly incorporate services and transform their organization to move on from a product-centric logic to a customer centric logic."* Adding to that, the conclusions of the thesis stress the importance for actors to transcend a product-centric or customer-centric logic. If actors involved in solutions instead strive to become *interaction-centric* and thus acknowledge the centrality of interaction among actors, then the implications of the temporal and spatial embeddedness of solutions may be better understood and jointly addressed to improve the efficiency and value(s) of solutions.

The remainder of Chapter 7 focuses on the key conclusions of the thesis as well as their theoretical and managerial implications. This discussion is divided in two main sections.

First, Section 7.2 discusses three topics with relevance for theory. Section 7.2.1 discusses the solution model of Tuli et al. (2007) in light of the thesis's results, specifically by drawing from the INA to gain insights into the implications of temporal and spatial embeddedness. Thereafter, as the literature on solutions often discuss the notion of value in connection to solutions, Section 7.2.2 provides a comment on matters related to the value of solutions in business networks. Finally, Section 7.2.3 elaborates upon the notion of boundaries in relation to solutions in business networks.

Second, Section 7.3 focuses on three topics with implications for managers. Section 7.3.1 addresses aspects concerning the organising of actors with respect to solutions in business networks, after which Section 7.3.2 discusses issues related to the organising of heavy vehicle maintenance solutions. To conclude the discussion of implications for managers, Section 7.3.3 discusses a few future challenges facing firms involved in providing maintenance solutions for the transport industry, with a specific focus on the actors and their roles within business networks.

In the final part of this thesis, Section 7.4 elaborates a reflection on the case study performed and the question concerning generalisation of the conclusions presented.

7.2 Theoretical implications and suggestions for future research

7.2.1 A re-conceptualisation of the model by Tuli et al. (2007)

In Chapter 2, processual perspectives to solutions, with specific attention to the model proposed by Tuli et al. (2007), were addressed. Even though the model has been questioned and alternative models have been proposed, it was chosen as a suitable example of the processual approach to solutions. To highlight the implications of the discussion in Chapter 6, a re-conceptualisation of the model proposed by Tuli et al. (2007) is suggested in this section. The re-conceptualisation can be understood as an empirically grounded development of not only the model in particular but also the processual approach to solutions in general.

The processual model of Tuli et al. (2007) involves four processes that span time in a linear, sequential fashion, see Figure 2.1. The processes range from the definition of requirements to post-deployment support. Drawing from the discussion in Chapter 6, particularly the conceptualisation suggested in Section 6.3.4, Figure 7.1 proposes an alternative way of looking at the model of Tuli et al. (2007). The figure shows how the model's processes can be replaced by the three-layered conceptualisation introduced in Chapter 6. Interaction and interdependencies not only concern elements within each layer but also the three layers together. Figure 7.1 also visualises how a solution develops over time, either in response to new or changed demands or in response to influences in the spatial or temporal dimensions, if not both. The model in Figure 7.1 thus also underscores the need for post-deployment adaptation discussed by Tuli et al. (2007). However, in contrast to the model proposed by Tuli et al. (2007), the suggested re-conceptualisation also emphasises the bidirectional influences related to the temporal and spatial dimensions. Additionally, the model underscores the importance of actors interacting to make adjustments and adaptations with implications for the interdependencies in time and space.

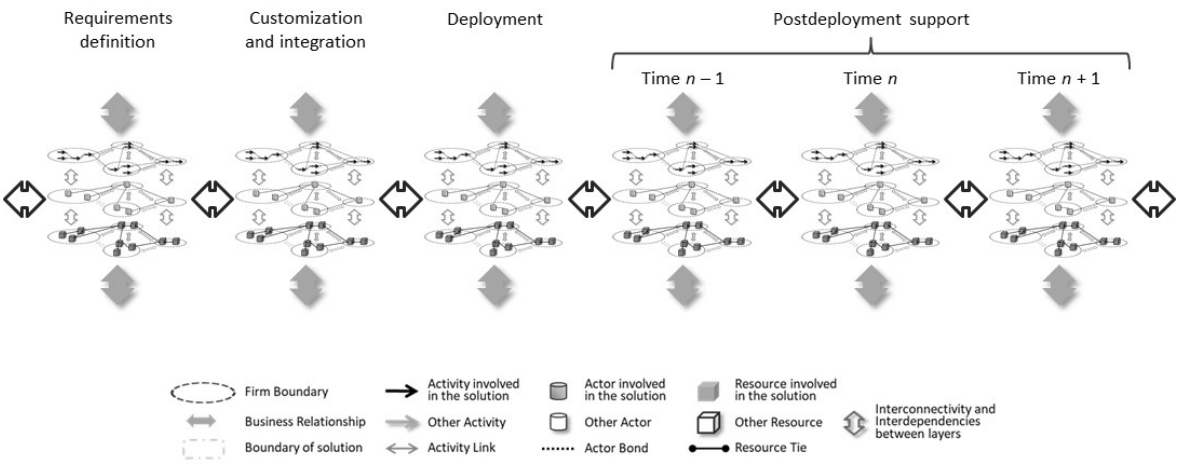

Figure 7.1: A suggested extension of the model suggested by Tuli et al. (2007)

Similar to the model of Tuli et al. (2007), as well as the models suggested by Petri and Jacob (2016), Töllner et al. (2011), Aarikka-Stenroos and Jaakkola (2012) and Storbacka (2011), Figure 7.1 highlights the importance of interaction between the supplier and buyer involved in a solution. The figure also indicates the significance of interaction amongst a wider set of actors embedded in a business network to the process of coping with the interconnectedness and interdependencies within and amongst solutions. Moreover, the re-conceptualisation also point to the centrality of influences from previous interactions as well as of expected interactions in the future.

By further contrast, whereas the models of Tuli et al. (2007), Petri and Jacob (2016), Töllner et al. (2011), Aarikka-Stenroos and Jaakkola (2012) and Storbacka (2011) focus on the processes involved in of solutions, Figure 7.1 highlights that those processes require interaction between actors for the organising of activities and resources. Applying an interorganisational perspective that draws from the Industrial Network Approach thus illuminates what occurs in the processes—that is, the linking of activities and the combining of resources.

To further develop the discourse on solutions, which is the focus of Section 2.2, it is suggested that the processual approach to solutions can be supplemented by continued research that takes an interorganisational perspective; a priority also expressed in recent service-related literature (Raddats et al., 2019). For solutions in business networks, it is critical to clarify the antecedents and implications of the temporal and spatial embeddedness

as observed in business networks. Additionally, to better understand the creation of value (see also Section 7.2.2) involving interconnected, interdependent solutions in business networks requires a more detailed analysis focusing on the elements involved in the solutions—that is, the actors, activities and resources.

7.2.2 A comment on the value(s) of solutions

Storbacka, Frow, Nenonen, and Payne (2012, p. 54) have posited that in the traditional view of value, *"companies add value throughout the value chain to the physical goods that they produce"* and that such value is *"'distributed' to customers who 'destroy' the value in their consumption process."* To that claim, they have added that value is assessed during exchanges between suppliers and buyers (Storbacka et al., 2012). In a similar vein, Vargo, Maglio & Akaka (2008) posit that the notion of value in exchange closely relates to what they call a "goods-dominant logic", which they have described as involving the manufacture of goods to be sold on a market. In that process, value is created via the exchange of goods and money, and as a result, value is embedded in the goods purchased by buyers and measured by the price on the market.

Applying a different perspective, Grönroos and Voima (2013), argue that in a service logic perspective, the customer (buyer) is the value creator, assessing the value as value in use, whereas the supplier generally provides potential value only and thus acts as a facilitator of customer-created value. However, in the case that the customer invites the supplier to actively participate in creating value in use, the supplier may become a co-creator of value, i.e. a co-creator of value-in-use (cf., Mustak, Jaakkola, & Halinen, 2013).

Hence, research addressing the organisational aspects of value and value-creation demonstrates different perspectives amongst scholars. While the literature often takes the perspective of either the supplier (Storbacka, 2011) or the buyer (e.g., Töllner et al., 2011), a dyadic perspective on suppliers and buyers has gained interest as well. Aarikka-Stenroos and Jaakkola (2012), for instance, discuss the dyadic, interactive and collaborative processes required for value co-creation, and Grönroos and Voima (2013) investigate the roles of suppliers and buyers in the (co-)creation of value.

Adding to these views, scholars have also widened the focus by suggesting an interorganisational perspective (Storbacka et al., 2012; Jaakkola and Hakanen, 2013; Kohtamäki and Rajala, 2016). Kohtamäki and Rajala (2016, p. 6), for instance, claim that

"[v]alue co-creation takes place in interactions within interorganizational systems, which may include dyadic relationships, value networks, and entire business ecosystems."

Despite the interest in such multi-actor perspectives, however, it has been argued that the implications of taking an interorganisational approach to value (co-)creation remain partly under-examined and therefore require further attention from scholars (Kohtamäki & Rajala, 2016; Mustak et al., 2013; Raddats et al., 2019). Kohtamäki and Rajala (2016, p. 10), for example, observe that many studies of co-creation either focus on a single firm or a dyad and therefore argue that *"[t]here is a need for studies of value co-creation in service networks, service ecosystems and service value systems."*

Addressing the creation of value in a context involving multiple actors entails additional challenges. La Rocca and Snehota (2014, p. 4) argue that "*[a]dmitting that value is not given only by the object but is always related to the subject and its context has important implications.*" Adding to that, Kowalkowski, Persson Ridell, Röndell and Sörhammar (2012, p. 1554) argue that *"resource-integrating actors will most likely have different views about what is valuable to them, based on their idiosyncratic goals, experiential knowledge, and context."*

In the thesis, Chapter 2 discusses two perspectives on value creation: one focused on the activity layer, the other on the resource layer. The activity layer relates closely to a firm's performance and operations and thus also to value creation. Through adjustment and coordination of activities, the performance of firms involved may be improved (Håkansson et al., 2009; Thompson, 1967), which may also result in lowering their operating costs. At a network level, the division of labour concerns how activities are organised among firms (Dubois, 1994). Changes in the division of labour—for instance, by outsourcing—thus provide means for firms to better leverage economies of scale or scope. In turn, taking advantage of economies of scale and scope affords opportunities to improve the efficiency and effectiveness of firms, which could also reduce operating costs and contribute to value creation. Since issues concerning the division of labour involve multiple actors, understanding and analysing the interaction between firms take on increased importance.

However, creating value also relies upon resource layer and the notion of resource heterogeneity. As Håkansson (1994, p. 258) has posited, *"[a] resource is said to be heterogeneous when its value (performance) is dependent on which other resources it is*

combined with. Consequently, a homogeneous resource has the same value regardless of which resources it is combined with." An implication of the relative value of resources is that the value of a specific resource may be altered, even improved, through interaction with other resources. Therefore, through interaction with a supplier, a buyer could influence the value of resources provided by a supplier (Håkansson et al., 2009, p. 72), meaning that combining and adapting resources is pivotal for actors seeking to create value.

Consequently, generating value through solutions is strongly associated with the activities and the resources of the business network. Creating value by organising the activities or resources, if not both, however, requires involvement of, and interaction between, actors; actors link and adjust activities as well as combine and adapt resources. Value is thus generated cross firm boundaries (cf., La Rocca & Snehota, 2017) and depends heavily upon the interaction between firms and actors that influences the process either intentionally or unintentionally.

In view of the preceding discussion, it becomes clear that a conceptualisation of solutions in business networks based on the Industrial Network Approach has a potential to advance discussions on the generation of value in an interorganisational context. Scrutinising the three ARA-layers of solutions, i.e. actors, activities and resources, can shed light on the task of organising, as well as on the implications of interdependencies within and amongst the layers. However, business networks and solutions have temporal characteristics as well. As Grönroos and Voima (2013, p. 135), for example, explain, *"[t]he central element of value-in-use for the customer connects to the temporal dimension, because value is created through the customer's usage over time."* As the context in which a firm operates changes over time, the perceived value of a solution could also change over time. Therefore, it can be argued that elucidating value generation in a business network requires analysing both the spatial and temporal implications of the network perspective.

Instead of avoiding the complexity of an interactive, interorganisational approach to the value of solutions (cf., Grönroos & Voima, 2013, p. 134), this thesis argues that researchers should aim at developing knowledge about the spatial and temporal aspects of value generation in business networks. In particular, an aggregated and multi-actor view on value generation in relation to the three layers of the ARA model seems fruitful.

7.2.3 Embeddedness of solutions in time and space: A matter of boundaries

The discussion in Chapters 6 has highlighted that the temporal and spatial dimensions are central to the study of solutions in a business network context. Put broadly, events, actions and actors are embedded in time as well as the (business network) space (Halinen & Törnroos, 1998). As Halinen and Törnroos (1998, p. 188) note, *"[i]t is particularly emphasized that business actors are dependent not only on one another, but also on a broader contextual setting specific to each company and on temporal reality -- past, present and future time*." Therefore, in research, scholars need to carefully consider how to approach the dimensions of time and space, because decisions underpinning conceptualisations relying on those dimensions have considerable implications for how scholars—and managers—understand and address a phenomenon.

With respect to the spatial dimension, Törnroos et al. (2017, p. 13) observe that *"[i]n the IMP network approach, the concept of space is mostly and implicitly used to refer to the structural configuration of a network at a specific point in time […]."* Such a business network structure is often based on the subjective perceptions of managers interviewed, an approach that Törnroos et al. (2017, p. 13) has called *"the mental approach to network space*." In this thesis, such mental projections are reflected in the sub-networks resulting from the firm-level case analysis presented in Chapter 4. However, not only the spatial dimension but also the temporal one pose implications for how the interaction and dynamics of business networks are understood. According to Halinen et al. (2012, p. 2015), *"[t]he way time is conceptualized affects our understanding of business processes*", and "*[t]he notion of time that a researcher adopts affects in a crucial way the kind of process understanding that is created*." Thus, because the two dimensions are not disconnected but interconnected for business processes in a business network, they should be addressed together. To that idea, Halinen et al. (2012, pp. 2017-2018) have added that *"the focal process under study defines which actors, activities and resources in the network are of importance at each time*."

Therefore, for research concerning solutions in business networks, choices with respect to the approach to and conceptualisation of the temporal and spatial dimensions are pivotal. Drawing far-reaching conclusions based on the so-called "mental network space" as perceived by managers interviewed at a given time, for example, may result in an overly narrow perspective on the interaction between firms and the connectedness of solutions. As

the case analysis shows, the efficiency, effectiveness and value of solutions relate closely to the actor-perspective applied. At any given time, different actors may perceive the value of a solution differently, and likewise, an actor's perception of the solution's value may vary over time. Therefore, for research on solutions in business networks, the notion of boundary setting in both time and space is central.

In the case examined for the thesis, the sub-networks represent one way to draw boundaries in business network space. In particular, the networks reflected in the sub-networks represent the managers' ideas concerning the business relationships and offerings of key importance for the firm. Similar ideas have been termed *network horizons* (Holmen & Pedersen, 2003) and *network pictures* (Laari-Salmela, Mainela, & Puhakka, 2015) in research applying the Industrial Network Approach. As shown in Chapter 5, however, several sub-networks are interconnected and form larger structures, as analysed in that chapter. Moreover, Chapter 5 indicates that the connected sub-networks form part of a larger network of firms, and depending upon how the boundary is set in space, the number of actors and business relationships to consider varies. Similarly, the scope of and interdependencies within activity patterns and resource constellations differ. For that reason, analysing the effectiveness and value of a solution can generate varying results depending upon how the boundary is set in business network space. From one actor's perspective, a solution may provide high value and improve efficiency; however, the same solution may have significant implications for the operations and efficiency of the firm's customers or the customers of those customers. Thus, for firms involved in solutions, it is critical to understand the implications of boundary setting in space.

In the thesis, also the implications of the temporal perspective of solutions have been emphasised. A solution should be viewed as a phenomenon that stretch across time (Evanschitzky et al., 2011; Grönroos & Voima, 2013), and because the needs of solution buyers change over time, the perceived value of a solution changes over time as well. Moreover, for firms involved in developing and using solutions, the preconditions can change over time as new technology is introduced. Thus, boundary setting with respect to time will have significant implications for how firms jointly manage the definition, development and deployment of solutions.

Boundary setting in space and time clearly poses wide-ranging implications for solutions. The perceived value of a solution depends upon which perspective is applied in space, and

the scope and value of a solution most likely vary over time. Therefore, for firms involved in defining, developing, deploying and using solutions, it is critical to understand the implications of various alternatives with respect to boundary setting. However, as La Rocca et al. (2016, p. 54) point out, *"the temporary bracketing process, identifying the stages – including the origin and ending of the process – is always somewhat arbitrary*." In that light, and in line with Halinen and Törnroos (2005, p. 1297) who argue that *"the boundary problem deserves more attention, as does the complexity issue and the time dimension"*, this thesis suggests that researchers pay further attention to the embeddedness of solutions in time and business network space. In particular, scholars should strive to address the challenges involved in the temporal aspects of the scope and value of solutions.

For future research, it is also suggested that boundary setting in business network space requires additional attention from scholars. As discussed in Section 7.3.3, the structure of business networks changes over time, and in that process, driven by new technology, regulations and business models, for instance, the roles that firms assume vary over time. Although a firm assumes the role as a supplier to one of its customers at a given time, it could later also take on other roles, e.g. the role of its (previous) customer and thus become a supplier to the customer´s customer. Similarly, through outsourcing, firms could opt to have a supplier perform the activities previously managed in-house. Therefore, researchers should also address the challenges involved for firms that jointly define, develop and deploy solutions that require adapting to changes in the business network structure and in the changing roles of firms over time.

7.3 Managerial Implications

7.3.1 Organising for solutions in business networks

In the conceptualisation developed and discussed in Section 6.3, the joint organising amongst firms is critical. After all, solutions result from actors linking and adjusting their activities as well as tying and adapting their resources. Figure 6.6 highlights that for solutions, actors have to organise activity patterns and resource constellations involving multiple other actors and both spatial and temporal interdependencies.

To develop and sell offerings, suppliers are often organised in separate functional units—for instance, development, manufacturing and sales divisions—specialised in different skills and competencies and with different responsibilities (cf., Scott & Davis, 2007). If the

producer also offers aftermarket support—maintenance, for example—then the sales division often also comprises aftermarket operations. Additionally, for firms that strive to increase their portfolio of services, a unit for developing services could be added to the organisational structure, as depicted in the organigram in Figure 7.2. For a firm organised according to a functional separation, offering a solution combining a core product with product-related services could be divided into numerous steps or levels. For instance, as shown in the figure, in sets of separate projects and processes (a) the core product can be defined, designed, developed and manufactured; (b) similarly but often in a separate stream, the services can be defined, designed and developed; and (c) the core product and services can be bundled and thereafter deployed by an aftermarket organisation.

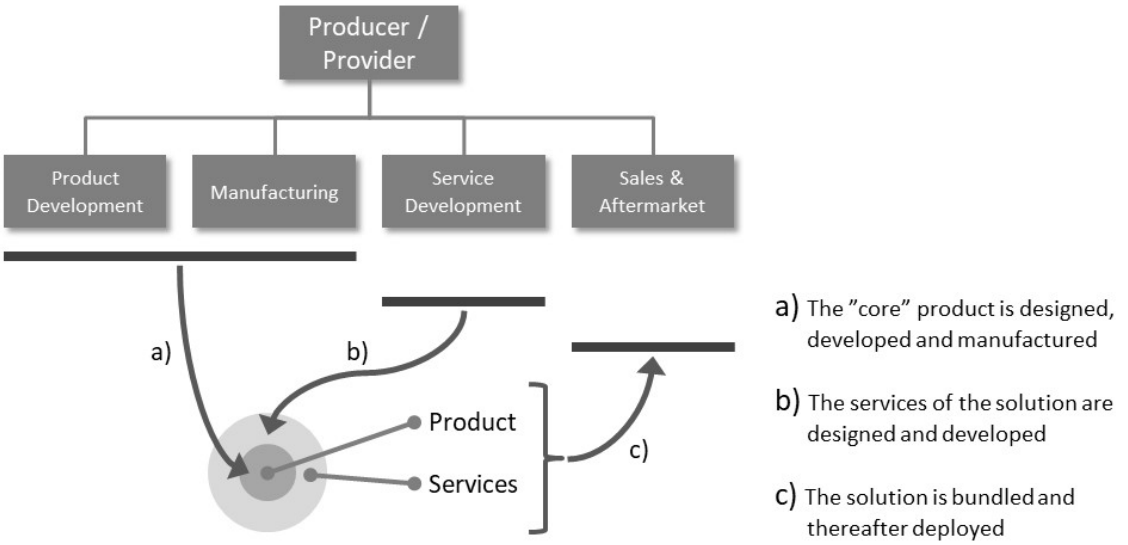

Figure 7.2: Firm-internal organising for the development of solutions for aftermarket deployment

For a solution-provider such as the one in Figure 7.2, organising projects, processes and offerings involves several challenges. To start with, the firm has to manage and coordinate projects and processes within the different functional units. Additionally, developing and supplying an integrated solution requires joint coordination of product development project(s), service development project(s) and aftermarket project(s). Moreover, the provider has to manage and coordinate the interaction between the firm's different functional units and its customers, suppliers and partners. The unit responsible for development, for instance, needs to cooperate with its suppliers and the market organisation

with the customers. Hence, if an organisation is divided in functional units this may lead to a lack of coordination between the various and simultaneous types of interaction that the supplier is involved.

Adding to this, as discussed in 6.3.4, the long time span of solutions entail that the processes often extend over a considerable time, starting with the definition of a solution and continuing into post-deployment. Hence, the challenges faced by firms do not only depend upon organisational structures and how the processes are organised but also upon how the multiple interfaces for internal and external interaction are managed. Consequently, the provider, together with its customers, suppliers and partners, may have to manage the interaction and coordination over a considerable amount of time.

A solution provider with separate units for product development, service development and aftermarket operations risks having to manage several simultaneous initiatives for interacting and coordinating with other firms. Moreover, those initiatives may be resulting from or be influenced by events occurring elsewhere in the business network as well as the outcomes of previous interaction and the firm's expectations for the future. At the same time, owing to the influence on the organising and interdependencies of a joint activity pattern and resource constellation, a range of multiple, less coordinated episodes of supplier–buyer interaction could have unwanted effects on a solution's efficiency, quality and value.

With reference to the case studied, and the maintenance of vehicles in specific, it becomes clear that the organisational structure of the vehicle OEM may pose challenges. The effectiveness, efficiency and value of the maintenance solutions offered does not only depend on the organisation that sell and operate those solutions (i.e. dealers and workshops). Already in conjunction to the design of vehicles and services to be part of integrated solutions, attention has to be paid to the specific needs of customers. Customers demands high uptime, that the vehicles are available when required, and that the cost for maintenance is reasonable. To achieve this, the solutions offered should combine products and services with the right specifications together with efficient and effective workshop operations involving the skills and tools required. Furthermore, the design and specification of products, services and workshop operations have to be iteratively adapted in relation to each other (cf., Jagstedt, Hedvall & Persson, 2018). Therefore, interaction and coordination is required between the units of the firm, as well as with customers buying and using the

products and related maintenance solutions. Hence, for the definition, development and deployment of solutions, an OEM organised according to functional division as in the example in Figure 7.2 may need to revise the organisational structure as well as the processes applied.

As underscored in the foregoing discussion, the definition, development and deployment of solutions do not occur in a vacuum, because the suppliers and buyers of solutions are embedded within a business network. In addition, as previously highlighted in various examples, solutions sold and purchased by firms in the business network are interconnected and interdependent. Owing to those circumstances, managers benefit from understanding and addressing the implications of embeddedness and interdependencies of actors and solutions in their particular business contexts. Perhaps above all, manufacturing firms with a product-centric organisational structure that reflect the modularity of solutions, need to consider alternative organisational forms that can improve the efficiency, effectiveness and value of their offerings.

First, considering solutions as interaction-centric, providers should organise their efforts in ways that facilitates and coordinates the interaction with customers and partners. For a firm organised as Figure 7.2, the interaction with customers is a key task of the market organisation. However, also other functional units could benefit from customer interaction as well; interaction between firms is a key enabler for the definition, development, deployment and post-deployment support required by solutions. To avoid unwanted effects on a solution's efficiency, effectiveness and value, intra- and inter-firm interaction necessary for solutions should be jointly coordinated.

Second, firms need to organise themselves in ways that enable solutions to meet simultaneous needs for customisation and standardisation. Whereas buyers expect adaptation to suit their needs, suppliers rely on economies of scale and scope to improve margins and revenues. Often, a firm's product development unit focuses on standardising the elements in solutions, whereas market-oriented organisational units strive for adaptation that can meet individual customers' needs. Because the combined elements of a solution should jointly meet the needs of customers, the coordination between organisational units is critical and requires cross-functional and cross-organisational collaboration as well as the involvement of customers and partners. In light of the interdependencies among firms and solutions in business networks, though, it should be noted that the balancing with respect to

standardisation and customisation is a matter that is subject to influences from the wider network of actors. Hence, for the design of solutions, suppliers also have to consider the near-term and long-term effects from events and actions taking place elsewhere in the business network.

7.3.2 Organising of maintenance solutions

With respect to the organising of maintenance solutions, the question of whether to *make or buy* is of high importance for managers. In a business-to-business context in general, outsourcing has been observed as a key business trend (Gadde, 2014) common in manufacturing (e.g., Kaipia & Turkulainen, 2017) and in logistics and transport (e.g., Gadde & Hulthén, 2009). Among the reasons for outsourcing, Kaipia and Turkulainen (2017) point to specialization, focus on core competencies, and releasing capital. In addition, as Maley, Kowalkowski, Brege, and Biggemann (2015) have argued, the principal drivers for outsourcing include cost savings and its perceived financial advantage, while Murthy, Karim, and Ahmadi (2015) have added that outsourcing also bypasses the need for in-house specialist work and specific tools otherwise required.

Also with respect to maintenance, questions related to outsourcing concerns the managers of many firms (Toossi, Lockett, Raja, & Martinez, 2013). Campbell (1995, p. 19) claimed that *"maintenance activities are good candidates for outsourcing"* because they are usually routine, well delineated and measureable as well as can be managed at an arm's length. Adding to that view, Maley et al. (2015, p. 275) have posited that "*maintenance costs are a significant portion of the operational expenditure for many asset-intensive industries and it is therefore not surprising that companies target maintenance for exigent cost savings."* In the same vein, Murthy et al. (2015, p. 100) have observed that though maintenance was traditionally performed in-house by the owner of the asset, "*[o]ver the last few decades, there has been an increasing trend in the outsourcing of maintenance where some or all the maintenance is carried out by an external service agent under a maintenance service contract."*

When heavy vehicle maintenance is concerned, hauliers' outsourcing the maintenance of vehicles is a prioritised issue for the original equipment manufacturers (OEMs) of trucks. The, so-called, aftermarket, represents a considerable part of the revenue stream for many OEMs. Consequently, for a truck OEM striving to improve the revenues from the

aftermarket, offering maintenance solutions therefore often involves a focus on internal efficiency. As Oliva and Kallenberg (2003, p. 168) explain,

> *"the move towards maintenance contracts is often triggered by a desire to make better use of the installed service organization. For the service provider, once the service organization is in place, it becomes a fixed cost and the main driver of profitability is capacity utilization."*

Therefore, for an OEM, offering maintenance contracts could improve the efficiency and lower the costs for the internal operations performing the maintenance. The question remains, however, of whether the improved internal efficiency of OEMs also benefit the hauliers that outsource their maintenance to these OEMs.

The literature reflects different views as to whether the buyers of maintenance solutions fully scrutinise the pros and cons involved in outsourcing. According to Murthy et al. (2002, p. 297), "*[i]n most businesses, maintenance is viewed as being a non-core activity and the focus has been to outsource it completely."* In the same vein, Pinjala, Pintelon, and Vereecke (2006, p. 2015) have observed that for manufacturing companies there is a "*"lack of understanding this relationship [between business and maintenance strategies] and only cutting down the costs of maintenance can influence the company's competitive strength equation and its ability to compete in the market."* On top of that, it appears that the outsourcing decisions of firms tend to be based on cost savings rather than its impact on the firm in the long term (McIvor, 2008). Therefore, even though the value of maintenance has gained attention, its outsourcing frequently remains price-oriented, which *"often results in short-term decisions which can be quite problematic in maintenance, as many of the benefits are created over a long term"* (Ali-Marttila, Marttonen-Arola, Kärri, Pekkarinen, & Saunila, 2017, p. 145).

In contrast to Campbell´s (1995) description of maintenance as an excellent candidate for outsourcing, largely because maintenance activities are usually routine, delineated, measureable and manageable at an arm's length, the case analysis and discussion of Chapter 6 stresses the implications of the embeddedness and interdependencies of firms and solutions. Neither the maintenance provider, nor the customers buying its solutions, can deal with maintenance as independent from other resources and activities. Moreover, reflecting the dynamic context that many transport operators and maintenance providers operate

within, the temporal aspects become pivotal as well, because changes in the demands of transport buyers in turn change the preconditions for efficient, timely maintenance.

In sum, because outsourcing relies heavily upon (re)organising activities and resources amongst actors, firms investigating options for providing or buying maintenance solutions should address issues related to the temporal and spatial dimensions of their business networks. The interdependencies within and amongst firms and solutions have implications for the preconditions for, and outcome of, maintenance solutions.

Solutions are the result of actors jointly organising activities and resources, and this also applies for maintenance solutions which depend on the activities and resources of transport providers and maintenance providers with partners. Therefore, for hauliers that are considering outsourcing, in-sourcing or re-sourcing, of the maintenance of their vehicles, it is important to understand which effects this could have on the activity pattern and the resource constellation. For instance, which internal activities are linked to maintenance activities to be performed by the maintenance provider, and what would outsourcing of those activities imply? Moreover, how could the interdependencies of resources involved influence or be influenced by the maintenance being outsourced or insourced? With a better understanding of the interdependencies amongst activities and resources, managers can be better prepared to make decisions required in the process of in- or out-sourcing. As discussed above, the value of a solution depends on the organising of activities as well as resources.

Moreover, for managers involved in supplying or buying maintenance solutions, an understanding of the implications of embeddedness is critical. As discussed throughout this thesis and as shown in Figure 7.3, solutions are interconnected and interdependent. In Figure 7.3, maintenance solution A is connected to and interdependent upon transport solution B. As was observed in several of the sub-networks analysed in Chapter 4, the transport planning involving the vehicles of the haulier have implications for the planning of vehicle maintenance. By extension, because the same maintenance provider offers solutions to other hauliers, as exemplified by the maintenance solution C, both maintenance solutions (A and B) are interconnected and interdependent as well. Hence, a maintenance provider has to seek means for dealing with situations wherein the plans involving one customer change and could negatively influence the plans agreed with other customers.

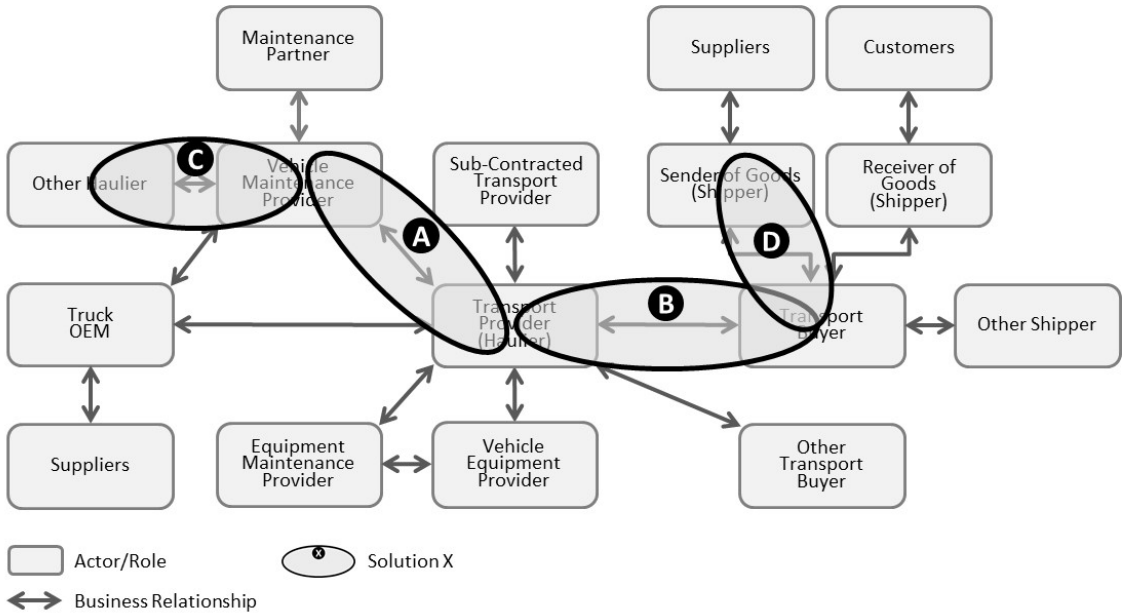

Figure 7.3: Visualising the interconnectedness and interdependencies among solutions

The implications of the interconnectedness and interdependencies of solutions are far-reaching. For managers involved in supplying or buying maintenance solutions, it becomes crucial to understand which other solutions influence and are influenced by the maintenance solutions in focus (as in the example of solutions A and B in Figure 7.3). The value of the maintenance solution, as well as any interconnected solution, depends on how they are connected and how firms manage them jointly. The value of a specific maintenance solution, for example, depends upon how well the interdependencies between maintenance activities and transport-related activities are managed.

> *In the past, a dealer sold a vehicle, and that was it. Today, the sale of the vehicle is only the start of a journey towards the next deal. The OEM and the haulier need to get far better in supporting each other on that journey to the next vehicle.*
>
> Manager, TH

At the same time, the interaction between firms in the business network is continuous, and new solutions are introduced or changes made to existing solutions. Therefore, the context in which the maintenance solution is embedded changes over time. For maintenance providers, for instance, the number and types of customers vary from one period to the next,

and for transport providers, customers' demands for transport capacity often vary over time. Therefore, managers of suppliers, buyers and partnering firms should jointly ensure that any maintenance solution provided is continuously adapted to current conditions.

7.3.3 Maintenance solutions for heavy vehicles: Some future challenges

Of the multitude of challenges that firms in the transport industry currently face, adapting to new technologies such as electromobility and automation is increasingly discussed by managers. At the same time, managers frequently debate digitalisation and connectivity not only as enablers and opportunities but also as challenges threatening to disrupt organisations, processes and business models. For maintenance solutions, automated and electrified vehicles will require new maintenance solutions, which, in turn, will require new skills, tools and spare parts to accommodate the technical characteristics of new trucks that differ from their predecessors. Beyond that, because vehicles in the future will be used differently from how the current vehicles are used, the demands of customers are liable to change as well. However, the development of technology also stands to provide opportunities for firms. Digitalisation and connectivity, for instance, show promise for the monitoring of vehicles and the avoidance of un-planned stops (e.g., breakdowns). Moreover, data collected from vehicles and maintenance providers could be used to improve the efficiency of supply chains for spare parts (Andersson & Jonsson, 2018).

Less frequent, however, are the challenges caused by changes to the organising of the industry the focus of the debate. Managers face the implications of digitalisation, connectivity, electromobility, automation, and the pressure to develop more sustainable transport solutions. With the introduction of new technologies and transport patterns, changes that presumably also push for different business models, the structure of the industry can be expected to shift. With such structural changes, the configuration and scope of roles taken by firms in the business network may shift as well. Figure 7.4 presents three examples of such configurations, each of which requires different roles for the key actors, as reflected in changes to the firm boundaries also shown in the figure.

In Configuration 1, for instance, a vehicle OEM provides vehicles and vehicle-related services. The vehicles, bought by a firm in the roles of vehicle owner and transport provider, are used for the transport services ("transport-as-a-service") bought by the transport buyer.

By contrast, another firm, in the role of maintenance provider, offers maintenance solutions to the vehicle owner/transport provider.

As shown, the two other configurations display different examples of how firms could assume and combine those generic roles. Configuration 3, for instance, regards a structure where the roles of the vehicle owner and the maintenance provider have been combined. In such a scenario, the vehicle OEM still base its offerings on the trucks sold, whereas the actor combing vehicle ownership and maintenance could offer its customers, the transport providers, solutions based on the idea of "trucks-as-a-service".

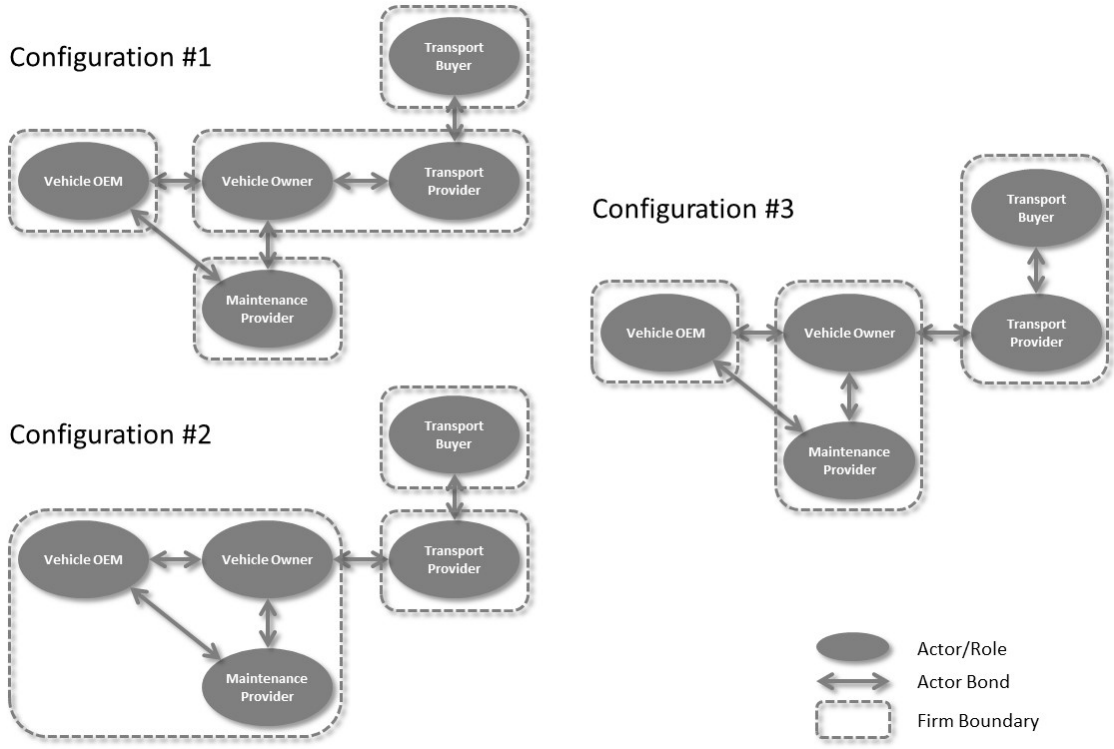

Figure 7.4: Three examples of different configurations where firms take on different roles

When firms assume and occasionally combine roles, their needs change accordingly. For instance, a firm acting as a vehicle owner has different needs from one that both owns and uses the vehicles. When the needs of the firms change, the scope of solutions provided and purchased changes, as will the business relationships. New structures will thus require changes to the scope performed and managed by actors, their business relationships and their business models. To coordinate the changes required and address their implications for

firms and solutions, the interaction between firms is of utmost importance. At the same time, reflecting the structural changes, the interaction will assume new forms and address new contexts, new opportunities and changing expectations amongst customers of vehicles, services and solutions.

7.4 Reflections

As a phenomenon, solutions are discussed in various types of industrial settings and with a variety of theoretical underpinnings. Drawing on the Industrial Network Approach (Håkansson et al, 2009; Håkansson & Snehota, 2017b), the case of heavy vehicle maintenance solutions in an interorganisational context has been used to problematise and conceptualise the phenomenon of solutions in business networks. Hence, theoretical generalisation (Eisenhart, 2009; Flick, 2009), also referred to as analytical generalisation (Yin, 2014), has been applied to link the case analysis with theory.

Based on the notions of actors, activities and resources of the INA (Håkansson & Snehota, 1995), a conceptual model of solutions in business networks has been developed. The model, conceptualising solutions as the outcome of a certain set of actors linking and adjusting a specific set of activities and combining and adapting a specific set of resources, highlights the interdependencies among elements of each layer (activities, actors and resources) as well as the interdependencies between the three layers. Additionally, the model points to the embeddedness of solutions with respect to the spatial and temporal dimensions of business networks.

The conceptual model developed, as well as the conclusions that can be drawn upon it, further current understandings concerning solutions in business networks. This, in turn, can support researchers and managers when applying new approaches to the analysis and development of solutions. Furthermore, as the conceptual model shed light on the interdependencies within and between solutions, the model can also provide means to better understand the implications of changes to the connected solutions, for example through the introduction of new technologies.

The case analysis and the subsequent discussion also add perspectives to maintenance solutions in business networks. In the case studied, heavy vehicle maintenance solutions are in focus. These solutions are provided by the maintenance providers to the transport providers requiring uptime, reliability and efficient use of their vehicles. The transport

providers, in turn, offer transport solutions to the transport buyers that purchase the transport of goods. The transport buyers expect the transport to be efficiently performed and in accordance to the transport plans set.

Hence, even if the vehicles are specific in that they are "mobile"—i.e. used for transport of goods between senders and receivers—the context has similarities to other settings. For a manufacturer, for example, the maintenance of its equipment is essential as well. The machines have to be operational in order to produce the goods bought by customers, and, the production is expected to be efficient, reliable, and performed according to the production plans agreed on beforehand; thus, even if the case involves characteristics specific to the transport of goods, there are features also found in other contexts.

The case study, applying an interorganisational and interactive approach to maintenance solutions, point to the interdependencies among resources and activities involved in maintenance solutions. Moreover, the results of the analysis underlines the importance of interaction between actors to address the interdependencies within maintenance solutions, and between the maintenance solution and other—connected—solutions. Because suppliers and buyers of maintenance solutions are embedded in business networks, and interact with numerous other firms that supply and buy other solutions, the case study and its outcome therefore can help managers involved in the development, sales and purchase of maintenance solutions to find alternative approaches that could result in better efficiency and/or improved value.

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APPENDICES

Interview Guideline

For the semi structured interviews, see Chapter 3, an interview guideline was used as support. Even though the interviews flowed freely, the guideline served as a “check list” ensuring that the most important areas were covered. Below, a high-level overview of the interview guideline is provided.

BACKGROUND DATA

- Interview Data
- Interviewee Data
- Basic Company Data (e.g., ownership, size, vehicles)
- Operational Data (e.g., business, operations, transport)

TRANSPORT BUYER

- Transport Buyer Purchasing Decision
- Transport Buyer Purchase Criteria

TRANSPORT PROVIDER

- Transport Provider Selling Decision
- Transport Buyer Purchase Criteria
- Vehicle Purchasing

TRUCK OEM

- Aftermarket
- Maintenance Offers
- Customer Involvement
- Maintenance Strategies

MAINTENANCE PROVIDER

- Customers
- "Services" Offered
- Sales of "Services"
- Operations Planning
- Development of "Services"

SOLUTION PROVIDER/BUYER (MAINTENANCE & OTHER)

- Defining a "Solution"

- Providing/Buying Solutions
- Developing/Offering Solutions
- Organizing for Solutions
- Actors/Activities/Resources

VEHICLE UPTIME

- Definition/Importance/Aspects/Follow-Up

VEHICLE MAINTENANCE

- Maintenance Strategy
- Maintenance Activities
- Maintenance "Offers"
- Needs/Demands
- Performing Maintenance
- Maintenance Requirements (in e.g. contracts)
- Maintenance Contracts
- Maintenance Costs
- Daily Maintenance

BUSINESS RELATIONSHIPS

- Most important customers
- Most important suppliers
- Changes over time
- Actors influencing vehicle maintenance?
- Main Competitors?

FUTURE DEVELOPMENT

- What developments do you see?
- Influence on vehicle maintenance?
- Influence on maintenance offers/solutions?
- Influence on industry structure?

SAMPLING SUGGESTIONS

- What additional companies or organisations would be valuable for me to meet with?
- What other persons, in the same company or outside, would be valuable for me to meet with?

READER'S NOTES