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## **Managing After-Sales Services: Strategies and Interfirm Relationships**

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## List of abbreviations

ATM	Automated teller machine
CEO	Chief executive officer
EDO	End of delivery obligation-point
EOL	End of life-point
EOP	End of production-point
EOS	End of service-point
GDP	Gross domestic product
OEM	Original equipment manufacturer
R&D	Research & Development
SCD	Supply chain disintermediation
SME	Small and medium-sized enterprises
SOP	Start of production-point

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## **Abstract**

After-sales business plays an instrumental role in dictating firms' financial well-being and competitiveness. Due to global competition, shrinking profits in primary products sales, and stagnating revenues, firms have expanded their after-sales businesses to boost sales, enhance profit, increase customer loyalty, and to differentiate their portfolio. Systematic, integrated approaches should optimally align after-sales management to the overall objectives of the firm and the current market situation. However, few academic publications and studies exist on this topic, as the literature review in this thesis shows.

This cumulative dissertation attempts to close the gap between the high relevance of after-sales business in practice and its insufficient academic study in three self-contained essays. The first essay proposes a three-stage model to develop a strategy for the spare parts logistics. The model includes several key components which should be considered during the strategy development process. Strategic alignment is used as a theoretical concept. The second essay identifies and analyzes archetypes of triadic and tetradic relationship constellations between supplier, manufacturer (OEM), customer, and (optionally) competitor in aftermarkets based on empirical data. These constellations represent the core elements of each network, hence they are an acceptable simplification to model complex relationship constellations in markets. The theoretical basis are concepts of social network research. The third essay builds on the results of the second essay and analyzes intra-firm, intra-network and external determinants according to the aforementioned relationship constellations in aftermarkets. From the characteristics of these determinants, the market structure, competitive intensity, and recommendations for competitive behavior can be determined. The theoretical basis are again concepts of social network research and in addition different types of relationships are described in the theoretical part of the publication.

A theory-building approach based on case study research methodology is used within this dissertation. The empirical sample is not company-specific, nor is it in the essays two and three restricted to a particular industry to ensure maximum generalizability of the research findings.

This thesis provides significant theory-building contributions to the emerging research field of after-sales management and contains specific recommendations for managers to improve their after-sales business.

## **Zusammenfassung**

Das After-Sales-Geschäft hat für zahlreiche Unternehmen in verschiedensten Industrien eine hohe Relevanz in wirtschaftlicher und wettbewerbsstrategischer Hinsicht. Insbesondere vor dem Hintergrund stagnierender Umsätze und schrumpfender Gewinne im Primärprodukt-Geschäft, ausgelöst unter anderem durch eine technische Angleichung der Produkte und einen globalen Wettbewerb, bauen Unternehmen ihr After-Sales-Geschäft aus. Neben Umsatz- und Gewinnzielen werden hierbei Kundenbindung und -zufriedenheit sowie Differenzierungsziele verfolgt. Systematische, holistische Ansätze ermöglichen eine optimale Anpassung des After-Sales-Managements an die jeweilige Unternehmens- und Marktsituation. Die Forschung bietet allerdings zu dieser Thematik bisher unzureichend wissenschaftliche Publikationen und Studien, wie die Literaturübersicht in dieser Doktorarbeit zeigt.

Die vorliegende kumulative Dissertation, die insgesamt drei wissenschaftliche Publikationen sowie ein Einleitungskapitel umfasst, schliesst (zumindest teilweise) diese Lücke zwischen der hohen Relevanz des After-Sales-Managements in der Praxis und einer bisher unzureichenden Beschäftigung mit ganzheitlichen Konzepten in der wissenschaftlichen Literatur. Die erste Publikation umfasst ein dreistufiges Modell zur Entwicklung von Strategien für die Ersatzteillogistik. Das Modell beinhaltet verschiedene Komponenten, die im Strategieentwicklungsprozess durchlaufen werden sollten. Strategic Alignment wird als Theoriekonzept verwendet. In der zweiten Publikation dieser Dissertation werden auf Grundlage empirischer Daten Archetypen von Beziehungskonstellationen in After-Sales-Märkten identifiziert und analysiert. Untersuchungsgegenstand sind Triaden, bestehend aus Lieferant, Hersteller (OEM) und Kunde sowie Tetraden, die zusätzlich einen Konkurrent als Marktakteur umfassen, da diese Konstellationen, die die Kernelemente eines jeden Netzwerks darstellen, eine hinnehmbare Vereinfachung sind, um auch komplexe Beziehungskonstellationen auf Märkten abzubilden. Die theoretische Grundlage bilden

Konzepte des Social Network Research. Die dritte Publikation baut auf den Ergebnissen der zweiten Publikation auf und analysiert firmeninterne, netzwerkinterne und externe Determinanten die zu bestimmten Beziehungskonstellationen in After-Sales-Märkten führen. Ausgehend von den Ausprägungen dieser Determinanten kann die entstehende Marktstruktur und das Wettbewerbsverhalten sowie die -intensität bestimmt werden. In einem weiteren Schritt werden Empfehlungen bzgl. des Wettbewerbsverhaltens für die unterschiedlichen After-Sales-Marktakeure ausgesprochen. Die theoretische Grundlage bilden wiederum Theoriekonzepte des Social Network Research und darüber hinaus werden im Theorieteil der Publikation verschiedene Beziehungstypen aufgezeigt. In allen Publikationen dieser Dissertation wird Case Study Research mit einer umfangreichen Fallstudienanzahl als Forschungsmethodik verwendet, wobei die empirischen Daten die Grundlage für die Theoriebildung darstellen. Die erhobenen empirischen Daten sind nicht unternehmensspezifisch und haben bei den Publikationen zwei und drei auch keinen Bezug auf eine bestimmte Industrie, um eine grösstmögliche Generalisierbarkeit der Forschungsergebnisse zu gewährleisten.

Die Ergebnisse dieser Doktorarbeit leisten im Forschungsbereich des After-Sales-Management wichtige theoriebildende Beiträge zur Erweiterung der wissenschaftlichen Literatur als auch pragmatische Empfehlungen für Unternehmensvertreter zur Optimierung ihres After-Sales-Geschäfts.

## **I Chapter – Introduction**

### **1. Relevance and motivation**

As a result of increased global competition, commoditization of primary products, and diminishing profit margins, the after-sales business has gained strategic importance for numerous companies across various industries. Accordingly, the perception of after-sales services has changed over the past few decades, from the traditional perspective of additional but necessary costs imposed exclusively by manufacturers (Lele, 1997) towards a potential source of competitive advantage and business opportunity (Armistead & Clark, 1992; Wagner & Lindemann, 2008). Due to increased awareness of the strategic value of service, firms are beginning to shift focus to aftermarkets. The after-sales business has emerged as a major source of competitive maneuvering, so that firms strive for competitive advantages with their after-sales service offer. Consequently, more manufacturers are shifting their emphasis from original products sales to customer needs; customers find value in the trouble-free operation of products. After-sales services enhance product availability during the entire product life cycle and are key to long term company success. Users require after-sales services and assistance to help them gain maximum value from their purchases to the point that primary product purchase decisions may no longer be solely based on the product's value (performance relative to cost) but also on the service price, quality, and portfolio available to support the use of the product. Thus, after-sales services maximize the value extracted by customers over the entire product life cycle (Goffin & New, 2001).

With the presence of a valuable aftermarket an incentive is created for competition. In the meantime this attractiveness of the after-sales business containing services and spare parts is recognized by further parties (e.g. competitors, suppliers) who are trying to gain a share of the aftermarket. The lucrative business division of Original Equipment Manufacturers

(OEMs) is increasingly under attack by suppliers and various competitors. For a long time, the aftermarket was the proprietary cash cow of the OEMs, and was strictly off-limits to the suppliers. Due to various reasons, more and more suppliers are trying to gain aftermarket shares, and have made the strategic decision to offer their services directly to the end customer. Hence, a highly profitable aftermarket creates a large incentive for the supplier to disintermediate the established supply chain and sell directly to the OEM's aftermarket customers.

Several definitions of after-sales services can be found and various terms are used throughout scientific literature. Synonyms for after-sales services include customer support, product support, technical support, and service. The definitions differ with respect to both the extension assigned to the concept of after-sales and the role within the firm's value chain.

Table 1 summarizes previous definitions of after-sales services.

Table 1: Definitions of after-sales services

<b>Author</b>	<b>Definition</b>
(Rigopoulou, et al., 2008)	“As a term, after-sales services has been used the most, to describe services that are provided to the customer after the products have been delivered.”
(Cavaliere, et al., 2007)	“[...] after-sales service, traditionally confined temporally as taking up those activities occurring after the purchase of the product and devoted to supporting the customer in the usage and disposal of the goods.”
(Saccani, et al., 2007)	“[...] after-sales services for manufactured goods encompass the set of activities taking place after the purchase of the product, devoted to supporting customers in the usage and disposal of goods.”
(Morschett, 2006)	“Industrial customer service encompasses all services offered by a manufacturing company to support the sales of their manufactured goods, e.g. maintenance or provision of a hotline. [...] Industrial customer services encompass a wide spectrum of activities. If services are provided post product purchase, they are called AS [after-sales service]. Included are warranty services, maintenance, repairs, user training etc. In most instances, these are services which enhance the productivity and efficiency of the good being sold.”
(Johansson & Olhager, 2004)	“The supply of after-sales services, including tangibles such as spare parts and consumables, related to the maintenance of industrial goods.”
(Urbaniak, 2001)	“Customer service can be defined as those activities that enhance or facilitate the role and use of the product.”
(Asugman, et al., 1997)	“[...] AS [After-sales service] is defined as those activities in which a firm engages after purchase of its product that minimize potential problems related to product use, and maximize the value of the consumption experience.”
(Ehinlanwo & Zairi, 1996)	“[...] after-sales service [...] would be defined as “all activities geared towards maintaining the quality and reliability of the car carried out after the customer has taken delivery with the goal of ensuring customer satisfaction.”

Building on the existing definitions, this work defines after-sales services as the sum of activities taking place after the purchase of a product which

- ensure that a product is available for trouble-free use over its useful life span and guarantee the continuous availability of goods (preventive maintenance)
- replace failed products in a timely and cost-effective manner (reactive maintenance)
- create competitive advantage for the customer (value added services).

Traditionally, after-sales services consist of spare parts management, maintenance, and repair activities. However, as its role has changed during the last decades, after-sales services have grown to encompass other services such as product installation, commissioning, training, consultancy, instructions, documentation, product upgrading and modification, diagnosis, inspections, software patches, warranty schemes, phone support, complaints management, returns management, financing, operating models, leasing, etc. (Patelli, et al., 2004).

After-sales management comprises the configuration, organization and realization of after-sales services (Boyt & Harvey, 1997; Saccani, et al., 2007).

Several studies have recently investigated the increasing strategic importance of after-sales services for various firms, like manufacturers, service providers, or spare parts producers. Within the scope of this dissertation, the following potentials are perceived to be the most important:

**Customer satisfaction.** After-sales services can create sustainable relationships with customers and contribute significantly to customer satisfaction (Kurata & Nam, 2010). By offering different after-sales services during the various stages of the primary product lifecycle, the provider can ensure product functionality and thereby customer satisfaction. This may lead to a fruitful relationship between the provider and the customer over time, allowing for more transactions (Ahn & Sohn, 2009). Returning customers are the most profitable ones as they require less marketing effort and relationship building (Hoffman & Bateson, 2010; Jacob & Ulaga, 2008). Therefore, after-sales services have acquired a critical



role as a means to satisfy and retain customers. Especially in a time when firms are experiencing increased pressure to downsize operations and to become more highly specialized in their core competencies, they demand more tailored services (Weissenberger-Eibl & Koch, 2007).

**Differentiation / Competitive advantage.** After-sales services have emerged as a major source of competitive maneuvering, so firms strive for competitive advantages with their after-sales service portfolio to differentiate offers from competitors (Goffin, 1994; Slater, 1996; Wilson, 1999). After-sales services are an important marketplace differentiator because primary products are often physically comparable. Services, however, are much more difficult to imitate and thus become a competitive advantage (Heskett, et al., 1997). Customers no longer demand just a product but also a comprehensive solution for their problem; they are increasingly moving away from requesting a specific product to requesting a certain service package (including the original purchase and all aftermarket needs) instead (Raddats, 2011). Hence, services significantly enhance the value of the product to its users, so customers may decide to purchase a product based upon service and aftermarket considerations. Furthermore, excellent service may enhance the success rate of new products (Cooper & Kleinschmidt, 1993; Goffin & New, 2001)

**Profit.** After-sales business provides a huge revenue source and has recently increased to offset profitability declines in primary product sales (Quinn, et al., 1990; Wise & Baumgartner, 1999). The aftermarket can be four or five times larger than the primary product market over a product's full life cycle (Bundschuh & Dezvane, 2003; Knecht, et al., 1993). Moreover, the after-sales business can contribute up to thirty percent of corporate revenue, and far exceeding the profit margins generating by the sale of original primary products particularly due to the lower price sensitivity of after-sales services (Alexander, et al., 2002; Anderson, et al., 1997; Craemer-Kühn, et al., 2004). This is because downtime costs may be high and the replacement costs of a machine frequently exceed maintenance costs. Further,

the market for after-sales services often runs countercyclical to the market for primary products in many industries. During times of economic prosperity, customers purchase usually more new machines, and, in recessions, customers instead opt to buy parts and service to maintain existing equipment. Hence, services provide a buffer against fluctuations in the primary product market (Kurata & Nam, 2010).

In summary, after-sales services stabilize long-term revenues, enhance customer satisfaction and retention, and provide an important strategic weapon in a competitive environment. Consequently, significant effort should be devoted to the strategic management and operational execution of after-sales services.

After-sales services pose unique management challenges. The provision of after-sales services and spare parts is often characterized by great timeliness, low volumes, high demand variability, and complex distribution network. Especially the product life cycle plays a crucial role. Thus, after-sales requirements should be considered during product R&D to ensure cost-efficient, tailored after-sales services. The service period is typically much longer than the production period of the primary products, so challenges due to long term planning arise. Due to heavy fluctuations in servicing and demand for spare parts, accurate demand forecasts are difficult to perform.

A major focus of this dissertation (Paper II and III) is on the relationship constellations between the players in aftermarkets. Aftermarkets (secondary markets) can be defined as markets for complementary products (secondary products) which are usually purchased subsequent to the purchase of another, related product (primary product) (Carlton & Waldman, 2010; Coppi, 2007; Shapiro, 1995). Hence, aftermarkets are characterized by: (1) purchase of components at different times (e.g. machine first, spare parts later) and (2) complementary components (the aftermarket product is used together with a primary product). The main players in aftermarkets which are relevant to this research are OEM, supplier, customer, and competitor. OEMs are the producer of a primary product. Suppliers

deliver parts to OEMs but might operate with direct customer contact in aftermarkets. Customers who have bought a primary product from the OEM later require after-sales services. Competitors are rivals to the OEMs and suppliers and offer quite different after-sales service portfolios.

To understand the development of aftermarkets and success factors in these markets, the broader context in which the individual firm operates must be taken into account. Most firms are interconnected and interdependent on other firms (Håkansson & Ford, 2002; Håkansson & Snehota, 2006). Too often, a firm evaluates and manages its business in the belief that the firm exists in isolation (Dubois & Fredriksson, 2008). Successful firms should analyze their situation and market position in terms of relationships and connections within the relevant market; firms are co-dependent on other firms' actions (Ahuja, 2000). The way two firms work with each other (e.g. competition vs. cooperation) has strategic importance to the other firms in the network. Network awareness helps firms to efficiently observe the aftermarket and identify future concerns and opportunities (Newman, et al., 2006). Therefore, the aftermarket players should invest their time and energy to ensure a long-lasting, stable relationship with customers throughout the entire product life cycle. Some firms protect their aftermarkets and try to lock-in customers by building barriers associated with high switching costs. Examples of such interdependencies of players in aftermarkets abound. In the automobile industry, OEMs use patents and copyrights to hinder independent repair and service competitors' access to technical interfaces, software, documentation, and other aftermarket technologies. In the automated teller machine (ATM) market, new encryption standards require the replacement or retrofitting of existing ATMs and restrict competing aftermarket providers' access to the software and security necessary to service next generation ATMs.

The first part of this introduction has been devoted to drawing “the bigger picture” of what this dissertation will be concerned with, and to defining some of the basic concepts that will be used.

## **2. Research objectives**

An increasing number of firms have identified the potential of the after-sales business but do not have adequate strategies and tools for aftermarkets. This thesis develops through a theory-building approach new concepts for after-sales management, and the structuring of relationship constellations in aftermarkets. Despite after-sales business increased relevance in the industry, there is a gap in scientific literature on after-sales management and aftermarkets (e.g. Ashenbaum, 2006; Asugman, et al., 1997; Legnani, et al., 2009). Whereas most previously published work concentrated on one or a few specific aspects of the after-sales management process (e.g. spare parts inventories), this thesis develops novel, comprehensive aftermarket strategies and models integrated within the wider context of relationship management. Thus, the overall understanding of after-sales management and aftermarkets is furthered.

The research question is of central importance for a dissertation, as it is not only part of the initiation of a research project, but also guidance through the whole research process. According to Punch (2009), a research question should contain five key elements. First, a clear direction for the research as an organizational element should be determined. Second, a clear distinction from other research endeavors should be established. Third, the right detail level should be chosen. Fourth, a reference or control system should be identified. Finally, required data should be collected.

This dissertation develops through theory-building new concepts and models in the field of after-sales management using empirical case study research. These concepts and models

have also a high practical benefit to support after-sales managers. In three separate scientific papers (Chapters II-IV), constituting the core of this thesis, the identified research gaps are addressed and the following three research questions covering different aspects of after-sales management are answered. Paper I focuses on aspects of spare parts logistics strategies and develops a three-step models for the configuration of a superior spare parts logistics strategy. Paper II and III have a focus on relationship constellation of different aftermarket players.

**Research question I.** An excellent spare parts logistics strategy enables manufacturers in the machine and plant construction industry to obtain high profit margins, longtime customer loyalty and the possibility to differentiate from competitors with similar primary products (Legnani, et al., 2009; Saccani, et al., 2007). The optimal utilization of these potentials requires a planned and structured strategic alignment of the spare parts logistics (Venkatraman & Camillus, 1984). Spare parts customers have high expectations in terms of delivery conditions and long-time availability of spares. Manufacturers are expected to fulfill these requirements during each of the product life cycle phases. Manufactures can achieve a competitive advantage if their spare parts strategy is aligned with the specific situation of the firm. However, in the past decades many firms in the mechanical engineering sector did not capitalize the latent potentials of the spare parts business in an adequate way and missed the opportunity to develop sustainable strategies for their after-sales sector.

Although strategic alignment is a top management concern, to our best knowledge no strategic framework has been developed for spare parts logistics so far. Prior research has focused mainly on adequate service portfolios for particular products, customers, or phase of product life cycle (Armistead & Clark, 1991; Cohen, et al., 2006; Frambach, et al., 1997; Lele, 1986; Loomba, 1998; Mathieu, 2001). Indeed, research on spare parts logistics strategies and the components of these strategies is limited. Exceptions are the works by Huiskonen (2001) and by Cavalieri, et al. (2008). The former analyzes the optimal supply chain structure

for different spare parts characteristics, such as criticality, specificity, demand pattern and value of parts, and concludes that spares on the continuum between standard and user-specific parts require different network structures, positioning of materials, responsibility of control and control principles. Hence, different spares require different spare parts logistics strategies. Cavalieri, et al. (2008) present a five-step decision-making model to develop a spare parts logistics strategy and then test its applicability with a case study.

In consequence of the described situation of manufacturers in the mechanical engineering sector and the lack of pertinent scientific literature, a three-step model which contains nine key components to configure a superior spare parts logistics strategy is developed in Paper I. This leads to the following research question I:

*QI: How to develop an optimal spare parts logistics strategy? (Paper I)*

- analyze the spare parts logistics of firms with varying levels of spare parts management professionalization
- identify and describe the main components of an effective spare parts logistics strategy in order to present a practical three-step model that allows after-sales managers to develop a superior spare parts logistics strategy for their firm
- present archetype scenarios of a well aligned spare parts logistics strategy

**Research question II.** The phenomenon of relationships and dependence between companies' business activities is of special interest in aftermarkets. Because of the importance of the after-sales business both in establishing a firm's competitive advantage and in sustaining profitability, firms should be aware of the activities and actors on their aftermarket. Firms increasingly realize that their network in aftermarkets (with suppliers, competitors, customers, etc.) is critical to their success (Uzzi, 1996; Zaheer & Bell, 2005). Nevertheless, many firms do not systematically analyze these relationship constellations nor their influence

factors and implications. Although, firms which successfully manage their business relationships are the ones with superior performance.

What happens to the relationship-constellation at the transition from the primary product market to the aftermarket? To answer this question, we will analyze constellations in triadic and tetradic relationship on aftermarkets. Certainly, these triads and tetrads might be embed into complex and extensive networks, but triads and tetrads are the fundamental building block of networks, and if we understand interactions and relations in triads and tetrads, we will be able to understand the whole network (Carrington, et al., 2005; Grandori & Soda, 1995). Considering three or, respectively, four parties and their relationships among each other will take us toward the network view of after-sales relationships, and will help us attain a better understanding of the real and complex relationships in aftermarkets. If we add more than four network parties (e.g. further competitors or suppliers), into our analysis, we will not gain more or better knowledge about the interactions and relationships in aftermarkets. By doing so, the fundamental situation of investigation does not change, and no novel relationship constellations arise which might be interesting for our research purpose.

In spite of the increasing relevance to current business practice, there have been relatively few systematic research projects on the subject of relationship constellations in aftermarkets to date. The focus of prior research has been either on relationship constellations (e.g. Choi & Wu, 2009; Wu & Choi, 2005) or solely on aftermarkets (e.g. Borenstein, et al., 1994; Carlton & Waldman, 2010); the combination of both has not yet been addressed. Hence, Paper II attempts to close this research gap by identifying and analyzing triadic and tetradic relationship archetypes in aftermarkets through the lens of social network research. This leads to the research question II:

*QII: Which triadic and tetradic relationship constellation archetypes exist in aftermarkets? (Paper II)*

- investigate aftermarket relationships from the perspectives of OEM, customer, supplier and competitor
- derive five triadic and twelve tetradic relationship archetypes from our case study research
- analyze relational dynamics in each archetype

**Research question III.** To understand aftermarkets and their success factors, the interactions and activities of firms should not be analyzed in isolation, but must be considered in a wider context (Dubois, 1998; Håkansson & Ford, 2002). The success of a firm in aftermarkets depends on how the specific market structure is addressed, the behavior of other market players, and the types of relations between them (Carlton & Waldman, 2010). Each firm is locked into a complex network of interdependent relationships. A firm's strategic position can be affected by rival and partner firms' strategic choices. Clearly, understanding how the determinants of a particular market structure work, and aligning the competitive strategy to that aftermarket structure has become the critical factor of a firm's success (Håkansson & Snehota, 2006). Therefore, to understand sources of profitability and competitive advantages, a firm must know and consider the determinants influencing the competitive structure of aftermarkets. These determinants can be classified into intra-firm, intra-network and external. Depending on the characteristics of a particular determinant, different types of relationships arise between players and the resulting market structure can be reasonably anticipated.

Nonetheless, little attention has been devoted by scientific and managerial literature to this topic. There is still a huge gap between the high importance of the after-sales business for an increasing number of firms, and the scientific literature dealing with aftermarkets and the strategic positioning of its players. In particular, to the best of our knowledge, no publication exists to date which investigates the determinants of certain aftermarket structures. In Paper



III, we seek to expand the existing knowledge of aftermarkets and close this research gap by analyzing which determinants and characteristics leads to certain relationship constellations on aftermarkets, and thus to a specific market structure. This leads to the research question III:

*QIII: What are the main determinants of relationship constellation formation in aftermarkets and how do these determinants define relationship types between the market players and influence the subsequent market structure? (Paper III)*

- identify and examine determinants, in the categories intra-firm, intra-network and external, which influence relationship constellations, and hence the competitive conduct on aftermarkets, which can be used to anticipate aftermarket formations and the competitive conduct of the players in those markets
- give recommendations to the players in the aftermarkets for their strategic positioning, and suggest approaches to managing the relationships from different perspectives

### **3. Research design**

This thesis is a cumulative dissertation which contains three scientific papers. For all three papers I have chosen the research methodology, collected and analyzed the empirical data, developed theoretical concepts and models and wrote the scientific articles by myself. With the support of my co-authors (Professor Wagner, Professor Eisingerich and Professor Hadjiconstantinou) I further improved and revised the articles. Hence, the whole creation phase of the articles has been conducted independently by myself and my co-authors supported me during the improvement phase of the articles. Each paper has its own research goal, datasets, specific focus and consequently different results. The papers have in common the same research methodology, namely case study research. The thesis is structured into four chapters. Chapter I comprises this introduction section. Three self-contained essays (Chapters

II-IV) make up the body of this research. Each contains a literature review, methodology section, presentation and discussion of results, and a conclusion.

The thesis relies upon multiple theories to answer the research questions (Teddlie & Tashakkori, 2009). Strategic alignment (Chapter II) and social network research (Chapter III and IV) are the theoretical basis for this work. The multiple theory approach enables analysis of the research questions from different standpoints and thus yields different insights.

Strategic alignment is the adjustment of an object (e.g. after-sales strategy) in relation to other objects (e.g. corporate strategy) which seeks to improve performance results and further competitive advantage (Bergeron, et al., 2004; Ciborra, 1997; Slagmulder, 1997). As part of strategic planning, strategic alignment ensures that personnel, products, processes and systems support the business objective. The formulated strategies should be aligned with the internal capabilities of a firm and the external opportunities and threats of the firm's environment (Joshi, et al., 2003). The optimal fit between external positioning and internal arrangements enhances the firm's performance (Bergeron, et al., 2004; Kefi & Kalika, 2005). The concept of strategic alignment is used in this dissertation to develop a process model for a spare parts logistics strategy.

The second theory concept applied in this thesis, social network research, focuses on interactions, behaviors and interdependencies between individual actors (Tichy, et al., 1979; Wasserman & Faust, 1994; Wellman, 1983). The roots of this theory are empirical observations that focus on discovering patterns of interactions among actors (Cook & Whitmeyer, 1992; Scott, 2000). Relationships and interdependencies between actors determine individual decisions and build the resulting network and market structure. The structure of a network in which an actor is embedded and the position in the network determine significantly its opportunities, constraints, and behaviors (Lin, 2001; Wasserman & Galaskiewicz, 1994). Hence, each actor should aim for a superior market position, maintain its relationships properly, and perceive embedment as a social asset (Lin, et al., 2001). Social

network theory is used in this thesis because it enables the study of individual actors embedded within the wider networks and markets (Brass & Burkhardt, 1993; Burt, 1995; Uzzi, 1997; Walker, et al., 1997).

The research design of this dissertation was chosen in a way that answers the research questions as accurately as possible while appropriately considering the existing knowledge on the subject (Bordens & Abbott, 2002; Creswell, 2008; Vaus, 2012). This thesis with research in applied social sciences, uses theory-building through empirical research to provide contributions to problems in practice, by delivering solutions applicable to corporate reality. Thus, an inductive, applied research approach is selected. According to Miller and Salkind (2002) applied research should follow a structured approach including four steps: (1) identification of the problem in practice, (2) assessment of existing theories in research, (3) development of models and solutions for the identified problems, and (4) validation of models and support in practical applications. Based on these steps, the research presented in this dissertation fulfills the following criteria:

**Industrial relevance.** The previous chapter (1. Relevance and motivation) shows that after-sales management currently represents an important issue in industry.

**Clear positioning and complementing of existing research.** Each essay of this dissertation contains a comprehensive literature review and identifies gaps, thus aligning the research goal with pre-existing research.

**Novelty.** To the best of the author's knowledge, the spare parts logistics strategy model (Chapter II), the establishment of relationship constellation archetypes in aftermarkets (Chapter III), and the analysis of determinants in aftermarket structure formation (Chapter IV) are untapped research fields and have not yet been sufficiently studied.

**Systematic approach.** Research questions are formulated and an appropriate methodology is selected based on industry needs and gaps in academic literature. Models are developed and archetypes are identified based on empirical case studies.

A theory-building approach based on case study research methodology is used within this dissertation (Stake, 1995; Yin, 2008). According to Kubicek (1975) and Eisenhardt (1989), case studies are best for the very early stages of research. Case studies allow collection of relatively detailed data, enabling a deep understanding of contextual factors grounded in data (Ellram, 1996; McCutcheon & Meredith, 1993; Stake, 1978). Thus, case studies allow the study of phenomena in their context (Flyvbjerg, 2006; Yin, 2003).

A single case study would have limited the generalizability of this dissertation's results (Glaser & Strauss, 1967). Thus, a multiple case study approach was employed in which several firms from different industries in Germany and Switzerland were selected as a sample. When selecting a case study methodology, the study must be carefully constructed to ensure sufficient rigor (Gibbert, et al., 2008). With these concerns in mind, this study was designed in three stages:

- 1. Preliminary contacts.** After-sales and service managers from several firms in different industries were identified and contacted by letter. The respondents were selected because they were recognized as being knowledgeable about after-sales strategy and the business models of their respective firms. The agreement to participate in the research was obtained by nearly sixty percent of the contacted managers. During a telephone call, the managers were informed about the research objective, and a preliminary understanding of the after-sales management of the particular firm was obtained.
- 2. Company visits.** All data was gathered in visits to firms in 2009 and 2010. The semi-structured interviews with one to three interviewees took between two and four

hours each. Every interview was recorded for later transcription, and detailed notes were taken. Further, direct observations (e.g. factory tours) and analysis of secondary sources (e.g. company documentation, corporate websites, and specialized press) was conducted. Use of different data sources and several informants allowed for triangulation to check the internal consistency of data (Voss, et al., 2002).

**3. Data analysis and post-visit contacts.** After completion of all interviews, in a first step a within-case analysis was conducted, followed by a cross-case analysis involving the case study firms. The data analysis was conducted in three steps following the recommendations of Miles and Huberman (1994). First, after each interview, a preliminary analysis was conducted during which the data was validated using triangulation and then reduced. Then, the summarized interviews were submitted to the interviewees and checked by them. Third, cross-case analysis was conducted to identify the main differences and common behaviors amongst the case study firms.

#### **4. Summaries of the papers**

##### **4.1 Paper I: A strategic framework for spare parts logistics**

Strategically aligned and efficiently implemented spare parts logistics can differentiate a business from its competitors, lower costs, increase revenues, and thus help firms generate greater value for consumers and ultimately increase profits. Based on multiple case studies with manufacturers in the machine and plant construction industry, this research examines the key components of a superior spare parts logistics strategy. The study suggests that an efficient spare parts logistics strategy can be developed with a three-step model that consists of nine components.

## **4.2 Paper II: Relationship archetypes in aftermarkets**

Aftermarket sales and profits have become an increasingly important part of an OEM's business model. The attractiveness of the after-sales business containing services and spare parts, however, has also been recognized by other parties (e.g. competitors, suppliers) who try to capture a share of the aftermarket. A highly profitable aftermarket creates a strong incentive for the supplier to disintermediate the established supply chain and sell directly to the OEM's aftermarket customers. Because of the importance of the after-sales business both in establishing a firm's competitive advantage and in sustaining profitability, firms should be aware of the activities and actors on their aftermarket. Nevertheless, many firms systematically analyze neither these relationship constellations nor their influence factors and implications and studies examining the aftermarket in the context of relationship constellations are lacking. In this paper, our goal is to examine triadic and tetradic relationships constellations (archetypes) in aftermarkets. To develop the relationship archetypes, we use social network theory, and in particular the concepts of structural hole, structural embeddedness and supply chain disintermediation, as well as case study research with a sample of twenty-nine companies belonging to one of the four market players' perspectives (OEM, supplier, customer or competitor). We identify and discuss five triadic and twelve tetradic archetypes of aftermarket relationship constellations. Each type of relationship is a unique configuration of relational characteristics.

## **4.3 Paper III: Determinants of relationship constellation formation in aftermarkets**

For an increasing number of firms, aftermarkets are acknowledged as a rich source of revenue, profit and customer loyalty. The lucrative business division of OEMs is increasingly under attack by suppliers and various competitors. The success of a firm in those markets depends on how the specific market structure is addressed, the behavior of other market

players, and the types of relations between them. Each firm is locked into a complex network of interdependent relationships. Clearly, understanding how the determinants of a particular market structure work, and aligning the competitive strategy to that aftermarket structure has become the critical factor of a firm's success. Nonetheless, little attention has been devoted by scientific and managerial literature to this topic. We aim to fill this gap by conducting an explorative empirical study, involving twenty-nine firms from various industries. The theoretical framework for our research is the social network theory and relationship research. We identify eight main determinants, in the categories intra-firm, intra-network and external, which are responsible for the formation of a particular aftermarket structure. The empirical findings show that, depending on the characteristic of a determinant, different relationship types between the aftermarket actors arise. We also present recommendations for each of the aftermarket players (OEM, supplier, customer and competitor), for their respective strategic positioning. Finally, we point out the need for further studies in this area.

## **5. Theoretical contributions**

This thesis develops through a theory-building approach based on empirical research novel concepts and models, contributes to the theoretical understanding of after-sales management, and adds to the academic debate on the fields of operations management and logistics. These models lend unique insights into spare parts logistics, after-sales services, and competitive conduct in aftermarkets. The specific findings and research implications are discussed in detail in Chapters II-IV. For this reason, this introduction section contains a concisely summary.

First, strategic alignment is employed to construct a novel, integrated three step model to harmonize spare parts logistics with a firm's specific situation and external market conditions. This model fills a gap in scientific literature; existing studies in the field of after-

sales service strategies focused mainly on adequate service portfolios for specific products, customers, or phases of the product life cycle (Armistead & Clark, 1991; Cohen, et al., 2006; Frambach, et al., 1997; Lele, 1986; Loomba, 1998; Mathieu, 2001). Various publications in the field of spare parts logistics and management restricted their scope to one or a few of the constituent components of a spare parts logistics strategy - especially inventory management (e.g. Axsäter, 1993; Bailey & Helms, 2007; Dekker, et al., 1998; Schultz, 2004; Teunter & Klein-Haneveld, 2002; Tysseland & Halskau, 2007).

Second, through the lens of social network research, triadic and tetradic relationship constellation archetypes are identified in aftermarkets using an empirical study. In essence, an analytical framework of relationship constellations unveils the overall market network structure in which the individual market players are embedded. This specification of archetypes constitutes an important step in theory building endeavour (Boyer, et al., 2000; Cook, et al., 1999; Doty & Glick, 1994; McKinney, 1966; Wacker, 2008). Archetypes abstract complex social phenomena based on empirical investigation and existing knowledge (Meyer, et al., 1993). Each archetype analyzed in this dissertation presents one part of a complete aftermarket configuration. Hence, knowledge of relationship constellation archetypes enables the determination of market structures and affords superior control of competitive positions within the market. Each player should understand how relationships between involved parties can potentially influence competitive advantage. In this dissertation triads consisting of supplier, OEM, and customer as well tetrads with an additional competitor are considered. Hence, interactions and interdependencies of single firms with single firms, single firms with multiple firms, and multiple firms with multiple firms are analyzed. In this regard triads and subsequent tetrads form the building blocks of larger networks and determine the resulting market structure. Previous literature in the field of relationship archetype research investigated only either dyadic (e.g. Asanuma, 1989; Carr & Pearson, 1999; Ellram & Hendrick, 1995; Ganesan, 1994; Grover & Saeed, 2007; Saeed, et al., 2005)



or triadic (Choi & Wu, 2009; Choi, et al., 2002; Li & Choi, 2009; Wu, et al., 2010) relationship types, mainly between suppliers and buyers. To the best of the author's knowledge, no publication previously existed which investigated relationship archetypes in aftermarkets. In particular, the dynamics in the transition from the primary product market to the aftermarket represents a novel research subject. The potentially arising interaction between a customer and a supplier, which have been strictly separated by an OEM in the primary product market, and their influence on the OEM and a further competitor are in the center. Hence, this dissertation enriches substantial network and relationship research.

Third, this research is one of the first attempts to theorize intra-firm, intra-network, and external determinants in aftermarket structure formation. Depending on the characteristics of each determinant, different relationship constellations between aftermarket players arise. If the types of relationships between the players are known, it is possible to predict the resulting aftermarket structure. Thus, knowledge of the determinants within a particular market structure should enable firms to develop an optimal after-sales strategy and improve market positioning. Again, a dearth of literature, mostly consisting of discussion of the economics of aftermarkets in legal publications (Bauer, 2007; Borenstein, et al., 1994; Carlton & Waldman, 2010; Coppi, 2007; Shapiro & Teece, 1994), existed on this topic. Thus, this thesis' exploratory empirical research promotes the analysis of relationship networks in the field of after-sales management research for the first time.

## **6. Practical implications**

The research results presented in this dissertation provide significant implications for practitioners. As the practical implications will be discussed in detail in each chapter, a summary of major implications is given here.

Practitioners have established consensus that after-sales management does and will continue to play a major role in business. At the same time, the empirical research in this dissertation shows that after-sales management in the firms under study has a very different level of professionalization, although all firms agree that the after-sales business is important. This observation is independent of the specific industry. Hence, a significant difference exists between the relevance of the after-sales business for firms and the level of professionalization. Moreover, existing tools and models for sales managers are insufficiently developed in scientific literature. The findings of this dissertation help to fill this disparity between the increased relevance of after-sales management in practice and the dearth of available after-sales strategies based upon systemic theoretical frameworks.

An important empirical observation is that many firms operate their spare parts business ineffectively without a clear strategy. This is surprising as the majority of these firms indicate the spare parts business as an important business segment of the entire firm. This dissertation provides managers with a simple three step model to develop a superior spare parts logistics strategy. Managers are guided through the key components of a spare parts strategy. First, the firm's current situation is assessed. Then, future developments are forecasted. Finally, the strategy is aligned with the firm's current situation and forecast's results.

Managers can use the findings regarding relationship formation in aftermarkets to position their own firm within the market. An after-sales manager must be aware that what takes place between other market players might have a direct effect on the operations of their own business. Thus, knowledge of relationship constellation archetypes and determinants of aftermarket structure are necessary to achieve competitive advantages. The results of this research help managers to identify and analyze the significant differences of relationship constellations between the primary product and after-sales business. Further, the determinants of a specific aftermarket structure are identified. With these findings, managers can anticipate future market developments and control the competitive conduct and intensity by establishing

different relationship types (e.g. cooperation or collusion) with other aftermarket players. The empirical findings of this dissertation should help managers to operate their after-sales business activities in an integrated manner, taking into account other market players and the overarching market structure.

## **7. Limitations and future research**

This dissertation sets forth significant groundwork for theory-building in the research fields of after-sales management and aftermarkets. Although valuable recommendations are put forward, there is ample room for further research due the limitations of the approach used in this work. First, as with all empirical research, the conditions under which the data was gathered and analyzed must be critically considered. The case study approach has inherent disadvantages (Darke, et al., 1998; Eisenhardt, 1989; Ellram, 1996; Yin, 2008). One major disadvantage of case study research is a lack of external validity, leading to idiosyncratic theories which are not generalizable.

Despite the use of multiple case studies and data triangulation, the findings of this dissertation are derived from a limited number of cases in German and Swiss firms. Although restriction to two countries allowed the assumption of homogeneous cultural, political, economic, and environmental operating conditions (Hofstede, 2003), further empirical (quantitative) research should aim to generalize the results in a more normative manner. To empirically test the validity of the results, future researchers should collect large samples in more countries, investigate similar research questions, and compare their results with this study.

The frequency and order of the dissertation's results should be quantified in future research. In Chapter III, archetypes of relationship constellation in aftermarkets are analyzed,

but the frequency of appearance of each archetype is not quantified within a large sample. The determinants in Chapter IV should be assessed and classified according to their relevance.

The analyzed case studies are drawn from a static background since the time dimension is missing. If the time dimension is added, additional effects can be analyzed. This leads into the field of network dynamics (Hall, 2000; Newman, et al., 2006). Most companies operate in a changing environment and there is a need to manage change within and through relationships. The analysis of interconnectedness between relationships over time is a challenging research topic.

Future studies should incorporate alternative theoretical approaches. This dissertation utilizes multiple theories. However, other theories could lend additional insight on after-sales management, particularly through analysis from a dynamic perspective rather than the presented static analysis. This could be accomplished using long term observations and would extend the results of Chapters III and IV to include network dynamics (Nagurney & Matsypura, 2005; Newman, et al., 2006).

In summary, this dissertation should be considered as a point of departure for future research due to its novel insights and models which are specifically applied to create a strategy for the spare parts logistics. The identification of relationship constellations in aftermarkets offers a generalizable theoretical construct to optimize capitalization of after-sales business.

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## II Chapter – A strategic framework for spare parts logistics

### 1. Introduction

Firms with a well aligned spare parts logistics strategy can add value for their customers beyond primary product benefits, thus building long-term customer loyalty and achieving high profit margins (Johansson & Olhager, 2004; Khandpur & Laub, 1997; Saccani, et al., 2007; Toffel, 2008). Firms across different industries now recognize spare parts supply not only as a legal obligation but also as a chance to offset stagnating or declining revenues and to increase profits in their primary product markets. For instance, the after-sales business in the machine and plant construction industry accounts for approximately 25% of total sales (with two-thirds from selling spare parts and one-third from services) and up to 50% of total profits (Bundschuh & Dezvane, 2003; Cohen, et al., 2006; Dennis & Kambil, 2003; Knecht, et al., 1993; Minahan, 2003; Wise & Baumgartner, 1999).

Drawing on Christopher's (2005) definition of logistics, we define spare parts logistics as follows: *Spare parts logistics of the manufacturer contains the market-orientated planning, design, realization and control of the spare parts supply and distribution, and associated information flows within a firm and between the firm and its network partners.* Therefore, spare parts logistics aims at a demand-driven, cost minimal provision of the required spare parts for the defective or preventive maintenance of primary products to ensure an optimal level of availability or reliability of the product.

Spare parts customers have high expectations in terms of the delivery of service and long-time availability of spares. Manufacturers are expected to fulfill these requirements during each of the three product life cycle phases: R&D, production, and utilization of the primary products. To do so, phase-specific characteristics have to be considered by the manufacturers. Furthermore, the primary product market is characterized by longer technical

product life cycles on the one hand and by shorter cycles for product innovation and production on the other. The consequence of these developments for the spare parts supply is the escalating complexity of spare parts assortments. Furthermore, the legal and facultative spare parts delivery commitments of the manufacturers exceed the production phase by multiples (Anon, 1996).

The demand for spares is characterized by fluctuations and volatility. It is affected by stochastic factors, such as intensity of product use, wear behavior, failure rates, or type of maintenance (Tavares & Almeida, 1983; Watson, 1987). Manufactures can achieve a competitive advantage if their spare parts strategy is aligned with the specific situation of the firm. A strategic planning and alignment of spare parts logistics is thus necessary for the following reasons:

- Changes in the primary product markets (global competitive pressure; technical equalization of products) (e.g. Wagner & Lindemann, 2008)
- Rising cost awareness (low capital lockup; more efficient inventory management) (e.g. Saaksvuori & Immonen, 2010)
- Unutilized potentials (high profit margin; long-time customer loyalty) (e.g. Cohen, et al., 2006)
- Intensive competition in the spares markets (many market actors; spares imitations) (e.g. Carlton & Waldman, 2010)
- Rising customer expectations (short lead times; long-term availability of spares) (e.g. Legnani, et al., 2009)

Although strategic alignment is a top management concern, to our best knowledge no strategic framework has been developed for spare parts logistics so far. Given the challenges and potential benefits of spare parts management, the goals of this research are (1) to analyze the spare parts logistics of firms with varying levels of spare parts management

professionalization, (2) to identify and describe the main components of an effective spare parts logistics strategy in order to present a practical three-step model that allows after-sales managers to develop a spare parts logistics strategy for their firm, and (3) to present archetype scenarios of a well aligned spare parts logistics strategy. To address these points we conducted an in-depth case study analysis, using detailed interviews with 10 different firms from the manufacturing industry.

This article is structured as follows: Section 2 reviews the current body of literature. Section 3 describes our methodological approach. In section 4 we present our case study findings. A three-step model with nine components for the development of spare parts logistics strategy as well as archetypes of optimally aligned strategies are presented in section 5. It concludes by offering avenues for future research.

## **2. Theoretical background**

Strategic alignment is the adjustment of an object in relation to other objects so that the arrangement can lead to the optimization of results (Van de Ven & Drazin, 1985; Venkatraman, 1989). Aligning an organization to its external environment requires forethought and proactive action. The concept of strategic alignment recognizes the need for any strategy to address both external and internal conditions. As part of strategic planning, strategic alignment ensures that products, processes, organizational structures, systems, and human resources support the business and organization goals. The fit between external positioning and internal arrangement is arguably critical for maximizing economic performance (Chan, et al., 1997; Reich & Benbasat, 1996). Strategic alignment also goes by the terms “fit” (Porter, 1996), “integration” (Weill & Broadbent, 1998), “bridge” (Ciborra, 1997), and “linkage” (Henderson & Venkatraman, 1992). However, in all cases, it concerns the integration of strategies in relation to the business and its environment (Venkatraman &

Camillus, 1984). We use the concept of strategic alignment as a theoretical framework for this research and apply it to the development process of a spare parts logistics strategy, which should be matched not only with corporate strategy, but also with company-specific and environmental factors. Alignment is operationalized in this study using nine key components of a spare parts logistics strategy. Figure 1 shows the different levels of a firm’s strategy and the arrows in the figure symbolize the need for strategic alignment. A spare parts logistics strategy constitutes a functional strategy.

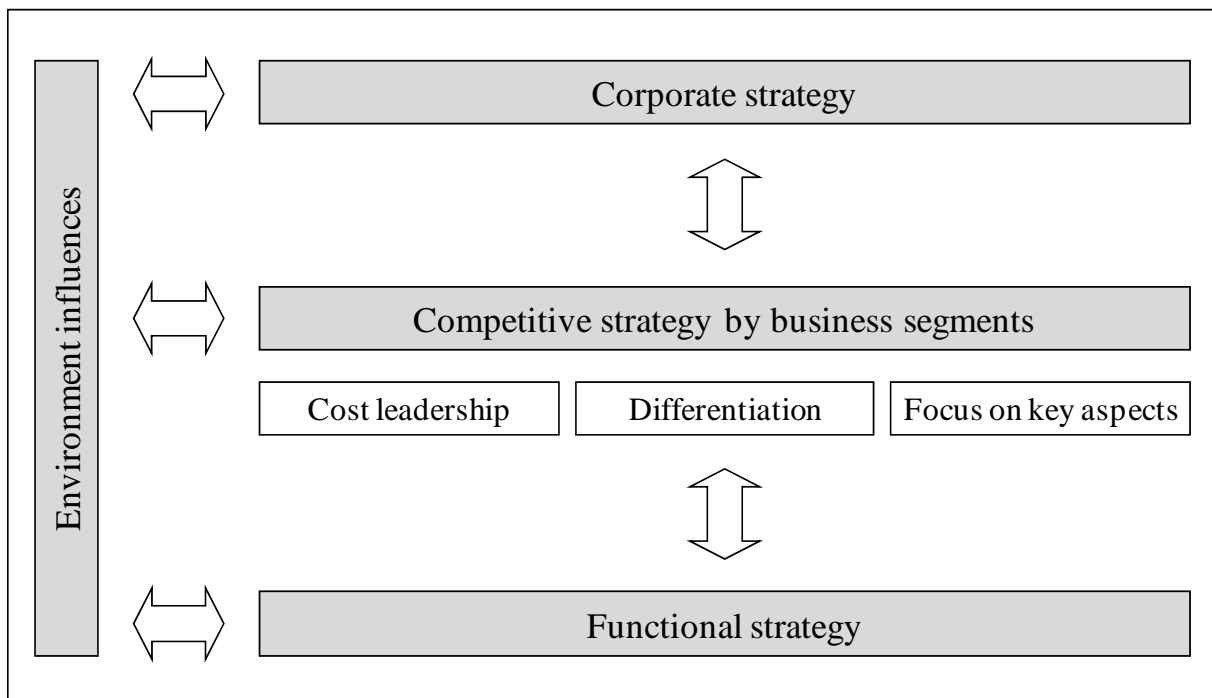


Figure 1: The concept of strategic alignment

Prior research has focused mainly on adequate service portfolios for particular products, customers, or phase of product life cycle (e.g. Armistead & Clark, 1991; Cohen, et al., 2006; Frambach, et al., 1997; Lele, 1986; Loomba, 1998; Mathieu, 2001; Tsai & Eisingerich, 2010). Indeed, research on spare parts logistics strategies and the components of these strategies is limited. Exceptions are the works by Huiskonen (2001) and by Cavalieri, et al. (2008). The former analyzes the optimal supply chain structure for different spare parts characteristics,

such as criticality, specificity, demand pattern and value of parts, and concludes that spares on the continuum between standard and user-specific parts require different network structures, positioning of materials, responsibility of control and control principles. Hence, different spares require different spare parts logistics strategies. Cavalieri, et al. (2008) present a five-step decision-making model to develop a spare parts logistics strategy and then test its applicability with a case study. A comprehensive literature review reveals that most prior research discusses a few specific issues and concentrates mainly on a single component. Nine aspects in particular have received considerable attention. However, no prior research deals with all of the strategy components that are relevant for spare parts logistics and the strategic aspects of spare parts logistics have been studied primarily in isolation. Table 2 presents an overview of the literature in the field of service management, after-sales services, after-sales logistics, maintenance management, and spare parts logistics. A holistic approach to strategy components of spare parts logistics that considers interdependencies among the components is just beginning to emerge, emphasizing the continuing need for research in this area. The present study develops a framework which includes the strategy components of spare parts logistics.

Table 2: Overview of literature

<b>Strategy components</b>	<b>Important publications</b>	<b>Main focus of the publications</b>
Spare parts market	(Ashenbaum, 2006; Baake, 2008; Stoate & Smith, 2005)	<ul style="list-style-type: none"> <li>• Restriction and monopolization tendencies</li> <li>• Competitive conduct</li> </ul>
Product characteristics (primary product / spare parts)	(Goffin & New, 2001; Huisken, 2001; Johansson & Olhager, 2004, 2006; Lele, 1986; Rose, et al., 1998; Saccani, et al., 2007)	<ul style="list-style-type: none"> <li>• Influence of primary product characteristics on spare parts supply</li> <li>• Influence of spare parts characteristics (criticality, specificity, demand pattern and value of parts) on spare parts supply</li> <li>• Product-service-frameworks</li> </ul>
Maintenance strategy of the customer	(Gopalakrishnan & Banerji, 2002; Jardine & Tsang, 2006; Kim, et al., 2007; Kim, et al., 2009; Orsburn, 1991)	<ul style="list-style-type: none"> <li>• Pros and cons of different maintenance approaches</li> <li>• Operator models</li> </ul>
Spare parts obligations	(Baake, 2008; Kim & Park, 2008; Orsburn, 1991)	<ul style="list-style-type: none"> <li>• Optimal warranty periods</li> <li>• Components which should be included or excluded from a warranty</li> </ul>
Primary product life-cycle	(Armistead & Clark, 1991; Aurich, et al., 2004; Dombrowski, et al., 2007; Shapiro, 1992)	<ul style="list-style-type: none"> <li>• Evaluation of spares supply alternatives in different life-cycle phases</li> <li>• Alignment of the spares provision to the primary product life-cycle phase</li> </ul>
Forecasting methods	(Patton & Bleuel, 2000; Patton & Feldmann, 1997; Willemain, et al., 2004)	<ul style="list-style-type: none"> <li>• Predicting spares demand by applying different forecasting methods</li> <li>• Classification and evaluation of different forecasting methods</li> </ul>
Goals of the spare parts business	(Cohen, et al., 2006; Dennis & Kambil, 2003; Knecht, et al., 1993; Wagner & Lindemann, 2008)	<ul style="list-style-type: none"> <li>• Insufficient capitalization of the after-sales business potentials</li> <li>• Approaches to better utilize the benefits of the spare parts business</li> </ul>
Supply options (production phase / utilization phase)	(Amini, et al., 2005; Dombrowski, et al., 2007; Fortuin, 1980, 1981; Rose, et al., 1998; Teunter & Fortuin, 1998, 1999; Teunter & Haneveld, 1998)	<ul style="list-style-type: none"> <li>• Analysis of supply strategies</li> <li>• Optimal final order quantities</li> </ul>
Inventory options	(Axsäter, 1993; Chang, et al., 2005; Cobbaert & Van Oudheusden, 1996; Dekker, et al., 1998; Kennedy, et al., 2002; Orsburn, 1991; Patton & Bleuel, 2000; Pinç & Dekker, 2011; Sarker & Haque, 2000; Sherbrooke, 1992; Teunter & Klein-Haneveld, 2002; TysseLand & Halskau, 2007; Zipkin, 2000)	<ul style="list-style-type: none"> <li>• Mathematical models to determine optimal stock-keeping levels and ordering policies</li> <li>• Analysis of storage options for spare parts</li> <li>• Obsolescence management</li> </ul>

### 3. Methodology

This research uses a multiple case-based research approach (Eisenhardt, 1989). Case study research is particularly appropriate where “research and theory are at their early, formative stages” (Benbasat, et al., 1987) as is the case for holistic spare parts strategies. We followed



the five-stage case study research process proposed by Stuart, et al. (2002), consisting of (1) the research question, (2) instrument development, (3) data gathering, (4) data analysis, and (5) dissemination.

The purposive sample consists of ten German machine and plant manufacturers. Machine and plant construction is one of Germany’s largest employers (~900,000 employees) and contributors to the country’s GDP (~5%). We followed the suggestion of Eisenhardt (1989) to study four to ten cases in order to achieve saturation. The firms in our case study range in size from SMEs to large enterprises. Table 3 provides an overview of the case study firms.

Table 3: Case study firms

<b>Firm</b>	<b>Main product</b>	<b>Revenues (million € 2009)</b>	<b>Number of employees</b>	<b>Spare parts revenues (million € 2009)</b>	<b>Length of the spares provision period (years)</b>
T1	Laser cutting machine tools	2,000	7,200	~500 (all after-sales services)	30-40
T2	Paper machines	550	2,600	20	60
T3	Compounding and extrusion systems	300	850	65	25-30
T4	Packaging machinery	20	150	~2	20
B1	Machines for asphalt conditioning	150	450	n.s.	5
B2	Water and wastewater valves	70	220	3.5	30
B3	Weighing and positioning systems	34	230	3.5	10
B4	Leveling machines and turnkey coil preparation lines	28	100	~2.2	15-20
B5	Conveyor technology and factory equipment	22	200	0.8	5-10
B6	Bandsaws	4	20	~1.2	15

Note: T1-T4 signify “top-performers”; B1-B6 signify “bottom-performers”.

We conducted semi-structured interviews with one or more spare parts or after-sales managers per firm, which enabled deep insights into the spare parts business, spare parts strategy, the development process of those strategies, and the strategy components considered (Mentzer & Kahn, 1995). In some cases the CEO took part in the interview, depending on his / her responsibility for the development of the spare parts logistics strategy. Each expert interview lasted approximately two hours. The interview guideline consisted of open- and closed-ended questions. Each interview was transcribed. In order to ensure internal consistency of the data, secondary data in the form of observation (e.g., company tours) and the analysis of secondary sources (such as company documentation, annual reports, corporate websites, specialized press) was obtained for each interviewed firm and these data were used to triangulate the interview data. That is, data triangulation was accomplished by having multiple respondents from different firms and through different sources of data, such as interviews, observation and documentation (Morse, 1991).

Data was analyzed employing an interpretative, hermeneutic examination (Ellram, 1996). Benefits of this technique are the consideration of circumstances, enabling an understanding of the situation within its own context. The process of data interpretation consisted of three activities (Miles & Huberman, 1994): (1) data reduction: selecting and aggregating raw case data; (2) data display: systematic and accurate assembly of the collected information; and (3) conclusion drawing: building constructs and logical chains of evidence.

#### **4. Spare parts logistics of the case study firms**

In the selection of case studies firms, we chose firms with highly professional spare parts logistics and others with underdeveloped spare parts logistics. Specifically, the underlying criteria for the classification of the firms were the existence of a well aligned spare parts logistics strategy and the consideration of a spare parts logistics strategy's nine key

components. Hence, we clustered our case study firms into the two categories; “top-performers” and “bottom-performers”. In so doing we sought to examine which components of a spare parts logistics strategy are taken into account by the top-performers and which shortcomings bottom-performers have, and to identify critical components that make up a successful spare parts logistics strategy. All top-performers considered all nine components (however, with different priorities) and provided an aligned spare parts logistics strategy, whereas the bottom-performers did not have a spare parts logistics strategy at all or the strategy was misaligned and firms did not consider all relevant components.

**The top-performers.** Four of our case study firms (T1-T4 in Table 3) belonged to this category. All of these firms have a dedicated after-sales department. The objectives of the spare parts logistics are clearly defined and the high attractiveness of this business is signified by an expansion of the spare parts business. Overall, the development of the spare parts logistics strategy is a well-planned process in which different scenarios are considered and reviewed.

“Customer needs have a high priority and customers can rely on an excellent spare parts service,” stated most of the interviewees in this group. The manufacturers practice intensive communication and consultation with customers regarding machine status, maintenance options, and intensity of utilization. “We are the partner of our customers throughout the life cycle,” commented one interviewee. Customer satisfaction surveys are carried out and customers’ willingness to pay is determined. A categorization of spare parts lists regarding criticality and wear characteristics is created for each customer (cost, benefit and risk consideration). Spares demand forecasting is realized using historical data, weighted-moving average, or future population trends. One interviewee put it as follows: “Based on the current situation, we try to anticipate future developments and align our spare parts logistics strategy onto these analyses.” Production costs of different spare parts supply options are calculated considering customer requirements and supply periods. Often manufacturers practice a

selective supply strategy depending on the product life cycle and use an equal parts strategy. All of the informants insisted that “the supply strategy should be aligned to the product life cycle and customer requirements. Thus, it is often necessary to change the supply option in the course of product life cycle.”

Supply and inventory options are coordinated with each other (e.g., what storage capacity is needed for final stockpiling, and which costs are associated with specific storage capacities). The manufacturers also calculate the availability and the costs of different inventory options, where availability has a high priority. The top-performers often have central storage and only fast-moving items are available at service locations and subsidiaries. Some customers also have spare storage space, primarily for frequently required wear parts. Selective storage is realized by criteria failure criticality and part value. The manufacturers try to manage long-term service contracts because they facilitate planning and a steady income flow. As one informant noted, “we always prefer a good and long-term customer loyalty to short-term profit opportunities.”

These top-performing firms possess a good knowledge of the spare parts market, competitors, and their strengths. “We observe the market very accurately and know the strengths and weaknesses of our competitors and the needs of our customers,” asserted one interviewee. The manufacturer points out competitive advantages such as high quality, knowledge, parts availability and experience. The greatest threats are spare-pirates and suppliers directly selling spares to customers. “In recent years the competition has increased dramatically in the spare parts business, especially since our suppliers often sell parts directly to the customer and inferior copied parts are offered in the Asian markets,” complained one after-sales manager who was interviewed. The manufacturers attempt to create market entry barriers through the incompatibility of parts and special knowledge.

**The bottom-performers.** The case study firms (B1-B6 in Table 3) that fall into this category have not defined clear objectives for their spare parts business and have no spare

parts strategy or their strategy is incomplete (because not all relevant components are considered) and misaligned. The potentials of the spare parts business are insufficiently exploited. A group of managers put it this way: “We are not satisfied with our spare parts business, because we recognize that we do not capitalize on huge profit opportunities.”

The sales and distribution department is often responsible for the spare parts business and there is no separate after-sales department. The spare parts business is handled partially by dealers. In most cases, customers initiate changes and store critical spares themselves to ensure availability. “Most of our decisions are made on the basis of intuition and gut feeling,” admitted most of the interviewees. Only limited preventive maintenance and service contracts are offered and often not adapted to the customer’s specific needs. Spare parts demand forecasts are rarely realized, and detailed knowledge of the market and competitors is lacking.

All of the interviewees in this group claimed that “I think that we have no spare parts strategy that is aligned to our firm’s situation. Usually, we just respond to customer inquiries.” The spares portfolios of the manufacturers include many parts which are easy to copy due to their low complexity and primary products are often low-maintenance. Overall, the optimization potential regarding the spare parts logistics of the manufacturer in this category is large. “Due to the absence of an adequate spare parts logistics strategy, our competitors can easily gain market share,” stated one interviewee.

## **5. Three-step model to develop an effective spare parts logistics strategy**

Spare parts logistics strategies determine long-term decisions. Hence, the knowledge and analysis of strategy components of spare parts logistics is essential to align the strategy to a firm’s specific situation and to ensure adequate spares supply during all phases of the primary product life cycle. Figure 2 depicts the key components of a spare parts logistics strategy in a three-step model. The nine components have been identified through the literature review and

the case study research. As noted previously the top-performers in our sample considered all components, whereas low-performers considered only some of the components. We developed the three-step model based on our case study analysis. That is, no firm in our sample is currently using the exact same approach and the proposed model was established based on the combination of case study data from the various firms. The identified three steps and nine components enable a holistic approach to the development of a spare parts logistics strategy. Each component will be analyzed in further detail in the following sections.

<b>Step 1: Identify the conditions</b>			
<b>Spare parts market</b> <ul style="list-style-type: none"> <li>• Economic situation</li> <li>• Profitability of the spare parts business</li> <li>• Market entry barriers</li> <li>• Number of market players</li> <li>• Competition intensity</li> <li>• Turnover rate of spares</li> </ul>	<b>Primary product</b> <ul style="list-style-type: none"> <li>• Installed base</li> <li>• Product lifetime</li> <li>• Operation intensity</li> <li>• Construction-conditioned product structure</li> <li>• Relevance of a product for all of the customers' business activities</li> </ul>	<b>Product characteristics</b> <p>Spare part</p> <ul style="list-style-type: none"> <li>• New part or remanufactured part</li> <li>• Repairable part or expendable part</li> <li>• Wear behavior of spares</li> </ul>	<b>Maintenance strategy of the customer</b> <ul style="list-style-type: none"> <li>• Failure-based maintenance</li> <li>• Condition-based maintenance</li> <li>• Time-based maintenance</li> <li>• Selective maintenance</li> </ul>
<b>Step 2: Anticipate future developments</b>			
<b>Primary product life cycle</b> <ul style="list-style-type: none"> <li>• R&amp;D</li> <li>• Production</li> <li>• Utilization</li> </ul>		<b>Forecasting methods</b> <ul style="list-style-type: none"> <li>• Subjective estimations</li> <li>• Indicators and coefficients</li> <li>• Stochastic methods</li> <li>• Model-based methods</li> </ul>	<b>Spare parts obligations</b> <ul style="list-style-type: none"> <li>• Delivery commitments (legal/voluntary obligation)</li> <li>• Service/maintenance contracts</li> <li>• Spare parts portfolio/assortment</li> </ul>
		<b>Step 3: Align the key components of a business' spare parts logistics strategy to identified conditions and anticipated future developments</b>	
<b>Goals of the spare parts business</b> <ul style="list-style-type: none"> <li>• Revenue/profit</li> <li>• Customer loyalty</li> <li>• Differentiation</li> <li>• Image</li> <li>• Diversification</li> </ul>	<b>Supply options</b> <p>Supply in the production phase</p> <ul style="list-style-type: none"> <li>• Spares out of regular series production</li> <li>• Spares purchasing</li> <li>• Reconditioning of used parts</li> </ul> <p>Supply in the utilization phase</p> <ul style="list-style-type: none"> <li>• Internal production or external production</li> <li>• Separate workshop</li> <li>• Utilization of compatible parts</li> <li>• Final stock</li> <li>• Reconditioning of used parts</li> <li>• Reutilization of used parts</li> </ul>	<b>Inventory options</b> <ul style="list-style-type: none"> <li>• Degree of warehouse centralization</li> <li>• Vertical/horizontal storage structure</li> <li>• Location choice</li> <li>• Inventory levels</li> <li>• Costs (storage costs/inventory infrastructure costs/transport costs)</li> <li>• Reactivity/efficiency of spares provision</li> </ul>	

Figure 2: Three-step model: Key components of a spare parts logistics strategy

## **5.1 Step 1: Identifying the conditions**

### **5.1.1 Spare parts markets**

For many years, the provision of spares was a profitable business of the OEMs with little direct competition. But as firms begin to recognize the attractiveness of spares markets, which, especially in the field of fast moving wearing parts, is emerging as a competitive independent sector, the primary product manufacturers are encountering mounting competition. However, due to the distinctive specificities and varieties of each manufacturer's parts, the entry barriers remain high. The specificity of parts, the turnover rate and profitability of the spares business determine the number of competitors and the intensity of competition in these markets. Spare parts might be provided by primary product manufacturers, bounded parts producers / dealers that have a contract with the manufacturers and by independent parts producers / dealers (Baake, 2008; Carlton & Waldman, 2010).

All case study firms belonging to the top-performer group maintain an in-house marketing team, which conducts market analyses regularly. Those firms are well informed about the portfolio and market shares of competitors. Furthermore firms T1 and T2 frequently conduct benchmarking analysis and integrate best-practice solutions into their day-to-day spare parts business. The low-performers B1, B3, B5 and B6 have an insufficient knowledge about their spares market. On the one hand they do not know their market share and the market share of the main competitors. They are also not able to identify all their competitors in the spare parts business. Good knowledge about the market however is an important requirement to successfully align one's spare parts logistics strategy.

### **5.1.2 Product characteristics**

Most manufacturers use synergy effects between their primary products and spares business, for instance through shared use of production resources, pooling of parts purchasing, or



utilization of the same distribution channel. These dependencies between primary product and spare parts should be considered when spare parts strategies are being designed. From the expert interviews, we were able to characterize and describe spare part and primary product characteristics in more detail.

### **5.1.2.1 Primary product characteristics**

Spare parts logistics should be aligned with manufacturers' primary products requirements (Inderfurth & Mukherjee, 2008; Johansson & Olhager, 2006; Rose, et al., 1998). Different primary products have varying requirements for spares provision, delivery time, and the quantity of spares demand. The better the manufacturer's knowledge of the primary products sold, the better the strategic alignment of spare parts logistics. The installed base of primary products is the starting point for the planning of spares provision. The case study firms T1-T4 have data about the products they sold in the past. The case study firms B1 and B3 do not receive information about shifts, capacity utilization, and the operating condition of machines from their customers. Other bottom-performers in our sample make at least a basic effort to gather this data.

Primary product parts are the templates for spare parts. Later adjustments or modifications of spares to diverge from the design and specification of primary product parts are costly and difficult to execute. Since the strategies available to spare parts managers are predetermined by the primary product design, the top-performers take spares requirements into consideration as early as possible. For instance, a final stock of high value spares leads to capital lockup for long periods of time. This could either be avoided by choosing a different supply option or by constructing a low-cost primary product part. Another way to lower the costs of providing spare parts are primary products that have a modular design so that the

same parts can be used for various products. In contrast, the bottom-performers do not display such foresight.

### **5.1.2.2 Spare part characteristics**

Spare parts - “parts and equipment that are completely interchangeable with like items and can be used to replace items removed during maintenance” (Patton & Bleuel, 2000, p. 36) - are only demanded after primary products have been sold. Thus, spares are subject to a derivative demand. The function of spare parts is the reestablishment or preservation of the primary products’ operability.

Firms differentiate wearing parts from parts which should last through the lifetime of the primary product. The former can be predicted with regard to time and quantity, whereas the latter suffers from unpredictable random defects, for example as a result of accidents or production defects. Especially the bottom-performers B2 and B6 mentioned that they lost the lucrative business of fast-moving wearing parts to competitors that offer the spares cheaper and with a better delivery service.

### **5.1.3 Maintenance strategy of the customer**

Maintenance consists of the procedures for the retention and regeneration of a nominal condition of machines and plants, as well as the determination and evaluation of the actual condition of technical systems. Maintenance strategies determine decisions regarding the temporal process, intensity, and kind of maintenance procedures used to achieve particular goals. These goals can be the enhancement of machine reliability or cost minimization. Maintenance tasks include inspection, service, and repair work, all of which can be carried out during operational status or during machine and plant downtimes. A failure-based, condition-

based, time-based and selective maintenance strategy can be distinguished (Gopalakrishnan & Banerji, 2002; Jardine & Tsang, 2006; Mobley, et al., 2008).

The costs of maintenance in relation to downtime costs are decisive in the selection of a maintenance strategy. Safety aspects and the specifications of a company in the form of expected machine lifetime, required availability, product portfolio and the market situation should also be taken into consideration. The selected maintenance strategy directly influences the total demand for spares by that company. All top-performers try to manage long-term service contracts including preventive maintenance on a condition-based or time-based base whereas the firms B1 and B5 do not offer service contracts at all. The customers of the firms B1, B2, B5 and B6 follow solely a reactive maintenance strategy.

#### **5.1.4 Spare parts obligations**

Machine and plant manufacturers are obligated to supply their customers with spares. Legal and voluntary obligations determine the duration and extent of spares provision. “Legal obligations” are triggered by the customer’s rights in the event of a defect, and “voluntary obligations” are triggered by contractual agreements or warranty obligations.

The spares provision beyond legal obligations is mainly done to differentiate the spares provision efforts and periods’ lengths from competitors to generate strong customer loyalty and to acquire new customers. The consequences are often long-time spares provision periods. Our case study research shows that the top-performers offer their customers significantly longer voluntary obligation periods (in average 36 years) in comparison to the bottom-performers (in average 14 years) to achieve a long-term customer loyalty. Each new product generation adds spare part assortments to the manufacturer’s spare part portfolio, and as a consequence, increases spare part obligations. The composition of the spare part assortments is mainly determined by the legal and voluntary obligations, as well as by the

installed base of primary products. The spare parts obligations influence considerably the appropriate supply and inventory options.

**5.2 Step 2: Anticipating future developments**

**5.2.1 Primary product life cycle**

Figure 3 shows how spare parts (repairable and wearing parts) are sold throughout the three product life cycle phases (R&D, production, utilization). This life cycle perspective is the basis for the planning and alignment of spare parts logistics strategy in the primary product life cycle.

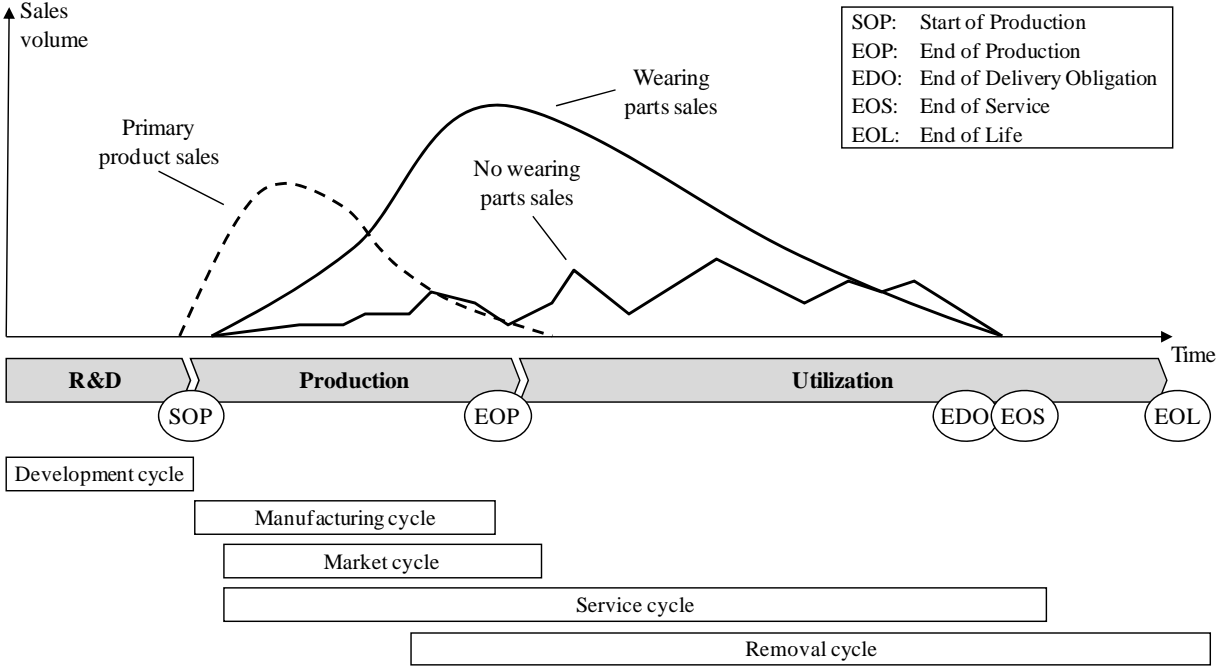


Figure 3: Product life cycle model for spare parts

The case study firms confirmed that 60% to 95% of all life cycle costs are determined by the product development phase. Therefore, the specific requirements of spares should be

considered at the beginning of the *R&D phase*, where the technical characteristics of the primary products are specified, and which irreversibly influences after-sales services.

The “start of production-point” (SOP) constitutes the transition to the *production phase*, where the manufacturing cycle starts. Primary products are manufactured, and the provision of spares begins. The service cycle starts with the distribution of the first primary products. Options for the provision of spares during the utilization phase are analyzed and selected at the end of this phase.

The “end of production-point” (EOP) is where the *utilization phase* of the primary products starts. The market cycle extends into the utilization phase, because manufactured products are still being sold at this point. The service cycle continues until the “end of service-point” (EOS). The legal obligation to provide spares (“end of delivery obligation-point,” or EDO) is often followed by a voluntary provision of spares (EOS). After the EOS-point, some products remain in use, which can be supplied with remaining spares until the “end of life-point” (EOL). The removal cycle ranges from the production phase to the EOL-point. An increasing number of manufacturers take advantage of the possibility to reutilize and recondition parts.

A life cycle approach helps to improve the delivery service while decreasing the cost of spare parts logistics. Life cycle costs can be calculated with some precision. On average, the case study firms allocate only two-thirds of their total costs to the price of a primary product and allocate the remaining one-third to after-sale services. Thus, in the machine and plant construction industry, the initial price at purchase represents only a portion of the entire life cycle costs of a product. As the previous section (“spare parts obligations”) has shown, the top-performers have a longer utilization phase than the bottom-performers. Hence, accurate spares demand forecasts for each life cycle phase have a higher priority for the top-performers than for the bottom-performers in our study. Furthermore, all top-performers as well as firms

B2 and B5 consider the dependencies between the point of time within the life cycle and the selection of an appropriate forecasting method.

### **5.2.2 Forecasting methods**

In the machine and plant construction industry, the spare parts business of manufacturers is subject to fluctuations and uncertainty because the forecasts of demands are affected by stochastic factors. Demand forecasts for wear parts can be made more accurately than those for breakdown parts because the instances of failure are more easily determined for wear parts. Breakdown parts are, in contrast, characterized by unscheduled failures. The maintenance strategy (preventive or reactive) selected by a customer determines whether the demand for spares will be deterministic or stochastic for both spares categories. Firms try to overcome forecast difficulty by applying different forecast methods, like subjective estimations, indicators and coefficients, stochastic methods, model-based methods and by anticipating the wear behavior patterns of parts (Boylan, et al., 2008; Eaves & Kingsman, 2004; Patton, 1984). An optimal strategic alignment of the parts logistics necessitates a reliable demand forecast for spares. Otherwise, the risk of obsolescence (overstocking), or cost-intensive custom manufacturing (under stocking) is unavoidable.

Nevertheless, the demand forecasts of the case study firms T4 and B2 are based on values of past demands, which are extrapolated onto the forecasting horizon. The forecasts of the firms B5 and B6 are based only on intuition and the firms B1, B3 and B4 do not conduct any forecasts. However, the top-performers T1-T3 use a combination of forecast methods aligned to the specific spare parts supply requirements, and to the product life cycle phase, resulting in the best possible solution and conduct a frequent revaluation. Hence, the firms T1-T3 try to anticipate future developments as good as possible and align their strategy on these forecasts. The firms T4 and B2 as well as B5 and B6 try also to get an idea about future

developments, however with less effort which might lead to strategies which are built on wrong assumptions. The firms B1, B3 and B4 achieve well aligned strategies only randomly, because they do not anticipate future developments at all.

### **5.3 Step 3: Aligning the key components of a business' spare parts logistics strategy to identified conditions and anticipated future developments**

#### **5.3.1 Goals of the spare parts business**

Spare parts logistics offers competitive advantages for manufacturers. Especially in times of stagnating or decreasing revenues and profits in the primary product business, manufacturers attempt to take advantage of this potential. All of the interviewees (and in particular the top-performers) concurred that “long spare part supply periods are not only a legal obligation for us but also offer various benefits.” Eight of the ten case study firms aim with their spare parts logistics business for more than one goal (B1 and B6 pursue only the goal “profits”). Nine of the ten case study firms pursue revenue and profit goals with their spare parts logistics (firm B3 pursues no revenue and profit goals leading to a misaligned strategy). A high customer loyalty is pursued by six of the case study firms (T1-T4, B2, B3) and four (T2, T4, B3, B5) try to differentiate themselves from competitors through spare parts services. Image (T1, T3, B4), diversification (T2, T4) and diffusion (T2, T4) are rather infrequent goals of the spare parts business of the case study firms.

#### **5.3.2 Supply options**

Spare parts supply for primary product customers during the whole product life cycle can be achieved with different supply options (Dombrowski, et al., 2007; Gopalakrishnan & Banerji, 2002; Orsburn, 1991). Figure 4 depicts the three phases of the spares supply planning and implementation in the product life cycle model, with the possible supply alternatives.

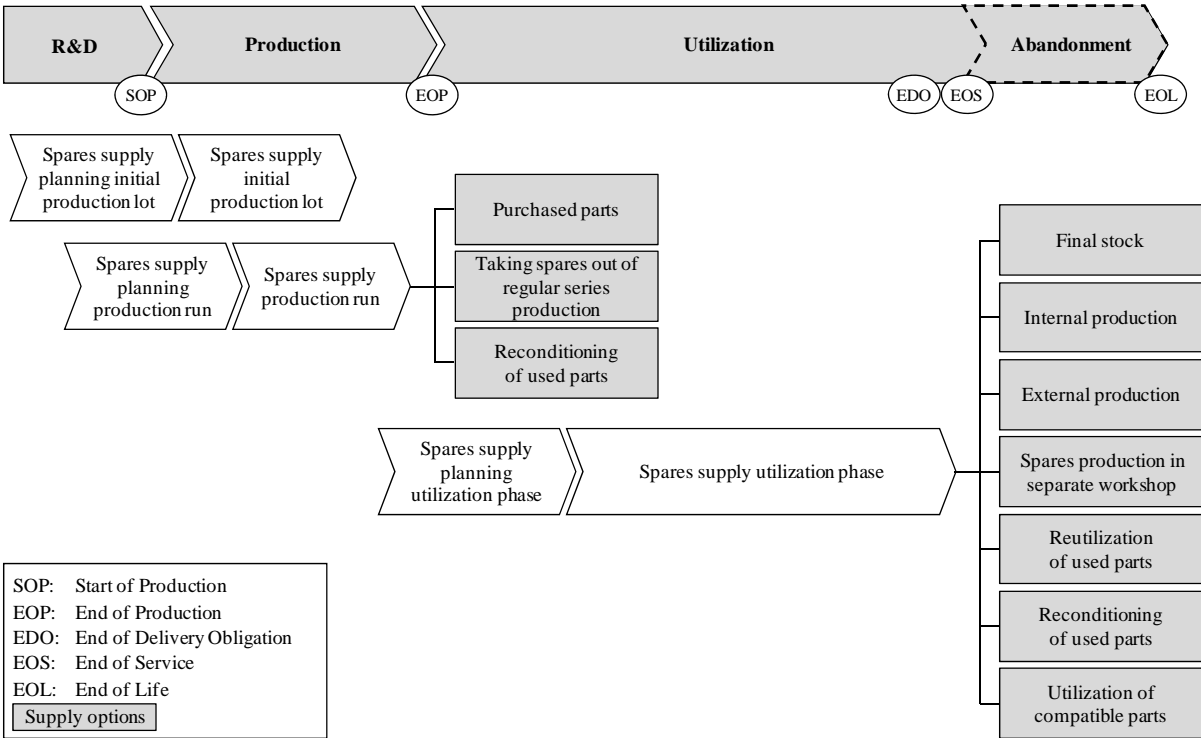


Figure 4: Spare parts supply options along the product life cycle

The life cycle-specific selection and, if applicable, combination of different supply alternatives, amount to a supply strategy. A combined or successive application of different supply alternatives is possible. The deliberate selection of only one supply option can be likewise a supply strategy.

**5.3.2.1 Supply in the production phase**

The sales date of the first primary product defines the beginning of the spares supply period. This first phase is characterized by uncertainty and forecast difficulties because of the absence of experience on the required amount of spares over time. The spare parts demanded after early failures can be taken out of the regular series production. Hence, there is no sales risk and there is no need for storage capacity for spares.



The spare parts supply during the series production phase is uncomplicated. Experience has accumulated on the spare parts demand in the past and spares can be picked out of the regular series production (all case study firms pursue this option). A flexible reaction to fluctuations in demand is possible. In addition, eight case study firms (T1-T4, B2-B5) purchase spares from suppliers (the manufacturers prefer the same suppliers for a primary product part and spare part if possible) and five (T1, T3, B2, B4, B6) obtain spares by reconditioning used parts during this phase. The latter alternative requires a system for returns and a sufficient stock of returned primary product parts. Hence, this option is practicable only after a certain amount of time and in combination with other supply alternatives.

### **5.3.2.2 Supply in the utilization phase**

The planning of the spares supply in the utilization phase is the most challenging part of the product life cycle, because the supply of spares must be ensured over a long period, and it is no longer possible to pick them out of the regular series production. Furthermore, the selected supply option determines partly the required inventory options. Consequently, the planning of the spares supply in the utilization phase should ideally be initiated during the production phase and should be arranged with the inventory options. A spares supply in the utilization phase can be ensured with the seven different supply alternatives presented in Figure 4. Nine of the ten case study firms (T1-T4, B2-B6) change the supply option during the utilization phase depending on the product life cycle. An internal and external spares production (each pursued by eight firms; except T3, B2 (internal); except B6, B1 (external)) as well as a reconditioning of used parts (T1-T4, B1, B4, B6) are the supply options pursued by most of the case study firms. The supply option reutilization of used parts is only pursued by firm B1. The remaining supply options are pursued by half of the case study firms.

### **5.3.3 Inventory options**

Spares inventory options contain decisions which influence stock levels, warehouse locations, degree of storage centrality, in-house or outsourced warehousing and storage equipment (Altay & Litteral, 2011; Orsburn, 1991; Slater, 2010). Inventory strategies determine the two components warehousing structure and inventory management, whereas the warehousing structure is the basis for the inventory management. The inventory strategy depends on the spares supply strategy selected by the manufacturer. For instance, the supply alternative “final stock” requires different warehousing structures from those used by “continuous spares production.” Furthermore, the manufacturers should consider the goals of the spare parts business when selecting an appropriate inventory strategy. For example, if the focus is just on profits they should centralize their spares warehousing to lower storage costs and minimize overstocking and obsolescence of parts. If customer loyalty and image are the main goals a high availability and fast delivery of spares during the entire supply period should take a high priority so that spares are stored locally with a tendency of overstocking.

Five case study firms (B1, B3-B6) have a central spares warehouse. Firm T2 has a local spares stock keeping; the remaining case study firms have a local and central warehousing structure. All case study firms pursue a selective storage, insofar as using different order patterns, inventory levels, safety stocks and spares availabilities for different spares categories. Most of the bottom-performer firms do not adequately coordinate their supply and inventory strategy leading to a misaligned spare parts logistics strategy and inefficient structures. For instance B4 and B5 meet the conditions (step 1 of our model) of pursuing the spare parts logistics strategy of a service leader. That is, a proximity to customers with a local warehousing structure and a high availability of spares (e.g. achievable with the supply option final stock) leads to an aligned strategy and superior performance results. However, both firms have implemented different (suboptimal) supply and inventory options.

#### **5.4 Archetype scenarios of well aligned spare parts strategies**

A superior spare parts logistics strategy can be developed on the basis of the presented three-step model. In doing so the steps should be followed in the sequence described above and all nine identified components should be considered. Figure 5 shows two examples of the suggested three-step model, one illustrating a well aligned spare parts logistics strategy (case study firm T1) and another illustrating a misaligned strategy (case study firm B3).

		<b>Case study firm T1 (well aligned strategy)</b>	<b>Case study firm B3 (misaligned strategy)</b>
<b>Step 1</b>	<b>Market</b>	Oligopolistic (limited competition); knowledge about the market situation and competitors	Competitive; no market analysis, insufficient information about competitors
	<b>Product/part characteristics</b>	Complex; good information about the condition of the installed base (intensive information exchange with customers)	Simple; no information about the condition of installed base
<b>Step 2</b>	<b>Maintenance strategy</b>	Preventive (intensive contact between firm T1 and its customers)	Reactive (customers demand low-cost spares mainly after breakdowns)
	<b>Spare parts obligations</b>	Long delivery obligation (maintenance contracts with many customers)	Customers demand only short delivery obligation (however, firm B3 offers long-term service contracts)
	<b>Life cycle</b>	Long production and utilization phase (spare parts logistic strategy is aligned with the particular life cycle phase)	Long production phase (spare parts logistic strategy is not adequately aligned with the particular life cycle phase)
<b>Step 3</b>	<b>Forecasting</b>	Accurate forecasts using indicators and coefficients (based on maintenance contracts)	Firm B3 does not conduct forecasts
	<b>Goals</b>	Firm T1 concentrates mainly on image and customer loyalty (customers require a long-term relationship with a spare parts provider)	Customers require low-cost spares without being bound to a provider; firm B3 tries to sell long-term service contracts
	<b>Supply options</b>	Supply options are aligned with the specific life cycle phase and requirements of customers (firm T1 uses all three available supply options during the production phase and all available supply options except “reutilization of used parts” during the utilization phase)	Spares are stored during the production phase (however, a sole supply out of the regular series production could avoid storage costs and overstocking) Final stock during the utilization phase (which is not based on a forecast)
	<b>Inventory options</b>	Local and central storage (spares inventories near important customers; “intelligent stockkeeping”)	Central storage (oftentimes over- or under stocking of spares during the utilization phase)

Figure 5: Examples of aligned and misaligned spare parts logistics strategies

Figure 6 depicts four scenarios of a successful, well aligned strategy, each with different characteristics of the components. These constellations have been identified based on the knowledge that we gained through the case study research conducted, which included analyses of the top and bottom-performers, and constitute typical archetypes of aligned spare parts logistics strategies. The archetypes do not represent the status quo of the case study firms rather they serve as guidance and present prime examples (however, some of the case study firms fit into one of the archetypes). We tried to select typical scenarios which occur often among machine and plant manufacturers. Other companies can take these constellations as examples, because the scenarios in Figure 6 represent well aligned spare parts logistics strategies leading to a superior performance in the spare parts business. Nevertheless, the spare parts logistics strategy of a firm should always be developed (step 3 of our model) based on a firm's individual conditions (step 1 of our model) and the anticipated future development (step 2 of our model).

Archetype scenarios				
	Cost leadership in competitive markets	Service leadership in competitive markets	Niche strategy in markets with limited competition	Long-term partnership in regulated markets
<b>Step 1</b>	<p><b>Market</b></p> <p>Highly competitive</p> <p><b>Product/part characteristics</b></p> <p>Simple</p> <p><b>Maintenance strategy</b></p> <p>Reactive</p> <p><b>Spare parts obligations</b></p> <p>Short delivery obligation</p>	<p>Competitive</p> <p>Complex, huge number of units (large installed base)</p> <p>Selective</p> <p>Long delivery obligation (some maintenance contracts)</p>	<p>Limited competition (oligopolistic situation)</p> <p>Complex, differentiated</p> <p>Preventive</p> <p>Long delivery obligation (maintenance contracts with many customers)</p>	<p>Regulated, certification requirements</p> <p>Complex</p> <p>Preventive (never fail policy)</p> <p>Delivery obligation for the whole product lifetime (maintenance contracts with most customers)</p>
<b>Step 2</b>	<p><b>Life cycle</b></p> <p>Long production phase, no information flow about the condition of installed base</p> <p><b>Forecasting</b></p> <p>Forecasts are possible due to the short delivery obligation</p> <p>Subjective estimations and indicators and coefficients</p>	<p>Long utilization phase (long lifetime of the product)</p> <p>Forecasts are hardly realizable due to long utilization phase</p> <p>Stochastic and model-based methods</p>	<p>Long production and utilization phase</p> <p>Accurate forecasts are possible due to the huge amount of maintenance contracts</p> <p>Indicators and coefficients</p>	<p>Long R&amp;D phase (intensive cooperation with customers during all phases)</p> <p>Accurate forecasts are possible due to a good knowledge about the condition of installed base</p> <p>Indicators and coefficients</p>
<b>Step 3</b>	<p><b>Goals</b></p> <p>Profits (major goal)</p> <p><b>Supply options</b></p> <p>Due to long production phase uncomplicated supply out of the regular series production</p> <p>Final stock during the utilization phase</p> <p>Cost-efficient central storage</p> <p><b>Inventory options</b></p>	<p>Differentiation (major goal), customer loyalty, diversification, profits</p> <p>Internal production, utilization of compatible parts, reconditioning of used parts</p> <p>Local, proximity to customers (extensive service network)</p>	<p>Image (major goal), customer loyalty, profits</p> <p>Internal production, separate workshop, final stock</p> <p>Local and central</p>	<p>Customer loyalty (major goal), reputation, profits</p> <p>Utilization of compatible parts, separate workshop, final stock</p> <p>Local, very responsive service network</p>

Figure 6: Archetype scenarios of aligned spare parts logistics strategies

**Cost leadership in competitive markets.** Firms belonging to this group offer products and parts in highly competitive markets. The main reason for customers to choose a particular spare parts provider is price. The case study firms B1, B3 and B6 belong to this category regarding the conditions of step 1. However, firm B1 and B6 do not adequately take care of their spare parts business and supply spares only on customer request. Similarly, firm B3 does not follow the recommendation of the archetype in Figure 6, leading to a misaligned spare parts logistics strategy. In particular, the firm tries to sell long-term service contracts to its customers, however with moderate success because customers do not want to be tied to a single provider for a long period of time. In general providers of fast moving wear parts often belong to this category. On the one hand, they face an intensive competition and low margins. On the other hand, a spares supply is easily realizable without the risk of over or under stocking due to a very long production phase and the provision of spares out of the regular series production. The long production phases result from infrequent technological changes of the products. The spare supply in the utilization phase is normally conducted with a final stock based on low-cost forecasts and stored in a central warehouse.

**Service leadership in competitive markets.** Most of the case study firms belong to this group (T2, T4, B2, B4, B5) regarding the conditions of step 1. Customers expect excellent after-sales services and a fast provision of spares during all product life cycle phases. They can choose between various competitors offering spares and after-sales services, resulting in a competitive market condition. The products are complex, however the number of units sold and hence the installed base are large. The spares providers face the challenge of long utilization phases and the need for accurate forecasting, which are difficult to manage. The case study firms T2 and T4 follow the recommendation for this archetype and reduce uncertainty about future spares demand by concluding service contracts with customers and significant forecasting efforts with a team concentrating on this particular task. The selected spare parts supply options should aim for a high availability. The firms have a comprehensive

service network, provide fast reaction in case of a spares demand, and achieve high customer loyalty as well as differentiation leading to superior profits due to their well aligned strategy. Furthermore, these firms pursue the goal of a better primary product diversification with their excellent spare parts business. The bottom-performers B2, B4 and B5 do not adequately forecast future spares demands leading to under- or oversupply of spares and consequently to dissatisfied customers and a decreasing customer loyalty or higher costs. Furthermore, firms B4 and B5 do not have a local service network. This misalignment of the spare parts logistics strategy leads to diminishing margins in the spare parts business.

**Niche strategy in markets with limited competition.** Firms belonging to this group offer complex niche products and face limited competition due to an oligopolistic market structure. The case study firms T1 and T3 have a strategy which is well aligned to the requirements of this category. They conclude service contracts with their customers, conduct regular information exchange about the conditions of the installed base and tie them to their spare parts business. Most customers have a preventive maintenance strategy, which enables the spares providers to forecast demands accurately based on indicators and coefficients. How these firms manage their spare parts business reflects back on the image of these firms. All decisions regarding the spare parts business and the alignment of the strategy are based on a well-balanced compromise between costs and service levels. Firms in this category should use different supply options with the goal to ensure a high spares availability and flexibility, but also considering the spare parts production costs. Based on the chosen supply options, rarely required spares should be stored centrally whereas often required wear parts should be provided in decentralized warehouses.

**Long-term partnership in regulated markets.** Machine and plant manufacturers belonging to this group regarding the condition in step 1 often operate in the medical engineering, aviation or military industry. None of our case study firms fulfill the condition of step 1 and hence no case study firm belongs to this category. However, this archetype



constitutes a valuable guidance for firms operating in these industries to align their spare parts logistics strategy. The number of competitors is limited due to statutory regulations and certification requirements. Customers have a very high demand for trouble free operations of their machines and hence conduct preventive maintenance. Manufacturers should establish long-term partnerships with their customers through intensive cooperation and information exchange regarding the conditions of the installed base - leading to strong customer loyalty. Forecasts are important to achieve an all-time availability of spares. Parts should be produced in a separated workshop or compatible parts might be used in the utilization phase of the primary product life cycle. The supply option final stock in this archetype normally requires a overstocking because a shortage of spares should be avoided. Most of the spares are stored locally to guarantee a short response time.

## **6. Conclusions and implications**

### **6.1 Conclusions**

The goal of this study was to analyze key components of a superior spare parts logistics strategy and to present a model for the development of such strategy. We analyzed the main determinants of spare parts logistics holistically and offer a three-step model with nine strategy components, which guides managers through the process of strategy development. Furthermore, we present four archetype scenarios of a well aligned spare parts strategy using our model.

### **6.2 Implications and future research**

The interviewed managers agreed that, “[...] our business with spares including the entire after-sales field will notably increase. We have to react to this growth and align our current spares provision.” (Representative quotation from a case study interview) While spare parts

logistics has been recognized as a success factor, many firms have inadequate knowledge of the strategy components of spare parts logistics and of strategy development in this field. Therefore, we identified key components of a spare parts logistics strategy and integrated them into a three-step model that can support managers in developing a spare parts logistics strategy for their firms.

An important managerial implication of our research is the necessity of strategic planning and alignment of spare parts logistics. This strategic alignment is possible with the model proposed in this research. The individual spare parts logistics strategy of each manufacturer should contain all components with different characteristics. During the selection of the components' characteristics, manufacturers should consider interdependencies among strategy components and coordinate the characteristics of the strategy components accordingly. Furthermore, restrictions on the characteristics of each strategy component should be considered. A professional approach, based on detailed knowledge, enables the use of the various types of business potential and their future growth. The systematic gathering and analysis of knowledge about their holistic system remains for many of the case study firms a novel task, one that results in the failure to take full advantage of business potentials. Past experience and intuition are often the basis for alignment in spare parts logistics. All case study firms belonging to the "bottom category" base their decisions mostly on subjective estimations. A method of evaluating the strategy components which is used by manufacturers belonging to the "top category" is the analysis of lists of spare parts in cooperation with customers and suppliers. Each spare is classified in terms of its relevance to the machine or plant operation, value, ability of storage, life cycle of the primary product and then categorized as a wearing or failure part.

To date, no prior research has assessed all of the strategy components of spare parts logistics and presents a model to develop a strategy. Most extant articles (Aronis, et al., 2004; Chang, et al., 2005; Chelbi & Aït-Kadi, 2001; Cobbaert & Van Oudheusden, 1996;

Kalchschmidt, et al., 2003; Schultz, 2004; Snyder, 1993; Tomásek, 1970) that have been written in relation to a spare parts logistics context focus on single aspects. Hence, the research conducted here broadens the knowledge of this topic in the scientific community. The findings of this research however are derived from a limited number of cases and thus the available data is equally limited. Furthermore, the data for this research were gathered within a single industry in Germany to facilitate a deep observation. General restrictions and limitations of the case study research approach apply (e.g., generalizability) (Benbasat, et al., 1987; Darke, et al., 1998; Voss, et al., 2002). Additional research on the strategic planning and alignment of spare parts logistics is richly deserving.

## 7. References

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## III Chapter – Relationship archetypes in aftermarkets

### 1. Introduction

When products are commoditized and profit margins shrink, aftermarkets become an important source of revenues, profits, differentiation and customer retention. Most manufacturing firms now offer their customers a variety of services as an integral part of their total offerings. Likewise, customers demand more than a mere technical solution to a problem (Johansson & Olhager, 2006; Oliva & Kallenberg, 2003). Thus, after-sales business is no longer a simple set of operative activities; rather it plays a strategic role and generates real value for customers. Aftermarket support refers to activities associated with products (e.g. spare parts), and services (e.g. engine overhauls, repair, maintenance and upgrades), after the initial sale and assists customers in the usage and disposal of the goods (Phelan, et al., 2000). An "aftermarket transaction" has two characteristics: (1) the aftermarket product or service is *in conjunction with a primary product*, and (2) the aftermarket product or service is *purchased after the primary product*. The after-sales business can contribute up to 30% of firms' revenues (Bundschuh & Dezvane, 2003; Dennis & Kambil, 2003) and often generates twice as much margin as primary products (Ashenbaum, 2006; Wise & Baumgartner, 1999) and this proportion is increasing (Wagner & Lindemann, 2008). Therefore, firms now see after-sales service offerings as a source of competitive advantage. A customer's purchase decision for a product is nowadays not only influenced by the product's value (performance relative to cost), but also by the service price / quality bundle available to support its use. Levitt (1983) sees the initial sale of a product only as the beginning of a longer supplier-buyer relationship, which has to be maintained and developed throughout the product life cycle.

The aftermarket has traditionally been the proprietary cash cow of the OEMs, and was strictly off-limits to the suppliers (Crandall, 1968; Legnani, et al., 2009). However, a lucrative aftermarket introduces a challenge with the potential to transform the supplier-OEM-customer relationship and creates an incentive for suppliers to disintermediate the established supply chain and to sell directly to the OEM's aftermarket customers. When this occurs, the OEM and supplier inevitably enter into a competitive situation. For numerous reasons, more suppliers than ever are competing for shares of the aftermarkets, and have made the strategic decision to offer their services directly to the end customer (Farris II, et al., 2005; Rossetti & Choi, 2005). Because of the competitive, strategic, and economic importance of the aftermarket to OEMs, the protection of the aftermarket has a high importance. From the OEM's point of view, the conflict situation becomes even more problematic since they depend on the same suppliers for design and manufacturing (Rossetti & Choi, 2008).

A network consists of nodes and links. The supply chain management literature has until now mainly focused on dyads (e.g. buyer-supplier) (Anderson, et al., 1994; Ellram & Hendrick, 1995; Larson, 1992). However, in order to capture the essentials of a network, we must examine how one node affects another and how one link affects another. The smallest unit of network configuration in which this occurs is a triad (Caplow, 1968). In this paper we extend the network even further - if necessary and reasonable - into tetrads. This allows us to theorize the dynamics of interaction of multiple firms with multiple firms (Manski, 2000). A triad (tetrad) is a set of three (four) actors and the possible ties among them. It is necessary to understand how one relationship between two parties in a network might affect the remaining parties in the same network, and to consider the context of the network in which the firms are embedded in order to understand relationship constellations in aftermarkets and make thoughtful relationship decisions (Grandori & Soda, 1995; Uzzi, 1997). Relationships and dependence among companies' business activities is of special interest in aftermarkets. Although firms are more aware than ever that their network in aftermarkets with suppliers,

competitors, customers is critical to their success, only few firms have systematically analyzed relationship constellations, their influence factors, and implications (Choi & Kim, 2008; Cohen, et al., 2006). Firms that successfully manage their business relationships are the ones with superior performance. A frequently quoted example is the Japanese automobile manufacturers which viewed relationship management as a primary business activity (Groves & Valsamakis, 1998).

The way two firms work with each other (e.g. competition vs. cooperation) has implications for the other firms in the network (Gulati, 1998; Håkansson & Snehota, 1989). Attractive aftermarkets create incentives for market entry and competition. A complex environment arises from relationships between an OEM and its customer, and between the customer and a supplier or competitor of the OEM (Wasserman & Faust, 1994). In our research, we aim to analyze constellations in triadic and tetradic relationships in order to shed light on the complex interactions among the actors on the aftermarket. In this context, the addition of more network parties (e.g. further competitors or suppliers) to our analysis, will not provide any further knowledge about the existing interactions and relationships (Newman, et al., 2006).

In spite of the increasing relevance to current business practice, there have been relatively few systematic research projects on the subject of relationship constellations in aftermarkets to date. To this end, we (1) investigate aftermarket relationships from the perspectives of OEM, customer, supplier and competitor, (2) derive five triadic and twelve tetradic relationship archetypes from our case study research, and (3) analyze relational dynamics in each archetype. Archetypes abstract a complex social phenomenon based on our understanding of existing knowledge regarding the phenomenon under investigation (Bailey, 1994; Doty & Glick, 1994). In order to understand the relational dynamics in aftermarkets, we adopt social network theory (Dunn, 1983) as our theoretical framework. We focus on the structural-hole concept, supply chain disintermediation, and structural embeddedness.

The remaining paper is organized as follows. Section 2 presents a literature review of after-sales management and aftermarkets, the relationship-archetype research, and describes our theoretical framework. We describe our research methodology in section 3, and present and discuss the findings in sections 4 and 5. The conclusions in section 6 offer theoretical and managerial implications and directions for future research.

## **2. Literature review**

### **2.1 Aftermarket**

A thorough analysis of the after-sales function is provided in (Orsburn, 1991; Patton, 1984; Patton & Bleuel, 2000; Patton & Feldmann, 1997). These textbooks cover various aspects of an optimal service portfolio and spare parts management in areas such as service parts inventory management, forecasting, procurement, marketing, and pricing methods. Most of the publications on after-sales management focus on the area of inventory management for spare parts compared to inventory management for regular products. Kennedy, et al. (2002) and Zipkin (2000) reviewed the spare parts inventory literature. Only a few studies of after-sales management examine aftermarkets.

Farris II, et al. (2005) analyze business-to-business relationships (alliances, web portals / e-commerce, ship direct and ship to repack) in aftermarkets and describe the types, advantages, and disadvantages of each with examples of organizations that made successful use of such relationships. Characteristics of aftermarkets are studied by Ashenbaum (2006), in particular, how supply chains should be designed for aftermarket needs. Hammant, et al. (1999) focus on the development of supply chain networks in the automotive aftermarket sector, where they document, model and simulate the development of supply chain structures in relation to the historical, present and predicted future market trends. Knecht, et al. (1993), Dennis and Kambil (2003) and Cohen, et al. (2006) point out the potential of aftermarkets,

and how firms are able to make best use of this potential with optimized pricing, tailored services, expanded service portfolios, business models to support service products, and products which are designed for serviceability. Wise and Baumgartner (1999) analyze four different business models (embedded services, comprehensive services, integrated solutions, distribution control) that can be used to open up aftermarkets.

Several researchers have concentrated on legal aspects of aftermarkets. Borenstein, et al. (1994), Carlton and Waldman (2010), Chen, et al. (1998), Elzinga and Mills (2000) examine whether legal regulations are necessary to impede monopolistic tendencies in aftermarkets. The 1992 “Kodak decision” by the US Supreme Court raised several questions about aftermarkets, and especially about the circumstances under which behavior by OEMs can have anticompetitive effects (Hovenkamp, 1993; Shapiro & Teece, 1994). Since then, over 20 antitrust cases against firms like Siemens, Xerox, Boeing, HP, and GE have turned on whether competition in complex primary product markets prevents manufacturers from exercising market power over proprietary aftermarket products and services (Morita & Waldman, 2010). In each of these court cases, large OEMs have attempted to stop aftermarket entry by suppliers or other competitors. Many OEMs have recognized the supplier’s threat and attempted to protect their aftermarket interests; Crandall (1968) uses economic analysis to show why General Motors had purchased Fisher Auto Body in order to protect its profits. Baake (2008) and Stoate and Smith (2005) study restriction and monopolization tendencies in the European spare parts market for automobile equipment and appropriate degree of protection offered to car manufacturers (OEMs) which is regulated by law.

There is a lack of studies examining the aftermarket in the context of supplier-OEM-customer and supplier-OEM-competitor-customer relationships. Therefore, the next section reviews the literature on relationship-archetype research outside of the aftermarket context.

## 2.2 Relationship-archetype research

Relationships among organizations do not exist in isolation (Håkansson & Snehota, 1989). A growing body of literature has described and analyzed inter-firm relationships (Grandori & Soda, 1995; Håkansson & Snehota, 1995; Uzzi, 1997) including dyadic relationships between buyers and suppliers (e.g. Anderson, et al., 1994; Hald, et al., 2009) and among suppliers (Choi, et al., 2002; Wu & Choi, 2005). Although, the analysis of dyadic relations offers rich insights into the management of single relationships, it cannot adequately capture the interactive nature inherent in networks, for example, it is not possible to identify how a link between two firms affects another link (Wasserman & Faust, 1994). In light of this, our research concentrates on relationship archetypes in triads and tetrads. Network effects and relationship constellations can be demonstrated using only these units of analysis (Grandori & Soda, 1995). The addition of more network parties (e.g. further competitors or suppliers) would not provide any further knowledge about the existing interactions and relationships.

In their study of industrial networks, Smith and Laage-Hellman (1992) present three triadic network structures: (1) one buyer interacting with two suppliers (see examples in (Choi & Wu, 2009; Choi, et al., 2002; Dubois & Fredriksson, 2008; Wu & Choi, 2005)); (2) a supplier interacting with an intermediary (OEM) and an end user (see examples in (Li & Choi, 2009; Rossetti & Choi, 2005; Rossetti & Choi, 2008)); and (3) one supplier interacting with two buyers (see examples in (Choi & Kim, 2008)). However, some approaches to relationship-archetype research do not fit into any of these classifications: Ritter (2000), Upson and Ranft (2010) as well as Madhavan, et al. (2004) analyze triadic relationships unrelated to the classification of Smith and Laage-Hellman. Ezzamel and Naim (2007), Larson and Gammelgaard (2001a, 2001b) and Pekkarinen, Spring and Ulkuniemi (2009) focus on logistics triads which comprise buyers, suppliers, and logistics service providers. Table 4 provides an overview of the pertinent relationship-archetype literature.

Table 4: Relationship-archetype literature overview

Reference	Content
(Choi & Wu, 2009)	identify nine triadic archetypes of buyer-supplier-supplier relationships and make use of the balance theory to investigate whether a relationship constellation is in a balanced or unbalanced status, and describe the development trend for each status.
(Wu & Choi, 2005)	empirically study the triadic context of the buyer-supplier relationship focusing on creating five archetypes of supplier-supplier relationships. Through systematic case analyses, the authors found that interactions between suppliers, or the lack thereof, affect the performance of the buyer's operations significantly.
(Choi, et al., 2002)	develop three archetypes of supplier-supplier relationships (competitive, cooperative and co-opetitive) and consider how these affect the buyer-supplier relationship. Whereas the definition of the first two relationships is intuitive, the latter type prevails when firms compete against each other while still pursuing some collaboration.
(Dubois & Fredriksson, 2008)	identify "triadic sourcing", where a buyer creates a bundled strategy for two closely-coupled suppliers. The authors offer a case example of Volvo-JCI-Lear triad, where the automotive manufacturer Volvo sources car seats from the suppliers JCI and Lear.
(Rossetti & Choi, 2005; 2008)	investigate supply chain disintermediation in the triadic relationship supplier-buyer-customer using the example of the aerospace industry.
(Li & Choi, 2009)	analyze relationship constellations in the triad supplier-customer-buyer during service outsourcing processes. They highlight three different phases between the involved actors: bridge (before outsourcing; the buyer is between its supplier and its customer), bridge decay (during outsourcing) and bridge transfer (post outsourcing).
(Choi & Kim, 2008)	introduce the importance of structural embeddedness when evaluating a supplier's performance. They argue that the performance of a supplier can only be correctly evaluated if the broader network is considered.
(Ritter, 2000)	discuss a triad consisting of a focal organization, two other organizations, and their (possible) relationships and develops a framework for structuring and analyzing relationship interconnectedness.
(Madhavan, et al., 2004)	analyze how often triadic structures in competitor alliance networks occur and identify technology and geography as the main drivers of transitive triads.
(Upson & Ranft, 2010)	develop in their conceptual article ten triadic competitive archetypes by combining three different behavioral patterns (aggressive, forbearance, indifferent) observed in the involved firms (the firm and its two most frequent rivals).
(Larson & Gammelgaard, 2001a, 2001b)	analyze barriers (e.g. coordination, technology, power imbalances, conflicts) and benefits (e.g. flexibility, higher inventory availability, on-time pickup and delivery, lower costs) of the logistics triad.
(Ezzamel & Naim, 2007)	develop a schema for analyzing the logistics triad using transaction cost economics.
(Pekkarinen, et al., 2009)	examine a triadic network comprised of two logistic service providers offering complementary services plus a customer (who is the buyer of the logistics services).
(Lazzarini, et al., 2008)	investigate the extent to which the parties in a tetrad (consisting of a buyer-supplier and supplier-supplier alliances), reinforce or undermine one another with regard to inter-organizational learning and cooperative efforts in production systems.

### 2.3 Social network research

Social network research centers on the relationships among social actors and the patterns and implications of these relationships (Dunn, 1983; Wasserman & Faust, 1994). Instead of analyzing individual behaviors and attributes, social network research is concerned with the ways that interactions among actors constitute a structure that can be studied and analyzed in its own right (Carrington, et al., 2005). Social network models conceive actors (such as firms or persons) as interdependent, consider relational ties among actors as channels for transfer or flow of resources, and view the network structures as providing opportunities or constraints on individual decisions and actions (Wasserman & Faust, 1994). Social network research enables us to interpret and analyze individual firm behavior or interfirm interactions within the context of larger relational structures (Carrington, et al., 2005). Below, we will introduce a set of concepts from network theory which are useful for our research purpose.

**Supply chain disintermediation (SCD).** Disintermediation represents a fundamental structural change to a supply chain by creating new relationships among the players involved. In our context, SCD constitutes an OEM's current or previous supplier overtly or opportunistically offering after-sales services and / or spare parts, which have been so far distributed by the OEM, to the OEM's customers (Kidd, et al., 2003; Rossetti & Choi, 2005). From the perspective of the OEMs the cost of disintermediation is great. Beside the immediate losses in the aftermarket, the OEM might experience decreasing primary product sales because products are used longer due to lower maintenance, repair, and overhaul costs. Therefore, when an OEM's aftermarket is important it should take the threat of SCD very seriously.

**Structural hole concept.** A structural results from the lack of direct connection among actors in a network (Burt, 1995, 2001). A structural hole is created when one node is connected to other nodes that are not connected to each other (Ahuja, 2000). The presence of a structural hole, however, does not mean that the disconnected nodes are unaware of each



other. Structural positions within a network determine the distribution of power, control and information in the network because actors in some positions in the network are better off than others. The use of structural holes by a firm (occupying the bridge position) provides superior access to information and greater opportunities to exercise control (Burt, 1995). Hence, a structural hole creates a competitive advantage for the actor whose relationships span the holes (Gulati, 1998). A firm's bridge position is not a permanent state and is subject to change. The position can decay or can be transferred (Burt, 2002; Li & Choi, 2009).

The concept of the third party as a middle man (*tertius gaudens*) or broker (*tertius iungens*) between two otherwise disconnected parties has a central role in the structural holes theory (Burt, 1995; Obstfeld, 2005; Zaheer & Bell, 2005). Both benefit from the bridge position. The concept of *tertius gaudens* addresses the issues of power and leverage, the concept of *tertius iungens* focuses on the role of the node sitting on the structural hole as a conduit for additional resources and information. In contrast to the role of the *tertius gaudens* who benefits from playing off the nodes on each side of the structural hole, the *tertius iungens* benefits by mediating between two disconnected nodes. Often, however, firms play both roles as dictated by circumstances.

**Structural embeddedness.** Embeddedness refers to the fact that economic action and outcomes are affected by a firm's relations and by the structure of the overall network of relations (Gnyawali & Madhavan, 2001; Uzzi, 1996). All relationships in aftermarkets should be seen as embedded in wider networks (Uzzi, 1997). The structural embeddedness of a firm can affect the other network actors in many ways. It can affect business decisions (decision embeddedness), behavioral choices (behavior embeddedness), and economic outcome (performance embeddedness). Simply put, the performance and strategies of a firm depend on the network in which the firm is embedded. The concept of structural embeddedness brings to the fore the impact a network has on the firm's business decisions, actions, and outcomes for both positive and negative performance (Gnyawali & Madhavan, 2001; Uzzi, 1996).

In sum, the literature reveals that prior research has only begun to investigate more complex relationship constellations (e.g. buyer and suppliers). This paper extends the limited research on relationship constellations by identifying and analyzing triadic and tetradic relationship archetypes in aftermarkets through the lens of social network research.

### **3. Methodology**

Our research design is based on multiple case studies and interviews (Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2008). This method gathers detailed data, making possible a deep understanding of contextual factors and issues related to aftermarket structures, while sacrificing statistical generalizability. Moreover, case studies allow the study of phenomena in their context. Our study adopted the grounded theory building approach (e.g. Glaser & Strauss, 1967; Strauss & Corbin, 1990). More specifically, the principles of theory building based on case studies were adopted (Eisenhardt, 1989). Our sample is composed of firms from industries as diverse as aviation, printing, automobile, defense, household appliances, passenger transportation, and machine building. We analyzed companies which operate as OEMs, customers, suppliers, and competitors, taking four perspectives onto the relationship constellations in aftermarkets. Consequently, our findings are neither industry- nor company-specific, which helps us to build a generic theory of relationship archetypes. Table 5 depicts characteristics of the twenty-nine firms included in our sample.

Table 5: Case study firms

Firm	Type of firm	Industry	Country	Number of employees	Revenues (m € 2010)	After-sales revenues / budget (m € 2010)
A	OEM	Elevator construction	Switzerland	42,000	6,900	n.s.
B	OEM	Home appliances	Germany	40,000	8,400	n.s.
C	OEM	Print	Germany	24,000	2,650	1,722
D	OEM	Aerospace	Germany	15,600	4,600	1,520
E	OEM	Automotive	Germany	11,000	4,200	250 (spare parts)
F	OEM	Mechanical engineering	Switzerland	7,500	1,575	167
G	OEM	Machine tool construction	Germany	5,200	1,181	423
E	OEM	Mechanical engineering	Switzerland	4,796	1,155	153
H	OEM	Home appliances	Switzerland	1,200	368	42
I	OEM	Mechanical engineering	Switzerland	800	667	333
J	OEM	Mechanical engineering	Switzerland	670	150	27
K	OEM	Print	Switzerland	565	178	27
L	Supplier	Automotive	Germany	60,000	9,371	1,600
M	Supplier	Measuring technology	Switzerland	8,400	913	83
N	Supplier	Industrial Goods	Switzerland	3,300	1,400	n.s.
O	Supplier	Textile Industry	Switzerland	2,100	300	270
P	Supplier	Print	Germany	100	30	7
Q	Customer	Public transportation	Switzerland	9,300	2,900	475
R	Customer	Construction firm	Switzerland	3,793	1,000	29
S	Customer	Construction firm	Switzerland	2,416	532	8
T	Customer	Military equipment	Switzerland	1,000	1,833	458
U	Customer	Public transportation	Switzerland	400	42	6
V	Customer	Public transportation	Switzerland	260	50	9
W	Customer	Beverage bottler	Switzerland	200	140	0.8
X	Customer	Real estate management	Switzerland	70	92	4
Y	Customer	Print	Germany	70	11	2
Z	Competitor	Aerospace and Defense	Switzerland	7,500	1,413	Offers primarily services and spares
AA	Competitor	Mechanical engineering	Germany	220	25	Offers only services and spares
AB	Competitor	Home appliances	Switzerland	24	7	1

Note: 1 € = 1.2 CHF

Data collection was performed through semi-structured interviews, a detailed questionnaire, direct observation (e.g. company tours), and the analysis of secondary sources (such as company documentation, annual report, corporate websites, specialized press). The data was collected throughout 2010 and 2011, always in combination with company visits.

The interviews focused on the after-sales strategy and business of the firm, the structure and competition of their aftermarkets, and differences associated with the transition from business relationships in the primary product market to those in the aftermarket.

The interviewees were selected because they were knowledgeable about the after-sales activities of their firm, and included members of the executive board, after-sales managing directors, service directors, managers in charge of after-sales, and customer care managers. These managers were sent a letter explaining the purpose of the research and asking for their co-operation, and then contacted by telephone so that the researchers could provide more details and arrange interviews. Once meetings had been confirmed, face-to-face interviews were carried out; each lasted from one to two and a half hours. Frequently, we were introduced to more than one interviewee at each firm. Each interview was recorded and transcribed in detail.

In order to ensure internal consistency of the data, secondary data (e.g. company documentation, annual report, corporate websites, press articles) was obtained for each interviewed firm and then used to triangulate the interview data. The secondary data provided background and context to the primary research data gathered from the interviews. Data triangulation was accomplished by having multiple respondents from different companies and through a variety of sources of data (interviews, observation and documentation) (Voss, et al., 2002). To strengthen the validity of the findings, a copy of the documentation and results was sent to the interviewees, asking them whether or not they agreed with the findings. Ambiguous answers were clarified through email or in follow-up questions.

The analysis consisted of data reduction, data display, within-case and cross-case analyses (Miles & Huberman, 1994; Yin, 2008). Following the procedure recommended by Miles and Huberman (Miles & Huberman, 1994), we first conducted the within-case analysis (*from the perspective of one market actor*, OEM, customer, supplier and competitor). These findings are presented in section 4. Once the within-case analyses were done, we conducted a cross-case analysis, studying the *relationships among the actors* and derived aftermarket relationship archetypes that capture the dynamics in aftermarkets networks. These findings are presented in section 5.

#### **4. The OEM, customer, supplier and competitor perspectives**

Each perspective involved in the relationship archetypes (OEM, customer, supplier, competitor) was analyzed in detail. The term “supplier” is used for a firm which has been an OEM supplier during the primary product business, but may or may not have acted as such in the after-sales business. We define “competitor” as a firm offering after-sales services and / or spare parts in direct competition with an OEM.

##### **4.1 The OEM perspective**

“The after-sales business is our cash cow.” All interviewees from OEMs made this or a similar statement during the expert interviews. The profit margin of the after-sales business was estimated between 35% and 65%, with an average of 44%. The profit margins in their primary product business are considerably lower, so some OEMs sell new machines only to reach a huge installed base, and to earn money with services and spares. Nearly all interviewed OEMs have expanded and professionalized their after-sales management during the last decade. They invested in marketing (merchandising, proactive sales, promotion campaigns), made commitments to provide outstanding services, and dedicated themselves to high customer satisfaction. Furthermore, the OEMs enlarged their service portfolio by offering new services like trainings, process optimization, leasing, operator models, total solution fulfillment, innovative modifications and upgrades, consignment warehouses, comprehensive guarantees (if all services are conducted by the OEM), full service agreements or compatibility only with OEM-spares. An after-sales director of a large home application manufacturer revealed: “We have to create a high customer loyalty, because only a huge effort on our part will bring back a lost customer.” The case study firms (OEMs) indicated that their market share for their own primary products amounts to an average of 65% for spares and 25% for services. However, the spread of the OEM market share was relatively

large. All of the interviewees agreed: “Our own primary product customers are in the after-sales service business our biggest competitors. Many customers have their own maintenance departments and conduct after-sales services by themselves.” Competitors (independent part manufacturers, spare parts pirates), as well as our primary product suppliers are the main competitors for spares. However, competitors and suppliers might also offer their own services on top or focus only on after-sales services.

For 83% of the interviewed OEMs, SCD is challenging, and they aim to avoid this through an active supplier management with joint development, tool-equipment provided by the OEM to the supplier or suppliers bounded by strict contracts. Certainly, the OEM can also try to generate added value to the spares production and act as more than an intermediary in this business to avoid SCD. For the case-study firms, an effective method of protecting their spare part business against competitors - at least temporarily – are compatibility attributes of spares (e.g. different connector plugs, software programming). The OEMs must offer an excellent service (attractive price, speed, single point of contact), especially for purchased spare parts to mitigate the risk of SCD. On average, the interviewed OEMs purchase 60% of the spare parts and produce 40% in-house, whereas the spread ranges from 20%:80% to 90%:10%. The spares supply strategies applied by the OEMs vary depending on the primary product, type of spare part (e.g. mechanical or electronic), and the industry. Certain OEMs buy large quantities of spares from their suppliers due to economies of scale; however, this strategy bears the disadvantages of high capital lockup, obsolescence, shortages, or overstocks.

All interviewed OEMs tried to buy from the same suppliers during the primary product business and the after-sales business. According to most interviewees, “a long-term relationship with suppliers is more important than short-term cost savings.” However, the OEMs mentioned that they switch suppliers if (1) the suppliers conducted a market withdrawal for parts early in the product life cycle, (2) near sourcing provides shorter reaction

times and higher flexibility compared to low-cost sourcing, and (3) serious problems occur in the business relationship between the OEM and supplier.

All OEMs emphasized the importance of short reaction times and a high flexibility enabled by a service network / agency close to the customer in a competitive environment. Machines and plants' downtimes incur high costs. Hence, most OEMs run a central spare parts warehouse and several storage locations near their main customers, thereby, having to provide huge spare parts assortments (up to 200,000 parts) but not concentrating on fast-moving spares like their competitors do.

In general, the competitive intensity in aftermarkets is low and dominated by the OEMs if primary products, spares or service work (e.g. comprehensive modernizations, electronic control units) are complex and know-how as well as quality are crucial. In this case, the profit margins are high. Thus, in the recent past an increasing share of complex electronic items is beneficial to the OEMs. Generally the competitive intensity is high for consumables, wear parts and standard parts with a high turnover rate and older machine generations with a huge installed base. Furthermore, the rivalry for services is much higher than for spares. The case study firms underlined that customer loyalty and retention varies widely from country to country (and is for example quite high in Switzerland). The OEMs have to decide if they want to support competitors offering after-sales services and customers who perform their own maintenance. On the one hand, if they sell spares to these parties they generate revenue and profits, but on the other hand, if they do not provide the spares, they might push them out of business and claim the services business for themselves. Service for equipment from other OEMs is offered only by 16.6% of the interviewed OEMs and only on customer demand. The portfolio is limited in these cases because know-how and spares are not available in sufficient quantity.

## **4.2 The customer perspective**

The service-case (machine failure and troubleshooting) should be experienced by the customer with minimal inconvenience. In the majority of cases, the interviewed customers expect that service providers solve problems and provide spares within hours. As an interviewee put it, “we only choose service providers with a comprehensive service network and a very fast spares supply for which we are willing to pay.” For the interviewed customers, a long-term relationship with a good quality, reliability and a fast delivery service is more important than short-term cost savings (and this also affects the primary product sales). All customers stated that they turn to suppliers or competitors if they are dissatisfied with the OEM’s after-sales service (prices, delivery capability, flexibility). Some customers prefer to have one contact partner for all after-sales concerns. A full-service contract with an OEM (or competitor), an operator model or leasing guarantees the customers a high level of machine availability, best spare parts quality, simplicity, technical know-how at a high level, defects liability and predictable costs. However, most of the interviewed customers (77%) have a framework agreement with an OEM in place for spares availabilities and price discounts, as well as fixed field service hourly wage rates. “The OEMs attempt massively to bind us onto their after-sales services. However, in the recent past suppliers and further spares and service providers have tried hard to get after-sales orders from us.” Beyond the warranty period, all interviewed OEMs only continue to offer guarantee services if customers used exclusively OEM spares. Furthermore, the OEMs try to sell long-term service contracts upfront with the sale of the primary product. The most important success factor for suppliers is that their potential after-sales customers are aware of their offers. The customers have the impression that most OEMs try to keep their supply chains opaque in order to avoid SCD.

Total cost of ownership and after-sales services are decisive in the purchase of a primary product. A group of managers put it this way: “All maintenance expenses are planned for the whole product life cycle when the primary product is purchased.” During the warranty



period the interviewed customers purchase spares and services only from the OEM. Afterwards the price, network, delivery service (availability) and safety aspects are factors which determine the decision whether spares and services are purchased from the OEM, suppliers, or other providers. Notably, the price of a part is 10-60% lower if customers purchase it directly from the supplier instead of the OEM. Furthermore, the bundling of spare purchases creates opportunities, so that some customers standardize their parts wherever possible and pool their orders to benefit from economies of scale. Customers with large machinery have their own spare parts storages organized according to demand frequency, value, and criticality. Certainly, the trade-off between storage costs vs. availability is always a consideration. Complex parts and special services (e.g. electronic controls or gears, modifications and upgrades) are purchased from the OEMs. Wear and standard parts are very often purchased from suppliers or bought on the open market, although many customers have had bad experiences with spares pirates (whose quality is as low as their prices). The older a machine or plant, the lower the tendency to purchase OEM parts and services. A third of the customers mentioned that their requirements for certifications and high quality standards limit the potential after-sales providers to the point of creating a monopolistic situation with the OEM as sole service provider. At the same time, 22% of the interviewed customers state that sole / single sourcing is not an option. If there is only one supplier, they strive for a partnership.

More than three-quarters of the interviewed customers perform maintenance with an in-house service department, purchase spares externally, and occasionally engage specialists from the OEMs for major revisions and modernizations. In such cases, the service know-how remains within the firm, fast reactions in the case of failures are possible, cost efficiency if the utilization ratio is high, the service know-how for different machines and brands is built up, and employees are committed to the firm (attitude, working philosophy) in a way that contractors rarely are. However, from time to time, the decision not to outsource is questioned

by the maintenance department. Most customers in our sample (77%) have a hybrid maintenance strategy; the remaining 23% have a preventive maintenance strategy. The customers follow the maintenance instructions of the OEMs. In order for preventive maintenance to be meaningful, the residual utilization period for high-end key parts should be long enough to justify replacement. Critical equipment and machineries (without redundancies) tend to be preventively maintained.

### **4.3 The supplier perspective**

“We have to be noticed by the customers through active marketing, a good service network and intensive customer care because the OEM is usually the first point of contact for the customers in the after-sales business,” commented an interviewee. The suppliers become increasingly conscious of the attractiveness of the after-sales business - not unlike the OEMs. All of the suppliers (100%) interviewed practice SCD, for which the customer’s familiarity with the supplier is a basic requirement. The balance of power and mutual dependency between supplier and OEM is another crucial factor for SCD. The supplier also needs to have reached a certain critical size or exclusivity of parts to venture SCD. For instance, the OEM is dependent on the supplier for next-generation products if the supplier is a technology, quality or innovation leader, and the OEM has no adequate replacement. Furthermore, the behavior of the OEM (transparency, communication, profit-sharing) can either inhibit or promote SCD. 40% of the suppliers deliver their parts to OEMs, competitors and customers.

The suppliers try to make service contracts with the customers for their components and often offer value added after-sales services like training, upgrades, and process optimizations. A compelling sales argument is the superior knowledge of their own parts which the supplier will automatically possess. The supplier is more frequently considered as a contender for after-sales services and spares supply if the parts are very complex. To assist with the initial

startup of a machine or plant gives the supplier a big lead for winning after-sales orders. The interviewed suppliers realized that offering services for the entire machine (and not solely for their own components) is an important competitive factor, because the customers do not want a long list of contact persons for their after-sales activities. “We have to perform better than the OEMs regarding price, know-how and speed, because customers get abandoned by the OEM’s after-sales services especially if they are unsatisfied with these aspects,” reported certain suppliers.

In general, a good cooperative relationship between the OEM and supplier is not only mutually beneficial, but also for the customer in the form of lower prices, faster response time and better know-how. One possible collaboration agreement might be that the OEM forwards customer inquiries directly to the supplier and the supplier delivers the parts to the customer, passing on a small margin to the OEM. In this way, the OEM and supplier can build an alliance against further competitors.

#### **4.4 The competitor perspective**

A variety of firms operate as competitors in aftermarkets. Competitors might be independent service companies of varying sizes, sometimes offering both services and spares, OEMs which do not focus exclusively on their own machinery, spare parts dealers, spare part pirates or spare parts repair services (especially for high value parts). These firms are partly managed by former employees of OEMs or they are outsourced, service departments independently-acting from OEMs. Some of these firms have specialized in one industry or machinery type or in machineries of a specific OEM. Furthermore, competitors might concentrate on a market niche, for instance, by offering services and spares for very old product generations which are no longer served by the OEMs, or they offer their services in a limited area where no OEM service subsidiary exists.

The intensity of competition in after-sales services is much higher than in spare parts. In general, the simpler a product, the more competition exists in the aftermarket, and the older a product the more likely it is that servicing and maintenance is carried out by competitors. All interviewed competitors offer services and obtain spares externally, either from OEMs, suppliers or other sources. A director of a service firm revealed: "The OEMs try to bind us to their spare parts supply through compatibility-barriers (plugs, software, etc.)." In general the competitors are satisfied with the spares delivery availability and speed of OEMs and other spares providers. For this reason, 66% of the interviewed competitors maintain only a small spares storage facility of their own, in some cases these spares are only stored in the cars of the service technicians. However, purchasing spares without an own inventory leads to dependency, and the spares producers determine the parts availability, and hence the product end of life.

"Our strongest sales argument and a main competitive advantage compared to OEMs is that we provide complete solutions for our customers. We offer services for different machines from different manufacturers." Most interviewees (competitors) made a similar statement during the expert interviews. In an attempt to establish good relationships with OEMs, competitors are supported with engineering drawings and a good supply of spares. Certainly, from a customer perspective it is desirable to have only one firm for all after-sales concerns. Often competitors not only offer a much better price, but also a quick and flexible response to customer concerns due to flat company hierarchy and their proximity to customers.

All interviewed competitors attempt to have the customer sign service contracts, because such long-term service contracts are profitable, and because acquiring new customers is significantly more expensive and time-consuming than maintaining a base of satisfied customers.

**5. Relationship archetypes in aftermarkets**

From our cross-case analysis, we derived five triadic and twelve tetradic relationship archetypes. They are intended to be a classification scheme that simplifies the complex dynamics of the relationship constellations in aftermarkets. From the data we learned that triads cannot depict all constellations on aftermarkets, therefore, we had had to extend our analysis to tetrads.

**5.1 Triadic archetypes**

We derived five triadic relationship constellation archetypes referred to as 3-1 to 3-5 (Figure 7). Arrows between the actors in each archetype indicate the flow of materials (after-sales services and spare parts), information or financial resources.

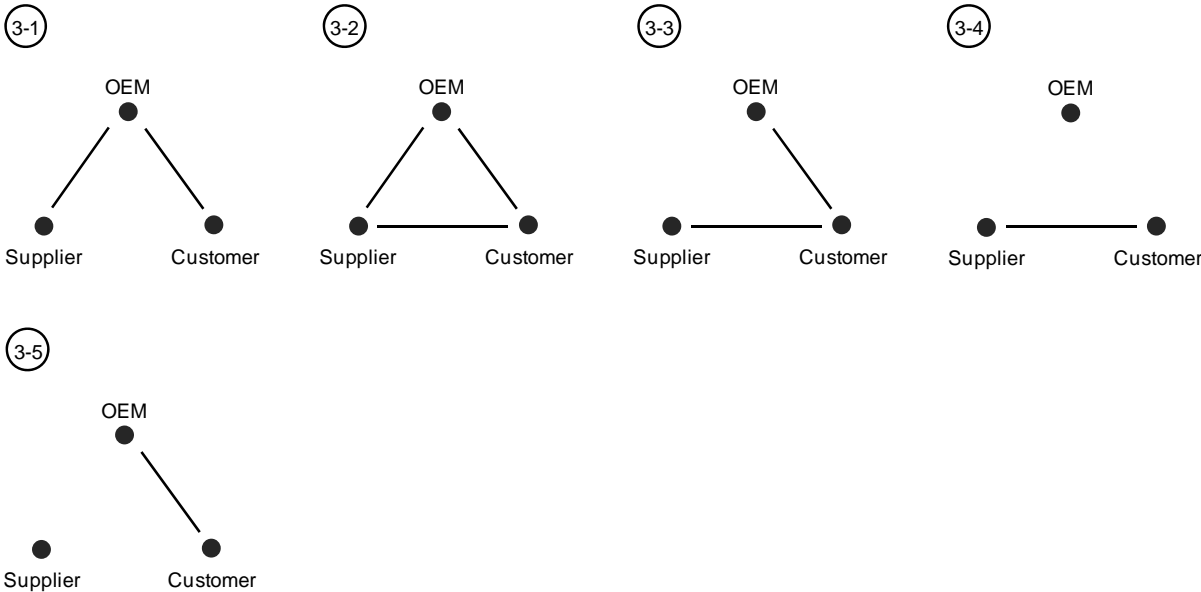


Figure 7: Triadic relationship archetypes in aftermarkets

Archetype 3-1 represents a classical value chain comprised of three actors. A supplier delivers basic materials, semi-finished goods or complete spare parts to an OEM. The OEM manufactures final spare parts using materials from the supplier or acts as an intermediary if

complete spare parts are received from the supplier. Subsequently the spares are delivered to the customer by the OEM; after-sales services might also be provided. The OEM acts as the bridge (*tertius iungens*) between the supplier and the customer with no direct link between the latter. In this case, the OEM has full control of what information to share and how to share it with its suppliers and customers. The OEM has access to information about the supplier's capability and capacity and the customer's after-sales requirements. This archetype often appears at the end of the primary product sales cycle and is an initial situation in the aftermarket. For instance, most interviewed OEMs aim for this archetype through service contracts, leasing, operating models with the customers and agreements with the suppliers. "Fifteen to twenty years ago only this archetype existed in aftermarkets," stated an interviewee. From the supplier's point of view, this archetype is not worth pursuing because the OEM acts as an intermediary and profits from a structural hole. From the customer perspective, the advantage is to have a single firm (OEM) for all after-sales concerns, offering high quality, safety, reliability and defects liability.

Archetype 3-2 depicts a situation where the same relationship constellations exists as for archetype 3-1 plus a connection between the supplier and customer. Hence, the supplier sells spare parts directly to the customer and might also offer after-sales services. At the same time, the supplier continues to deliver the same parts to the OEM. This new connection can either be initiated by the supplier (marketing / advertisement) or the customer. A basic requirement for SCD is that customers know the supplier at all. However, the supplier needs to be of a certain critical size, power or exclusiveness to venture SCD and often the customer has a huge machinery / fleet if he intends SCD. Interviewed customers with no maintenance department of their own mentioned that it is important for them that the supplier also offers after-sales services in addition to spares. Definitely, the OEM will give away a part of its after-sales business to its supplier.

Archetype 3-3 is characterized by a rivalry between the OEM and its former supplier. For any number of reasons, the connection between the OEM and supplier has ceased to exist. The supplier might sell spares to the customer, offer after-sales services or provide both. The case study firms indicate that this archetype applies mostly to spare parts; generally, it is not a common archetype, as the interviewed OEMs suggested that they would only switch suppliers in exceptional cases (termination of production, bankruptcy of a supplier; trouble in the relationship). For standard parts, the replacement of incumbent suppliers is easier as there is a big choice of suppliers.

Archetype 3-4 shows a situation where the OEM has gone out of business due to various reasons. No links exist between OEM and supplier or customer. This relationship constellation might occur for single spare parts, up to the whole service and spare provision for a complete product generation. In the latter case, the supplier is the customer's only business partner. Mostly, both the supplier and the customer have a certain critical size, and the supplier should have enough power or exclusivity to pass over the OEM. Certainly, from the supplier's point of view, this relationship constellation is attractive and worth pursuing. As long as the OEM stays disconnected from the customer, the supplier enjoys a position of the *tertius gaudens*. Hence, OEMs will try to prevent this relationship configuration. This archetype is only tolerated by the interviewed OEMs for very old product generations. The case study firms indicate that this archetype occurs for fast-moving c-parts or for system components (motors, gears, electronic control units, etc.) where the OEM acts only as an intermediary.

Archetype 3-5 illustrates a relationship constellation where the only connection exists between the OEM and the customer. The former supplier of the OEM is out of business. Like archetype 3-3, the OEM might produce the parts that had been obtained from the supplier either by himself or has acquired another supplier. The case study firms confirmed that this archetype occurs rarely; however, the situation may arise where the supplier is located in a

low-cost country and due to reasons of flexibility and speed the OEM selects a more expensive supplier due to close proximity.

### 5.2 Tetradic archetypes

Extending the triadic archetypes, we identified twelve tetradic relationship constellations (Figure 8), referred to as 4-1 to 4-12, respectively. This section only describes those tetradic archetypes which are not realizable in a triadic relationship constellation.

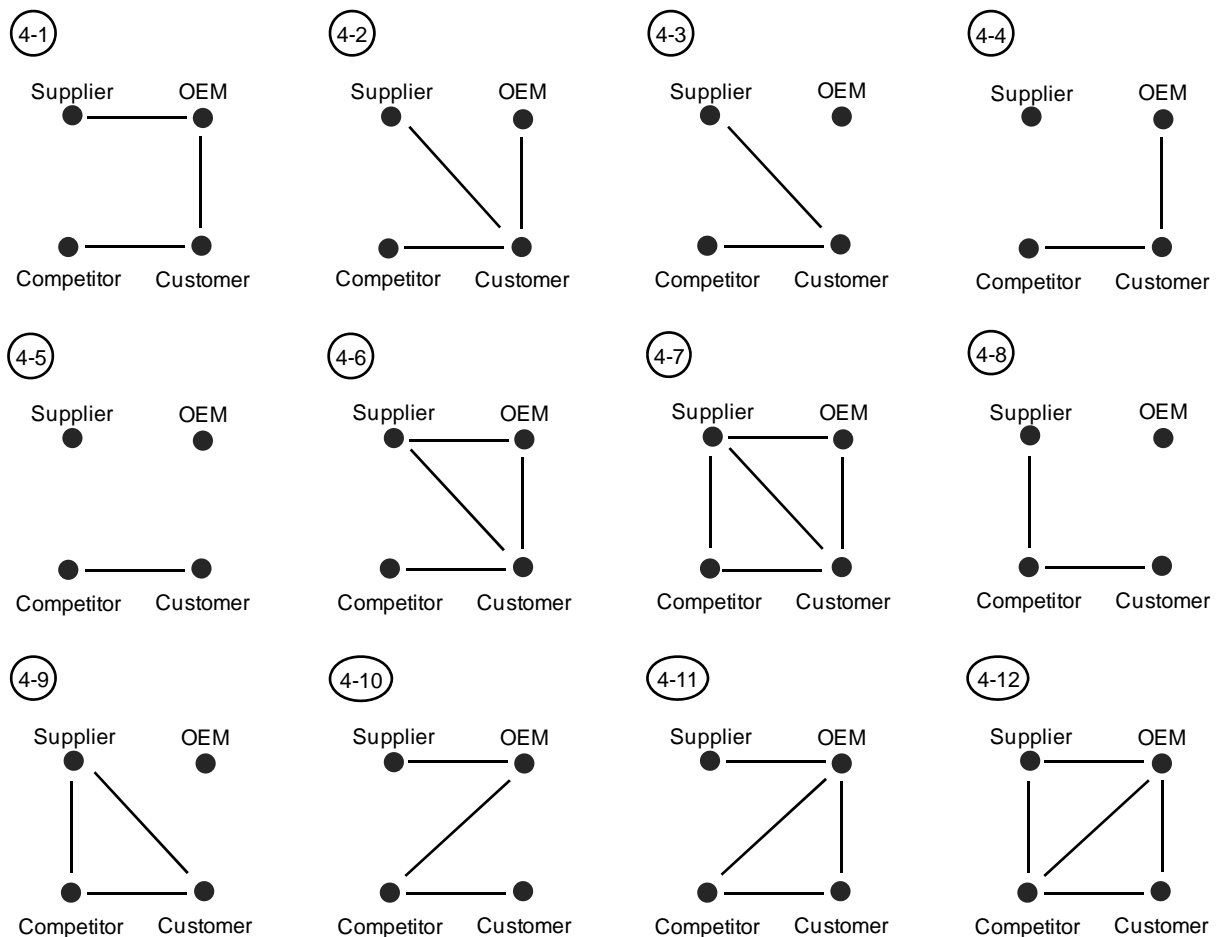


Figure 8: Tetradic relationship archetypes in aftermarkets

Archetype 4-1 is based on the same aftermarket relationship constellation as the triadic archetype 3-1 but in addition a further party (competitor) competes with the established value



chain. The competitor might offer a few spares up to a complete after-sales service portfolio to the customer in direct competition to the OEM. The case study firms reveal that the competitors often specialized on services or fast-moving spares, such as, consumables and wear parts (lubricants, brake discs, toner, etc.). These business segments are often highly competitive and thus they offer only low margins, however the size of the installed base is as well a crucial factor, whether competitors are attracted or not. The interviewed OEMs often try to counter competitors with high quality to ensure a longer product life and higher operational reliability.

Archetype 4-2 illustrates a relationship constellation where the customer can choose among three sources offering after-sales services and / or spare parts. The OEM, supplier and competitor are rivals in the aftermarket. There is no link between the OEM and his former supplier due to various reasons. This competitive situation can occur for a single spare part up to a complete after-sales service portfolio. However, the case study firms mentioned that this archetype occurs rarely in the spare parts business, because the OEMs intend to prolong a business connection between themselves and their suppliers, a fact confirmed by the OEMs we interviewed. This constellation appears more often in services, whereas mostly customers contact different providers to initiate business relations with them. All interviewed customers are conscious of the trade-off between one firm for all after-sales concerns, and a portfolio of after-sales providers with the best combined price-performance ratio but higher transaction costs.

Archetype 4-3 consists of a supplier and competitor, both offering spares and / or after-sales services to a third party (customer). The OEM is out of business; perhaps it consciously withdrew from the market of very old product generations, or customers decided to buy consumables and standard parts from another party. All case study firms indicate that this archetype rarely occurs.

Archetype 4-4 consists likewise of two parties, an OEM and competitor, both of which are offering spares and / or after-sales services to a third party (customer). There is no link between the OEM and his former supplier for whatever reason. This archetype occurs rarely at the case study firms because OEMs intend to perpetuate a business connection with their suppliers, and suppliers try actively to participate in the after-sales business. This constellation might occur for certain services or if the OEM bought up a final order of spares from the supplier, for instance simple mechanical parts which are not affected by obsolescence.

Archetype 4-5 represents a relationship constellation where the OEM and supplier are out of business due to a variety of reasons. Only a competitor offers spares and / or after-sales services to the customer. The competitor might offer better after-sales services than the OEM or the supplier in the form of lower prices, higher quality, higher speed and better customer care. This archetype is prevalent in low-cost markets because OEMs and their suppliers are too expensive and a lower quality is sufficient. However, not all spare parts (particularly custom-made parts) can be procured on the open market as most competitors concentrate on fast-moving items.

Archetype 4-6 shows the classical value chain (supplier → OEM → customer), but there also exists, in addition to this, a direct relation between the supplier and the customer and, a competitor offers spares and / or services to the same customers. All three parties which offer spares and / or after-sales services are in a competitive situation - SCD occurs. However, the supplier and OEM are still working together, because the supplier delivers spares and components to the OEM, who resells these parts to the customer. This archetype is often initiated by customers who wish to optimize their price performance ratio by obtaining after-sales services and spares from different providers. The case study firms revealed that this archetype is typical for consumables and wear parts (c-parts), as well as for after-sales services. However, the interviewed customers mentioned that they often perform these

services by themselves, and purchase spares from several sources. The willingness of the customers to assume risk is crucial here, determining if and to what extent they are willing to buy non certified parts on the open market. Some of the interviewed suppliers strive for this archetype since collaboration with a competitor is not desired. Instead, the supplier and OEM combine forces in attempt to put the competitor out of business.

Archetype 4-7 is characterized by the same relationship constellations as archetype 4-6 with an additional link between the supplier and the competitor. Hence, the supplier delivers the same components and / or spares to the OEM, the customer, and the competitor but each with different pricing conditions depending on the order quantity. Furthermore the OEM, supplier and competitor might offer after-sales services to the customer. The supplier must be both willing and able (in terms of capacity, transaction costs, etc.) to work together with three actors. Such suppliers often produce exclusive parts and have considerable market power - perhaps even a monopoly - and the other actors might be dependent on them. The likelihood of opportunistic behavior on the part of the supplier is high, and the relationship between the supplier and the OEM is not intact; a good OEM-supplier relationship might prevent the supplier-competitor business connection.

Archetype 4-8 shows a relationship constellation where the OEM is out of business due to various reasons. A new relation has emerged between the former OEM supplier and the competitor. The supplier no longer delivers parts and components to the OEM but to the competitor. The customer obtains spares and services only from the competitor who has a certain market power. “We offer the supplier more attractive conditions than the OEM”, said an interviewee from a competitor firm. A dysfunction in the relationship between the OEM and supplier could have been caused by too high pricing pressure from the OEM on the supplier. However, this archetype might be tolerated by the OEM for machines which have reached the end of their product life cycle or certain components.

Archetype 4-9 is characterized by the same relationship constellations as archetype 4-8 with the addition of a direct link between the supplier and the customer. The former OEM supplier and a competitor divide the aftermarket up between themselves - maybe for a particular spare part or up to the services and spares required for a complete product generation. They remain rivals and business partners simultaneously. This archetype might be tolerated by the OEM similar to archetype 4-8 (e.g. for old product generations). The case study firms indicate that this archetype often occurs if customers are dissatisfied with the after-sales performance offered by the OEM or if no local OEM service dependencies exist and thus customers avoid establishing after-sales business relationships with the OEMs.

Archetype 4-10 contains a supply chain from the supplier via OEM to the competitor and finally on to the customer. The case study firms mentioned that, in this relationship constellation, the OEM delivers spares to the competitor and the competitor provides all services and spares to the customer. The customer receives all after-sales services and spares for his equipment from one provider. “We have the competitive advantage in that we offer after-sales services to customers for machines from different OEMs,” stated an interviewed manager from a competitor firm. The competitor benefits from a structural hole between the OEM and customer. An OEM-competitor agreement may exist as a full service contract between customer and competitor while the OEM concentrates on spare part production. The OEM has to decide whether or not to collaborate with the competitor; the OEM benefits from the spare parts business while at the same time supports the competitor allowing them to offer original spares to their own customers.

Archetype 4-11 represents the same supply chain as archetype 4-10 plus an additional link between the OEM and customer. The customer does not want to be dependent on one firm in the after-sales business but has business relationships with a competitor and OEM. The latter work together to deliver spares to the customer. However, the OEM tries to prevent

a direct link between the supplier and competitor (by contract, joint development, etc.) so as to benefit at least from the spare parts business.

Archetype 4-12 is characterized by the same relationship constellations as archetype 4-11 but with an additional link between the supplier and competitor. As indicated by the case study firms, this is a common archetype in which, the competitor obtains spares from the supplier as well as from the OEM. The competitor might be a spares wholesaler, service repair shop or a dealer who offers services for the products sold by him or a specialist firm (e.g. only large revisions, upgrades, trainings, process improvements).

## **6. Conclusions**

A main motivation behind this research was that firms increasingly recognize the promising benefits of aftermarkets and are consequently trying to increase their market share. As a result, the competition in these markets is intensifying. In addition to facing numerous competitors, suppliers are abandoning their longstanding relationships with their OEMs and competing against them in the aftermarket. Indeed complex relationship constellations have emerged. This paper explores the gap between the growing relevance of aftermarkets to many firms in a variety of industries and the lack of systemic research on competition and relationships in aftermarkets. In an attempt to fill this gap (at least partially), we identified five triadic and twelve tetradic archetypes of relationship constellations to structure and analyze relationship interconnectedness, using case study-based research. Understanding triadic and tetradic relationship constellations is a first but sufficient step to analyze larger networks; the former are the building blocks of higher-order and complex network structures. Therefore, by extending the social network theory into the after-sales context, we revealed triadic and tetradic relationship archetypes. Furthermore, the empirical evidence presented in this paper suggested that there are no ideal and universal relationship types, either for the

competitor, supplier, OEM or customer. As our research shows, it depends on the perspective of the player.

### **6.1 Managerial implications**

This study offers practical guidance for after-sales managers to reconsider and improve their current practices by adopting a network perspective. They need to be aware of the interdependencies among the actors on the aftermarket which will affect the operations of their own firm. Thus, proactive steps are necessary to manage and succeed. The analysis of interconnectedness also forces managers to think about specific situations and explain and justify their perception of the business network in which their company is embedded.

The actors in aftermarkets may have different strategies and their interplay with respect to their position in gaining market share and achieving competitive advantages would aim at: (1) trying to influence the network structure in their own favor; (2) gaining a position of power in the form of a structural hole in order to control others' behavior; (3) establishing cooperation, co-opetition and competition with other aftermarket actors depending on the situation; (4) achieving an optimal position of structural embeddedness within the after-sales network.

A cooperative and fair OEM-supplier relationship and a mutually beneficial OEM-customer relationship might be ideal from the OEM's perspective because it decreases the possibility of SCD by the supplier and customer. At the same time, a competitive OEM-competitor relationship and an initiated competitor-customer relationship might be ideal from the competitor's perspective because it might increase the market share of the competitor at the expense of the OEM. These observations together point to a conflict of goals among the actors in aftermarkets, as different actors favor different relationship constellations.

In conclusion, the practical contributions for managers are as follows:

- Archetypes can be used as a classification scheme to capture relational dynamics in aftermarkets.
- The ability to categorize relationships can be a means of controlling and managing the aftermarket.
- Archetypes can be used to construct successful after-sales strategies to meet the company's objectives.
- After-sales managers can become more effective and successful in their competitive aftermarkets.

## **6.2 Theoretical contributions**

First, through the lens of social network theory, we analyze relationship constellations among different actors in aftermarkets. In doing so, this study is one of the first attempts to theorize relationship patterns in the triadic and the tetradic context in aftermarkets. Our network perspective of aftermarkets provides a more complete and comprehensive understanding of firm competitive behavior (Håkansson & Snehota, 1995; Manski, 2000). We have broadened the relationship-archetype research approaches of Choi and Wu (2009), Dubois and Fredriksson (2008) Rossetti and Choi (2005; 2008), Choi and Kim (2008), who focused only on triadic relationship constellations by expanding our analysis to tetrads. Furthermore, we considered more complex relationship constellations, than for example Lazzarini, et al. (2008) who analyzed tetradic alliances consisting of one buyer-supplier and one supplier-supplier relationship.

Second, specification of seventeen archetypes is a theory development endeavor (Bailey, 1994; Doty & Glick, 1994). Each archetype represents a holistic configuration of multiple constructs (e.g. relational posturing, relational behavior) that capture intricate relationship constellations in aftermarkets. All proposed archetypes emerging from the

twenty-nine cases condense the intricacies of competitor-supplier-OEM-customer relationship to types that are easy to relate and grasp. Each archetype encompasses certain assumptions, describes certain relational dynamics and forebodes certain future developments of the relationship.

### **6.3 Limitations**

First, the primary disadvantage of case studies is the lack of external validity and generalizability (Eisenhardt, 1989). We tried to compensate this concern by using a quite varied sample that suggests a possible generalization of our findings to numerous industries. Case studies do provide an opportunity to understand complex situations and generate hypotheses (Voss, et al., 2002; Yin, 2008). For instance, this exploratory research provided a better understanding of the manner in which actors operate on aftermarkets.

The second limitation concerns the relatively small sample size. The findings of this paper are derived from a limited number of cases and relations among different factors and configuration choices are provided on a qualitative basis. We took on the ambitious task of collecting network data and we ended up with seventeen relationship archetypes. Broader empirical research would help transforming suggestions into a normative model.

Third, we were unable to collect data from all firms involved into the analyzed relationship constellations. For instance, if we interviewed an OEM we tried to conduct talks with their customers, suppliers and competitors. To overcome this shortcoming by triangulating data, we collected information from additional interviewees and through further observation and documentation.

Fourth, we analyzed twenty-nine cases from a static viewpoint. If a time dimension is added, additional effects can be analyzed. This leads into the field of network dynamics (Newman, et al., 2006). Most companies operate in a changing environment and must manage



change within and through relationships. The analysis of interconnectedness between relationships over time is a challenging research topic.

#### **6.4 Future research**

The network structure of aftermarkets and the competition on those markets provide fascinating areas of research. The findings of the present study illustrate the importance of knowledge about relationship constellations in aftermarkets, shedding light on valuable avenues for future research. Our study is only the first step in this direction. Nevertheless, we have been able to gain insights into triadic and tetradic relationship constellations in aftermarkets by using social network concepts. There remain ample additional opportunities to extend our research.

First, a broader sample of firms would help to better understand differences between specific industries where the firms operate in and the relationship constellations. For example, some case study firms from industries such as aviation, health care, passenger transportation or defense mentioned that statutory provisions and formalities have a strong impact on their business and the competitive situation. In these cases, the number of competitors in the aftermarket is limited because each part needs a certification, and services can only be offered by authorized firms. Therefore, comparing relationship constellations based on the archetypes derived in our research across industries would be a worthwhile area for future research.

Second, future research could focus on the endogenous and exogenous influence factors which cause a certain relationship archetype to arise in aftermarkets. Furthermore, researchers could examine which of these factors influence not only the likelihood of certain relationship archetypes, but also how fast and with which strategies (aggressive, forbearance, retract) the actors in aftermarkets respond to the new conditions, as well as the effects (neutral, positive or negative) of inter-organizational relationships on other inter-organizational relationships.

Third, to further empirically test the validity of the proposed seventeen archetypes of aftermarket relationships, future researchers may collect large samples of empirical data and use cluster analysis (Kaufman & Rousseeuw, 2005) or the numerical taxonomy method (Sneath & Sokal, 1973) to identify types of relationship archetypes and compare them with the ones specified in this study. The idiosyncratic nature of case research methods calls for further testing of the proposed archetypes.

## 7. References

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## **IV Chapter – Determinants of relationship constellation formation in aftermarkets**

### **1. Introduction**

In comparison to the primary product business, the after-sales business offers various advantages, not only for OEMs, but for an increasing number of other firms. Besides the opportunity to generate a stream of revenues and profits for every primary product sold over the entire product life cycle, without being affected by cyclical fluctuations, the after-sales business is a strategic driver for long-term customer satisfaction and loyalty. Nowadays, in many business sectors, retaining customers has become more important than finding new ones. In industries such as automobile, household appliances, mechanical engineering, and aviation, firms have sold so many units over the years that the revenue potential of the aftermarkets have become four to five times larger than that of the primary product market. The after-sales business of an average manufacturer contributes to 30-40% of total revenue and up to 70% of profits - with margins twice to three times as high as in the primary product business. In an increasing number of industries, the opportunities for revenue and profit generation are currently greater in the aftermarket than those existing in the primary product market because of the progressive commoditization of primary product features, and huge labor cost advantages of Asian producers, resulting in dwindling profit margins in the primary product business (Bundschuh & Dezvane, 2003; Dennis & Kambil, 2003; Legnani, et al., 2009; Rolstadaas, et al., 2008). However, the attractiveness of aftermarkets has also been recognized by an increasing number of other market players like suppliers, and competitors to the OEMs, leading to an intensification of competitive activity in these markets. Knowledge about how the competitive mechanisms of the aftermarket work, the players involved in them, and the business relationships between them, are key to success and beneficial to achieve

competitive advantages (Carlton & Waldman, 2010). At the same time, customers' purchase decision are no longer solely based on the product's value (price-performance ratio), but on the overall product lifecycle costs, as well as the portfolio of service and spares being offered. As a consequence, they are ever more demanding when it comes to excellent after-sales services (Jacob & Ulaga, 2008).

Several definitions of after-sales services / management can be found in the pertinent literature (Asugman, et al., 1997; Goffin & New, 2001; Phelan, et al., 2000; Shapiro & Teece, 1994). We define after-sales management as sum of activities taking place after the purchase of a primary product, whereby the aftermarket product or service is used in relation to that primary product. Hence, the portfolio of after-sales services encompasses both spare parts and services like maintenance, repairs, trainings, upgrades and much more. The goal of after-sales services is to ensure the continuous availability of the primary product for trouble-free operations during its entire lifecycle, to solve the problems which degrade its function, as well as increase its overall efficiency and productivity.

Aftermarkets - also called "secondary markets" - comprise markets for complementary products and services which are purchased subsequent to the purchase of a primary product, to which they relate. Aftermarkets are characterized by huge revenue and profit potentials, a high variability of demand, low volumes for certain spare parts, a high need of timeliness, and complex distribution networks. Several different firms operate in aftermarkets (Carlton & Waldman, 2010). In this study we concentrate on the following four main actor groups: *OEMs* (*Original Equipment Manufacturers*) are the brand owners, who produce and sell the primary product. *Suppliers* of the OEMs may move beyond the primary product market in a variety of configurations. In the aftermarket, they might continue to act as suppliers, or, having terminated the business relationship to the OEM, they move on to selling their parts directly to the customers, or they act as a combination of both. *Customers* are those who have bought the primary product, and require after-sales services over the duration of its product life cycle.



They can choose between different after-sales service providers (OEM, supplier, competitor). Belonging to the group *competitors* of the OEMs, are other OEMs, service providers, repair shops, parts manufacturers, spare parts pirates, and retailers which offers after-sales services and / or spares.

To understand aftermarkets and their success factors, the interactions and activities of firms should not be analyzed in isolation, but must be considered in a wider context (Dubois, 1998; Håkansson & Ford, 2002). A firm's strategic position can be affected by rival and partner firms' strategic choices. Therefore, to understand sources of profitability and competitive advantages, a firm must know and consider the determinants influencing the competitive structure of aftermarkets (Håkansson & Snehota, 2006). These determinants can be classified into intra-firm, intra-network and external. Depending on the characteristics of a particular determinant, different types of relationships arise between players and the resulting market structure can be reasonably anticipated.

In this study, we intend (1) to identify and examine determinants which influence relationship constellations, and hence the competitive conduct on aftermarkets, which can be used to anticipate aftermarket formations and the competitive conduct of the players in those markets, as well as (2) give recommendations to the players in the aftermarkets for their strategic positioning, and suggest approaches to managing the relationships from different perspectives. This means that neither persons, products, nor firms are the object of our research, but the determinants which influence the relationships formed between them, which ultimately will constitute the aftermarket structure. Due to the explorative character of our research, we have taken a case study approach. In doing so, we focus not on a single industry, nor on a particular firm size, to obtain generally applicable data and conclusions.

In order to achieve our research goals, we use relationship research, as well social network theory as our theoretical framework. Through these two theoretical lenses, we specify a total of eight determinants of relationship formation in aftermarkets. We then

proceed to make recommendations to the players involved for their competitive conduct and identify which types of relationships to other players facilitate market success.

The remainder of this paper is organized as follows. The next section presents a literature review and our theoretical framework. Section 3 describes our methodical approach. Following this, in section 4, we present our research findings. In this section, we point out determinants of aftermarket structure formation, and give recommendations on how firms should interact in aftermarkets. Finally, Section 5 draws a conclusion and points out managerial and theoretical implications of our work, as well as suggests directions for future research.

## **2. Literature review and theoretical framework**

The success of a firm on the aftermarket depends - beside its own resources and skills - on the knowledge of the market, and other players. The competitive behavior of one firm affects other firms in the same market. Firms are dependent on each other, and operate in the context of interconnected business relationships. The market structure has a strong influence on the best competitive strategy of any particular firm. Hence, for every firm, it is important to know the determinants which constitute the structure of its aftermarket (Easton, 1992; Håkansson & Snehota, 1995, 2006; Ritter & Gemunden, 2003).

This paper is a follow-up to the work from Jönke, et al. (2012). Through case study research, the authors identified five triadic, and twelve tetradic relationship constellations in aftermarkets. In their study, triads comprise OEM, supplier, customer, and tetrads, in addition a competitor. Building on these results, we want to analyze here which determinants and characteristics leads to certain relationship constellations on aftermarkets, and thus to a specific market structure. Therefore, our literature review comprises the literature in the field

of competitive strategy and conduct in aftermarkets, as well as the introduction of the theoretical background of our work (relationship research and social network theory).

## **2.1 Industry structure and competitive strategy**

Research on competitive strategy has been concerned primarily with understanding what makes a firm successful in its market environment. In early works in this field, scholars (e.g. Andrews, 1971; Ansoff, 1965; Chandler, 1962; Learned, et al., 1965) had given equivalent attention to firm strengths and weaknesses versus the opportunities and threats in the competitive environment. The theory of generic competitive strategy from Porter (1980, 1985) is one of the most substantial and influential contributions to the study of strategic behavior in firms. Porter analyses the competitive environment in which a firm operates when assessing the firm's own strategy. He identifies five basic competitive forces which determine the market structure: threat of new entrants, bargaining power of buyers, rivalry between existing competitors, threat of substitute products, and the bargaining power of suppliers. The strength of these forces can range from intensive to low. The theory supports firms by identifying competitive advantage (cost or differentiation), and makes recommendations about the strategic positioning required to prosper in their environment. The goal of competitive strategy for a company is to find a position in its industry, where these competitive forces will do it the most good or the least harm. The very general approach of Porter, which is neither industry-specific nor focused on a particular market (e.g. aftermarket), has been widely used by researchers studying relationships between firms' competitive strategy, and has been recognized as the dominant paradigm (Hill, 1988; Miller, 1986; Mintzberg, 1988; Murray, 1988).

## **2.2 Competitive conduct in aftermarkets**

A growing number of publications in the field of after-sales management emphasize the strategic importance of the after-sales business. This literature encompasses various fields of investigation, from after-sales strategy (Armistead & Clark, 1991; Frambach, et al., 1997), supply chain management in aftermarkets (Ashenbaum, 2006; Farris II, et al., 2005; Lewis & Naim, 1995), profitability of the after-sales business (Cohen, et al., 2006; Dennis & Kambil, 2003; Wise & Baumgartner, 1999), the transition of product-orientated manufacturers to a service-orientation customer view (Gebauer, 2007; Oliva & Kallenberg, 2003), product life cycle models (Cohen & Whang, 1997) to spare parts logistics (Huiskonen, 2001; Kennedy, et al., 2002). From this huge number of publications in the field of after-sales management, we identify and present in this literature review the relevant literature for our research purpose. Although managers and scholars alike have recognized the after-sales business as key to long-term economic success, only a few scientific studies have been carried out on the factors influencing the structure and the competitive conduct of the players in these markets.

The aftermarket, however, has been studied from a competitive perspective in legal publications. A significant body of literature in this field discusses the economics of aftermarket competition. Those papers discuss the impact (price, dependencies, availability) of monopolies of OEMs, the market power of the customer, the competitive conduct of other market players, and factors which promote or inhibit the monopolistic tendencies of the OEMs. In the beginning of the 90s the “Kodak-case” (Carlton, 2001; Festa, 1993; Hovenkamp, 1993; Shapiro, 1995) was the starting point for a protracted debate of whether anticompetitive effects are likely to arise when the OEM of a primary product monopolizes the aftermarket. The core of the debate addresses the question of whether an OEM can use its market power to charge supracompetitive aftermarket prices to its consumers, and thus risk losses in the primary product market in the future. Two opposing views try to answer this question. The first is the “Chicago view”, which argues that it is unlikely that an OEM can

enforce supracompetitive aftermarket prices. The second one is the “post-Chicago view”, which states that the OEM always tries to monopolize its aftermarkets and charge supracompetitive prices (Hovenkamp, 2001). In the meantime, several studies (Coppi, 2007; Gundlach & Foer, 2007) have shown that, in many cases, OEMs try to monopolize their aftermarket even if the primary product market is quite competitive, and consumers are fully informed about lifecycle costs. Shapiro (1995) analyzed the consequences and implications of the Kodak-case in a widely-cited study. He identifies four main reasons leading to aftermarket monopolization, with particular attention paid to the economic welfare of the end customer. Shapiro and Teece (1994) note that monopolization in aftermarkets can occur even if the competition intensity is high in the corresponding primary product market - in agreement with all later economic aftermarket analyses. The authors investigate the possibility of opportunism on the part of OEMs, and how reputation and contracts might limit opportunism. Klein (1993) argues inline with Shapiro and Teece about monopolistic tendencies in the aftermarkets based on the Kodak-case. Klein observes as well that reputation and contracts are adequate to prevent opportunistic behavior and aftermarket price increases on the part of OEMs. Borenstein, et al. (1995, 2000) develop analysis procedures for models of aftermarkets with well-informed customers who anticipate future aftermarket pricing from current actual pricing. The customers in their models are “locked-in”, that means customers cannot recover the cost of their investment in the primary product if they discover that aftermarket prices are higher than they expected. OEMs might act opportunistically, dependent on the customers’ anticipations. The authors show that there is generally a net social gain from removing aftermarket entry barriers. Hall (1997) takes an economic approach to antitrust policy. He investigates policy decisions that result in changes in competition in aftermarkets and measures the resulting changes in economic welfare for customers. The core of the analysis is a study of how markets would change in the face of a particular antitrust remedy.

Furthermore, some supply chain management scholars have studied competitive conduct in aftermarkets. In his research Lele (1997) develops after-sales strategies for OEMs to fulfill the needs of individual customer as cost-efficiently as possible in a competitive environment. He formulates three classes of strategies, namely product-design-related strategies, strategies focused on service support systems, and strategies aimed at reducing customer risks, depending on the downtime cost faced by the customers (consisting of fixed costs which do not depend on the downtime and variable ones which depend on the downtime). Ashenbaum (2006) analyzes the optimal design of supply chain structure to address both production and aftermarket needs in an increasingly competitive market. He gives advice which areas of supply chains should overlap, and be used together by primary and after-sales products alike.

This review shows that there is still a gap between the high importance of the after-sales business for an increasing number of firms, and the scientific literature dealing with aftermarkets and the strategic positioning of its players. In particular, to the best of our knowledge, no publication exists to date which investigates the determinants of certain aftermarket structures. In this article, we seek to expand the existing knowledge of aftermarkets and close this research gap. In the next sections, we will introduce the theoretical framework with which we will proceed.

### **2.3 Types of relationships**

Each firm operates in the context of various interconnected business relationships. The type of relationship affects the nature and the outcome of a firm's actions and its potential sources of efficiency and effectiveness (Gulati, et al., 2000; Håkansson & Ford, 2002; Håkansson & Snehota, 1995). Relationships are subject to a dynamic change and dependent on the present embeddedness of a firm into its environment (Johanson & Mattsson, 1992). Relationships can

change, for instance, from cooperation at one point in time, to competition, or co-opetition, at another. Types of relationships have been studied from many different perspectives. For instance, cooperation between competitors (e.g. Gomes-Casseres, 1994; Ring & Van de Ven, 1992), or how a relationship between a buying firm and a selling firm is affected by a third party, usually another seller or buyer (e.g. Gadde & Mattsson, 1987; Holmlund & Kock, 1995). Furthermore, business relationships have a vertical (firms on different levels of a supply chain) and horizontal (firms on the same level in a supply chain) dimension (Gulati, et al., 2000). In the following we will present different stereotypes of relationships, in a continuum between “cooperation” at one extreme, to “conflict” at the other end.

**Collaboration / cooperation.** Cooperation can be defined as coordinated actions taken by two or more firms in interdependent relationships to achieve mutually-beneficial, outcomes or singular outcomes with expected reciprocation over time (Hamel, et al., 1989; Kanter, 1994). There is a vast variety of forms of cooperation (formal and informal cooperation). The goals of a collaboration can be very diverse, however. A collaborative effort between firms that pool their resources might achieve more together (more resources, better skills, fewer risks, lower costs) than they could on their own. Repeated interactions and trust between the cooperating firms is an important requirement for a successful relation and leads to commitment to each other.

**Coexistence.** The relationship type coexistence can be defined as a situation in which actors operate in the same market with similar or the same objectives, but do not interact with each other. This nonobservance of the other actors arises due to ignorance of the actor in question, or a conscious decision to act independently. Even if a firm (e.g. OEM) is unaware of another actor (e.g. competitor) this firm might feel its impact through customers it is unable to capture.

**Co-opetition.** Co-opetition describes a business situation in which firms engage in simultaneous cooperation and competition with each other (Brandenburger & Nalebuff,

1996). A combination of competitive and cooperative aspects in one relationship might create higher profits for both firms involved (Lado, et al., 1997). The central, overarching goal is to create mutually-beneficial economic exchanges due to common interests in a competitive environment due to conflicting interests. OEMs might try to establish co-opetition between suppliers to elicit both collaborative synergy and market efficiency.

**Collusion.** The relationship type collusion can be defined as a collaboration between firms which directly or indirectly harm a third actor. Collusions might affect common competitors, and, in this case, they have a positive effect for the initiating parties, or they are understood as a necessary evil, for instance if the injured party is a customer, or society in general. However, it is not the main objective of a collusion to harm a third party, but is an inevitable outcome.

**Competition.** Competition between two or more actors in the same market occurs if they have similar goals, but their market success depends on a third party (e.g. customer). A competitive relationship might exist for instance between two OEMs offering after-sales services to the same customer, or between an OEM and supplier which sales spares directly to the customer. Often an action-reaction pattern arises between the competitors, because if a new service is offered by one of the competitors, the other will follow suit with a similar offer.

**Conflict.** The relationship type conflict can be defined as a situation in which the actors have mutually exclusive objectives, and battle against each other. At an intense level, this can mean striving to force the other actor out of the market. Conflicting firms conduct their market behavior primarily in terms of their competitors. Thereby, conflict can be pursued by direct or indirect means.



## 2.4 Social network research

Social network research centers on the relationships among social actors and the patterns and implications of these relationships (Dunn, 1983; Jackson, 2008; Wasserman & Faust, 1994; Wasserman & Galaskiewicz, 1994). Instead of analyzing individual behaviors and attributes, social network research lends its attention to how interactions among actors constitute a structure that can be studied and analyzed in its own right (Carrington, et al., 2005). Changes in one level of social network affect changes in another level (e.g. the network as a whole), and the reverse is also true. Social network research enables us to interpret and analyze individual firm behavior or interfirm interactions within the context of larger relational structures (Carrington, et al., 2005). In the following sections, we will introduce a set of concepts used in network theory which are useful for our research purpose.

**Supply chain disintermediation (SCD).** Disintermediation represents a fundamental structural change to a supply chain by creating new relationships among the players involved. In our context, the phenomenon of SCD constitutes an OEM's current or previous supplier overtly or opportunistically offering spare parts and / or after-sales services which have been so far distributed by the OEM to the OEM's customers (Rossetti & Choi, 2005). From the perspective of the OEMs the cost of disintermediation is great. Beside the immediate losses in the aftermarket, the OEM might experience decreasing primary product sales because products are used longer due to lower maintenance, repair, and overhaul costs.

**Structural hole concept.** A structural hole is defined as a lack of direct connection between actors in a network (Burt, 1995; Burt, 2001; Obstfeld, 2005). A structural hole occurs if one node is connected to other nodes that are not connected to each other (Ahuja, 2000; Gargiulo & Benassi, 2000). The structural hole between two disconnected nodes does not mean that the disconnected nodes are unaware of each other. Structural positions within a network determine the distribution of power, control and information in the network because actors in some positions in the network are better off than those in other positions (Tsai &

Ghoshal, 1998). A firm's bridge position is not a permanent state and can decay or can be transferred (Burt, 2000, 2002; Li & Choi, 2009).

**Structural embeddedness.** Embeddedness refers to the fact that economic action and outcomes are affected by a firm's relations and by the structure of the overall network of relations (Gnyawali & Madhavan, 2001; Provan, 1993; Uzzi, 1996). All relationships in aftermarkets should be seen as embedded in wider networks. Several authors (e.g. Gilsing & Duysters, 2008; Granovetter, 1985; Moran, 2005) distinguish structural from relational embeddedness, whereas the structural dimension includes social interaction, while the relational dimension, in contrast, refers to assets that are rooted in these relationships, such as trust and trustworthiness. In our research we will focus on the former, because structure refers to the characteristics of a network, such as how many firms a company interacts with, and how tightly- or loosely-coupled its relationships are (Håkansson & Ford, 2002). The concept of structural embeddedness brings to the fore the impact a network has on the firm's business decisions, actions, and outcomes on both positive and negative performance (Lin, 2001; Uzzi, 1996).

### **3. Methodology**

Our research design is based on multiple case studies in order to identify determinants of aftermarket structure formation and give recommendations to the main actor groups on those markets regarding their strategic positioning. The interviews focused on the after-sales business and strategy of each interviewed firm, the structure and competition of their aftermarkets, and types of business relationships. Due to the exploratory purpose of the research, case studies constitute an appropriate methodology (Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2008). This method gathers relatively detailed data, enabling a deep understanding of contextual factors and issues related to aftermarket structures, while

sacrificing statistical generalizability. Moreover, case studies allow the study of phenomena in their context. Our study adopted the grounded theory building approach (e.g. Glaser & Strauss, 1967; Strauss & Corbin, 1990). More specifically, the principles of theory building based on case studies were adopted (Eisenhardt, 1989). Our sample is composed of twenty-nine firms. Our empirical investigation was carried out in companies from a broad range of industries (e.g. aviation, printing, automobile, defense, household appliances, passenger transportation, machine building). We analyzed firms which operate as customers, OEMs, suppliers, and competitors, taking four different perspectives onto the formation of a particular market structure. Consequently, our findings are neither industry-specific nor company-specific, which helps us to build generalizable statements. We use pseudonyms (A, B, C, etc.) in order to protect the anonymity of the companies and the involved participants. Table 6 describes the sample firms.

Table 6: Case study firms

Firm	Type of firm	Industry	Country	Number of employees	Revenues (m € 2010)	After-sales revenues / budget (m € 2010)
A	OEM	Elevator construction	Switzerland	42,000	6,900	n.s.
B	OEM	Home appliances	Germany	40,000	8,400	n.s.
C	OEM	Print	Germany	24,000	2,650	1,722
D	OEM	Aerospace	Germany	15,600	4,600	1,520
E	OEM	Automotive	Germany	11,000	4,200	250 (spare parts)
F	OEM	Mechanical engineering	Switzerland	7,500	1,575	167
G	OEM	Machine tool construction	Germany	5,200	1,181	423
E	OEM	Mechanical engineering	Switzerland	4,796	1,155	153
H	OEM	Home appliances	Switzerland	1,200	368	42
I	OEM	Mechanical engineering	Switzerland	800	667	333
J	OEM	Mechanical engineering	Switzerland	670	150	27
K	OEM	Print	Switzerland	565	178	27
L	Supplier	Automotive	Germany	60,000	9,371	1,600
M	Supplier	Measuring technology	Switzerland	8,400	913	83
N	Supplier	Industrial Goods	Switzerland	3,300	1,400	n.s.
O	Supplier	Textile Industry	Switzerland	2,100	300	270
P	Supplier	Print	Germany	100	30	7
Q	Customer	Public transportation	Switzerland	9,300	2,900	475
R	Customer	Construction firm	Switzerland	3,793	1,000	29
S	Customer	Construction firm	Switzerland	2,416	532	8
T	Customer	Military equipment	Switzerland	1,000	1,833	458
U	Customer	Public transportation	Switzerland	400	42	6
V	Customer	Public transportation	Switzerland	260	50	9
W	Customer	Beverage bottler	Switzerland	200	140	0.8
X	Customer	Real estate management	Switzerland	70	92	4
Y	Customer	Print	Germany	70	11	2
Z	Competitor	Aerospace and Defense	Switzerland	7,500	1,413	Offers primarily services and spares
AA	Competitor	Mechanical engineering	Germany	220	25	Offers only services and spares
AB	Competitor	Home appliances	Switzerland	24	7	1

Note: 1 € = 1.2 CHF

Case studies were performed through semi-structured in-depth interviews, a detailed questionnaire (available from the authors upon request), direct observation (e.g. company tours), and the analysis of secondary sources (such as company documentation, annual reports, corporate websites, specialized press). The secondary data provided background and context to the primary research data gathered from the interviews. In order to ensure internal consistency of the data, secondary data was obtained for each interviewed firm and these data were used to triangulate the interview data. Therefore, the data triangulation was

accomplished through having multiple respondents from different firms and through different sources of data, like interviews, observation and documentation (Kvale, 1996; Voss, et al., 2002). The case study data were collected through the years 2010 and 2011. All data were gathered in visits to firms. Each interview was recorded and transcribed in detail. The respondents were selected because they were recognized as being knowledgeable about the after-sales activities of their firm. Interviewees included the executive board, after-sales managing director, service director, the manager(s) in charge for after-sales, and the customer care manager. These managers were contacted by letter, which explained the purpose of the research and asked for co-operation, and then by telephone to provide more details and to arrange interviews. Once meetings had been confirmed, face-to-face interviews were carried out which lasted approximately one to two and a half hours each. Frequently, we were introduced to more than one interviewee at each firm. To improve the validity of the findings, a copy of the documentation and results was sent to the interviewees, asking them to indicate whether they agreed with the findings. Unclear answers were clarified through email or in follow-up questions in subsequent rounds.

The analysis consisted then of data reduction, data display, within-case and cross-case comparisons (Miles & Huberman, 1994; Stuart, et al., 2002; Yin, 2008). Following the procedure recommended by Miles and Huberman (1994), we first conduct the within-case analysis where we analyze each firm's specific aftermarket situation. Once the within-case analyses are done, we conduct a cross-case analysis, where we compare and contrast the identified determinants of aftermarket structure formation and identify the main differences and common behaviors among the strategic positioning of the aftermarket actors.

#### **4. Determinants of competition structure in aftermarkets**

We have identified altogether eight main determinants of aftermarket structure formation through case study research. We have selected these eight determinants due to the frequency of their mention and the emphasis of their importance by the interviewees. These determinants are neither industry- nor company-specific, so that a transferability to other firms and industry sectors is given. By analyzing aftermarket structures we concentrate on the main four actor groups (OEM, supplier, customer and competitor). In this chapter, we describe first the identified determinants, then we will analyze resulting relationship types between the market players depending on the characteristics of the determinants. Subsequently, we give recommendations for each of the aftermarket players regarding their strategic position and competitive conduct to maximize after-sales profits.

Figure 9 represents the intra-firm, intra-network and external determinants which influence the relationship and competitive constellation in aftermarkets. The points in the graphic symbolize the intra-firm determinants. The circle contains the intra-network determinants, and the quad encompasses the external determinants. Some of the determinants (belonging to the first two groups), can be influenced by the aftermarket actors, whereas the external determinants must be taken as given.

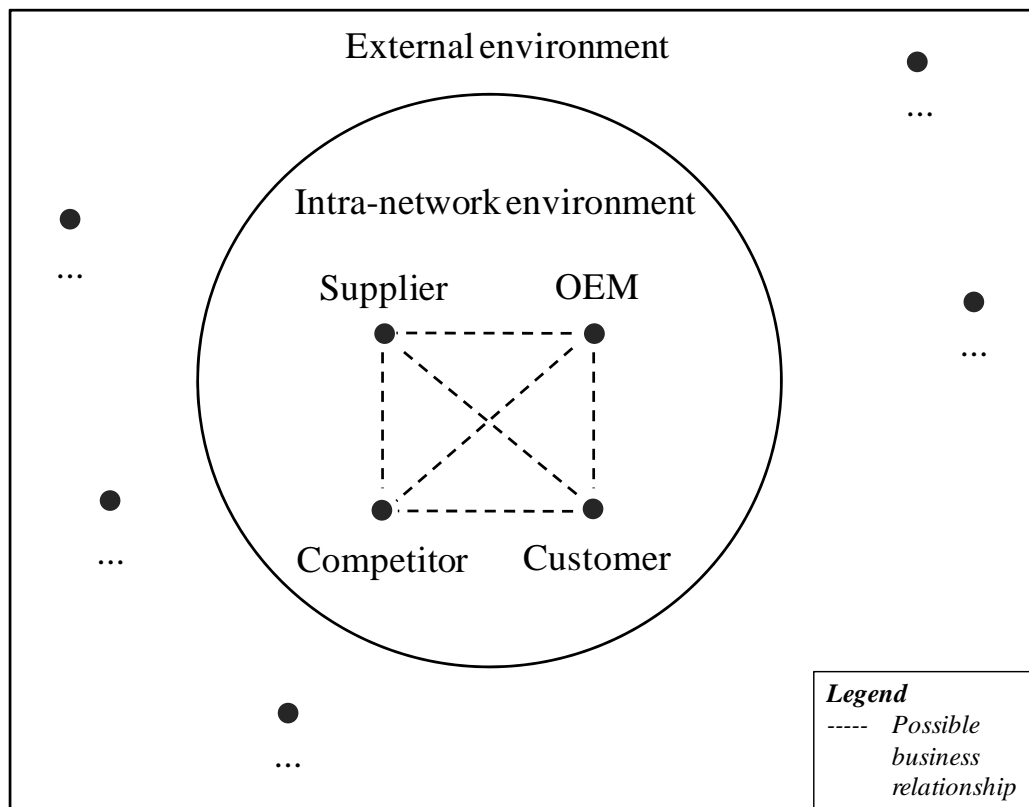


Figure 9: Determinants of relationship and competition structure in aftermarkets

#### 4.1 Intra-firm determinants

##### 4.1.1 Capabilities, potentials and resources of the market players

The skills and competencies of an aftermarket firm determine significantly if a firm can offer after-sales services appropriately and quickly. Specific investments in the form of know-how, knowledge management and documentation, service network and tools are the basis for any firm in the aftermarket to offer excellent services. In order to provide customers with excellent service, the case study firms mentioned that, besides know-how, a densely organized service network, delivery availability, quality, flexibility, the extent of the after-sales service portfolio and service orientation are the most important capabilities that firms must have. In addition to this, experience, customized solutions, liability for defects, reliability, consignment stores, and spare parts repair options have been mentioned to be crucial. The

service case (correction of a defect, preventive maintenance, etc.) should be experienced by the customer as positive as possible.

Aftermarket players need the ability to adapt to different market situations, because some countries (e.g. China) require lower qualities and prices. Furthermore the perception of customers regarding the criticality of regular maintenance vs. the repair of a failure with downtime costs can differ widely. Customer awareness of the offered after-sales service portfolio is a necessary condition for aftermarket success. Especially suppliers and competitors face this obstacle, because, in general, the OEM is the first party to be contacted due to the initiating business transaction with the primary product. Therefore, it is advantageous for suppliers to take part in the sale and set-up of a new machine or plant, and offer trainings to customers.

The compression of product lifecycles, together with the increasing proportion of electronics in many components, requires more specialized expertise and a faster adoption of new know-how in the after-sales business. In this situation, OEMs often have a competitive advantage because they already possess a great deal of knowledge from the design and construction of the primary product. Hence, a specialization in a niche is an advantage for many players. While OEMs and suppliers might concentrate solely on their own products and components, competitors might specialize in specific products, regions, or product generations. Another advantage for competitors could be that they offer services for a range of products from various manufacturers, so that customers have to deal only with one contact firm for all their after-sales needs. In this case, customers may no longer need to maintain their own in-house maintenance department. Certainly, all forms of specialization will need to attain a critical mass in order to achieve profitability.



#### **4.1.2 Requirements / demands of the customers**

Customers possess enormous power in the aftermarket, since they decide which orders are submitted to whom, and as such significantly influence the competitive constellation. Hence, customers are the most crucial group in aftermarkets. However, these customers, as a group, are heterogeneous, and the expectations they articulate during the interviews vary widely. In general, they have high demands upon excellent after-sales services, and often demand value-added services (e.g. trainings, spare parts repairs) in addition to the typical portfolio. The case study firms (customer group) can be segmented into the following three groups: The customer group *risk avoiders* wants to sign a full service contract to avoid unscheduled costs. *Basic-needs* customers require a standard level of service and take different offers into consideration before deciding. The customer group *hand holders* requires an extensive service portfolio, with high availability of parts and quick response times. They are willing to remunerate this accordingly.

The case study firms note an increasing sophistication among customers who consider total cost of ownership make price-performance-comparisons across the entire market, negotiate fixed-rate service contracts over the entire product life cycle, weigh up pros and cons of new investment against anticipated maintenance costs for the continued deployment of aging assets, merge to form buying groups, and purchase their spare parts through a broker. The tendency of customers to professionalize their behavior promotes competition in the aftermarket by limiting the scope of an OEM to charge supracompetitive prices. The number one factor when selecting an after-sales service provider are price / quality, and availability (service network). In addition to this, customers consider fixed and variable downtime costs (existence of backup systems, failure-criticality), and flexibility (e.g. customers with a seasonal business expect maintenance and service capacity at a specific time). Finally, the risk appetite of customers will determine if they are willing to establish a business relation with an aftermarket provider with whom they are not familiar.

All case study firms (customers) mentioned that during the warranty time period all of their after-sales services and spares, including preventive maintenance, are sourced exclusively from OEMs. The fear of losing the warranty prevents customers from switching to other providers. After the end of the warranty period, customers select their after-sales providers on the basis of the above-mentioned, differentiated criteria. Business contacts to new aftermarket players, like suppliers or competitors, are often initiated by customers due to dissatisfaction (on price, quality, speed) with OEMs. In this case, customers actively approach suppliers and / or competitors. SCD is most likely to occur if components are complex, and customers value the expert knowledge of suppliers. In the long term, the positive or negative experience with a provider determines whether a business relationship is continued. Certainly, each after-sales provider tries to establish a good business relationship with their customers. Customers must always tradeoff the advantages of working with one single firm with low transaction costs and accountable for all their after-sales needs, against the offers of many providers with a better price-performance-ratio.

Customers with a big machinery / fleet often conduct after-sales services with their own maintenance department, and involve external specialists for large repairs or complicated failures. The benefits of a proprietary maintenance department are in-house expertise, quick response, and the ability to service machines from different OEMs. In this case, customers purchase spare parts from an external source and must decide if they want to store their own spare parts, in which case the advantages are availability and bundling of purchasing volumes, while capital lockup and risk of obsolescence constitute the downside of that inventory buildup.

## **4.2 Intra-network determinants**

### **4.2.1 Market power / dependency**

The market power of the players, in form of knowledge, information, control, and dependencies, is a crucial determinate of an aftermarket structure. Market power can be defined as the manipulation of the behavior of one social unit by another, e.g. a OEM has power over a supplier to the extent that the OEM can compel the supplier to take an action that he would otherwise never consider. Exclusiveness through patents, long-term contractual service agreements, comprehensive service networks, all time spare parts availability, or unusually complex parts enables the respective after-sales service provider to gain market share and in some cases even establish a temporary monopoly.

Power imbalance is directly related to the degree of one firm's dependence on another. A dependency in aftermarkets is evident if one firm relies on, or is controlled by another firm. Dependencies can be classified as technical, knowledge-based, social or contractual. The case study firms indicate that some OEMs are dependent on their distributors, because these have the direct contact to the customers. Customers might also be dependent on OEMs, if these grant obligingness on the condition that all spares and services to date have been sourced from themselves. Furthermore, a customer might have bought a huge spare parts package with the purchase of the primary product or have signed a long-term service or leasing contract with an OEM. Even if this deal is profitable for the OEM and avoids unscheduled costs for the customer, the customer is again dependent on the OEM. This situation often arises in the energy, aerospace and medical engineering sectors. Furthermore, customers might find themselves locked-in. This occurs if they are forced to use aftermarket products from the OEM exclusively due to reasons like patents or specialized knowledge, and switching would incur prohibitive costs. In this situation, in order to benefit from a competitive aftermarket, customers would have to buy a different primary product, accompanied by capital losses on

the sale of the used equipment and the costs of retraining. The lock-in effect creates a monopoly for the OEMs in the aftermarket for their products. However, there exists a tradeoff between exploiting the locked-in customers, and the potential loss of sales of primary products which results because of customer reactions and competitive pressure exerted by other OEMs. Besides a full lock-in effect, there might exist several entry barriers to an aftermarket. These include initial investments which are often unrecoverable. Another barrier to enter into the aftermarket might be the investment into knowledge and an adequate service network. The challenge posed by the latter is to create a costly global service infrastructure that is capable of responding locally to the requirements of the installed base. OEMs have the advantage that they know precisely where and for what applications the products have been installed, and what exactly their technical specifications are.

#### **4.2.2 Relationship management**

“Relationship management is the key to success on aftermarkets” was a statement made by most of our interviewees. Relationship management between the aftermarket players encompasses the type of interaction, degree of commitment and trust, likelihood of opportunism, and considerably affects the resulting market structure. The establishment of a successful business relationship requires endurance and ongoing effort from all parties involved. As expressed by an interviewee: “With some of our customers we have relationships over several decades and we are almost a family.”

Strategically important, long-term business relationships tend to be characterized by a willingness of both involved firms to commit a variety of different physical and human assets to a set of future transactions. Such relationship-specific investments implicate switching costs, because these investments are difficult or expensive to transfer to another relationship, or may lose their value when applied to another firm. The higher the investment on both sides,

the more likely it will be that a good long-term business relationship develops. Knowledge about the capacities, goals, current problems, and date of new investments of the other market players enables superior relationship management.

The aftermarket players should conduct relationship management on both the vertical level (business partner up- and down-stream) and the horizontal level (competitors in the same supply chain level):

The former category comprises the customer, OEM and the (sub)supplier relationship, depending on which perspective is taken. Certainly, each of the case study firms aims for a good long-term customer relationship through high customer satisfaction. At the time of primary product sales, OEMs try to bind customers to their own after-sales services. Long warranty times by OEMs increase trust and customer retention, while suppliers and competitors might win customers in the aftermarket through a good communication of their competitive advantages. A good relationship is in general a prerequisite to establish new business models such as leasing or operating models. Often customers ask for exactly the same maintenance team from the same service provider, because this team is familiar with the customers' machines and equipment. Customers are often only familiar with the after-sales portfolio of their OEMs, the visibility of the supplier's offerings will be crucial to their success. Therefore, if the supplier intends to force disintermediation, a proactive marketing is often required. From the OEM point of view, SCD must be averted. A fair treatment of suppliers in the form of transparency, information disclosure, fair pricing, planning reliability, and fair contracts reduces the probability of disintermediation. Some of the interviewed OEMs even strive for a deep collaboration with their suppliers in the aftermarket. Both parties might agree that the supplier could potentially sell spare parts directly to the customer. Therefore, in the collaborative agreement, the OEM receives a percentage of the business generated, and guides customers directly to the supplier. The advantages of this process include faster delivery, lower prices, and an alliance between OEM and supplier against

further competitors. In general, the case study firms state that the establishment of new business relationships is more time-consuming and costly than developing existing ones. For non-standard parts, switching suppliers is either virtually impossible, or only feasible at high additional costs.

Horizontal relationship management applies to the business connection between OEMs and competitors, as well as - if SCD has taken place - between suppliers, OEMs and competitors. Many of the interviewed competitors have specialized on services and do not produce spare parts by themselves, but purchase them. OEMs and suppliers must decide if they want to sell spare parts to competitors. On the one hand, they can obtain additional income, while on the other hand, they support their own competitors, as spares are necessary to offer a full after-sales product portfolio. Some OEMs aim for a deep cooperation with a competitor, so that they are able to offer their customers a broad product portfolio and a widespread service network - a trusting relationship is a basic requirement. Furthermore, OEMs have to balance the pros and cons of a competition among each other, deciding whether they want to offer after-sales services for products from other OEMs, or solely for their own.

### **4.3 External determinants**

#### **4.3.1 Attractiveness of the aftermarket**

The attractiveness of aftermarkets in the form of profit and revenue generation opportunities is an obvious determinate of the number of competitors, the competitive intensity, and the margin which can be achieved by each player. "Meanwhile, profits are generated in the after-sales business and no longer mainly with the sale of primary products" commented an OEM interviewee; the case study firms agree upon the high profitability of the after-sales business. However, this transformation of the after-sales business from a necessary evil to a lucrative

cash cow has occurred in most of the interviewed OEMs in recent decades. The advertising and marketing for the after-sales business have ramped up, with the risk that, in doing so, OEMs are suggesting with their campaigns that they sell “fault-prone primary products”. An advantage of the aftermarket in comparison to the primary product market is that its demand is less price sensitive. Especially for reactive fault repairs, the high costs of downtime make the repair urgent and limit the possibility of comparing different offers on the market. The price sensitivity for preventive maintenance is likewise low in some sectors, but not all, because quality has the highest priority due to the risk of deterioration of equipment and personal injuries resulting from an inferior or improper repair. Furthermore, the attractiveness of the aftermarket for OEMs results from the opportunity of differentiation and customer retention, especially because of the ever-increasing technical commoditization of primary products.

The aforementioned advantages are not only recognized by OEMs, but by an increasing variety of competitors which try to maximize their own aftermarket profits. The size of the installed base, product durability, and service intensity determine the attractiveness of the aftermarket. The after-sales strategy of each firm specifies how these potentials shall be exploited. The OEMs need to offer a full range of after-sales services for their products due to warranty obligations, whereas competitors can specialize on fast-moving parts with a high volume, or on high-priced complex parts with high margins.

### **4.3.2 Laws and regulations**

The category of the determinant laws and regulations encompasses both voluntary commitments and legal regulations. The self-commitments of the aftermarket players include industry standards, guarantee commitments, goodwill and spare parts supply periods. Legal regulations can be divided into anti-monopoly laws and safety-oriented legislation. The

former category of legal regulations applies to firms with a dominant market position and aims to limit their market power to foster competition. Some of the interviewed OEMs tend to have a quasi monopoly position, or at least a very strong market position due to a well-established brand name. In some industries such as military, aerospace or medical technology, safety-oriented legislation has a significant impact on the aftermarket structure and the political influence is large. Only certified firms are allowed to offer after-sales services, the maintenance interval and timing of upgrades are pre-set, only certified parts are allowed to be used, backup systems and a high assurance of supply must be provided, and documentation is important. Hence, in total the barriers to entry in these markets are high. However, among the few competitors who remain, the competition is often fierce.

### **4.3.3 Characteristics of primary products and spare parts**

Given the complementary nature of aftermarket products and the fact that they are always related to the support of primary products, the demand for after-sales services is correlated to the demand and usage of the primary products. A firm operating in the aftermarket must first of all obtain a good understanding of the primary products.

Primary products can be categorized into disposable products (e.g. small household appliances), repairable products (e.g. office equipment), rapid response products (e.g. construction equipment), never fail products (e.g. airplanes, medical devices). Each of these categories imply a different requirement for after-sales service levels, and the willingness of the customers to pay for these will vary. Disposable products do not need any after-sales services, because (as the name implies), they are replaced if a failure occurs. Repairable products require a good balance between an adequate service level and an acceptable price. Rapid response products need a regular preventive maintenance and, in the case of an unscheduled failure, a repair fulfilled within hours. In this case a comprehensive service



network with local spare parts storage is indispensable. Never fail products require intensive preventive maintenance, and a replacement of the primary product after a specified life span. The number of market players and the competitive intensity is the highest in the second and third category. In the fourth category, the number of competitors is limited due to safety and certification reasons, but the competitive intensity is high. Furthermore, the competitive structure of the aftermarket is determined by the primary product characteristics, size and age (phase in the product life cycle) of the installed base, service intensity, production methods (single- vs. volume production), and technical complexity. The higher the technical complexity, the less the OEMs are affected by competition, because those products are typically engineering-intensive and require comprehensive know-how; although SCD is a risk for the OEMs if suppliers deliver complex parts, because customers may directly contact the experts for those parts if an after-sales issue arises. In general, complex parts generate higher margins and a smaller number of competitors. If OEMs produce parts by themselves, or at least construct parts and commission a supplier with the production, SCD can be averted, but the rivalry from competitors cannot be eliminated. Summing up, the development and construction of the primary product has a significant influence on the aftermarket.

Spare parts can be classified based on the four criteria criticality, specificity, demand, and value of parts. The criticality of a part is related to the variable and fixed downtime costs caused by the failure of that part. The specificity of spare parts range from standard parts, which are fast-moving items and widely used, to custom-made parts for a specific customer. In addition, parts can be divided into spare parts for unscheduled failures, and wear parts whose demand is usually higher but easier to forecast. For standard wear parts, the competition is usually the highest and the margin the lowest. The demand pattern of spare parts is characterized by irregular and occasionally very low demand, as well as the difficulty of forecasting customer needs. The value of spare parts will determine the supply and storage strategy, because the stocking of high value parts is a costly and unattractive solution.

#### **4.3.4 Time horizon**

We observed during our case study research that competition in the aftermarket is more intensive the older the primary products are, often due to a lower complexity of those products combined with a larger installed base. Some OEMs deliberately withdraw from the aftermarket for very old products because it is no longer lucrative for them. In contrast, some service providers have specialized in just that segment.

The case study firms indicate that, due to the decline of the product value and the expiry of warranty claims, some customers switch from preventive maintenance at the beginning of the product lifecycle to reactive maintenance at the end of the lifecycle. This is another indicator of an increase in competition as the primary products age. Hence, the time horizon is a determinant of the competitive structure in aftermarkets.

#### **4.4 Influence of the determinants on the relationship constellations in aftermarkets**

Depending on the characteristics of each of the eight identified determinants, different relationship constellations between the aftermarket players tend to arise. If the types of relationships between the players are known, it is possible to anticipate the resulting aftermarket structure. The relationships between customers and the remaining aftermarket players are not analyzed, because all of them presumably strive for the best possible customer relationship. The findings from our case study research constitute the basis for the determination of the resulting relationships. Table 7 provides an overview of the eight determinants, possible characteristics, the resulting intensity of competition and the different relationship types which come into existence (see chapter 2; “types of relationships”) between the aftermarket players. In spite of the correlations, it is difficult to predict precisely the ensuing relationship constellations. Therefore, we analyze only two extreme characteristics

(e.g. low vs. high; existent vs. nonexistent) of each determinant and indicate the most likely resulting relationship types.

Table 7: Determinants of competition structure in aftermarkets and their implications on relationship constellations

	<b>Determinants of competition structure</b>	<b>Range of possible characteristics of the determinant</b>	<b>Resulting competition intensity</b>	<b>Type of relationship (OEM-supplier)</b>	<b>Type of relationship (OEM-competitor)</b>	<b>Type of relationship (Supplier-competitor)</b>
Intra-firm determinants	Capabilities	OEM has market leadership	low	cooperation / collusion	competition	coexistence
		equally distributed	high	co-opetition	competition / conflict	Competition / co-opetition
	Customer requirements	homogeneous	high	co-opetition	competition / conflict	competition / co-opetition
		heterogeneous	medium	cooperation / co-opetition	competition	coexistence
Intra-network determinants	Market power	concentrated	low	cooperation / collusion	competition / coexistence	coexistence
		distributed	high	co-opetition	competition / conflict	competition / co-opetition
	Relationship management	existent	medium	cooperation / collusion	co-opetition	co-opetition / coexistence
		nonexistent	high	co-opetition / competition	conflict	competition
External determinants	Attractiveness	high	high	co-opetition	conflict	competition
		low	low	cooperation	coexistence	coexistence
	Laws	existent	high (but number of competitors limited)	co-opetition	competition	coexistence
		nonexistent	high	co-opetition / competition	competition	co-opetition / coexistence
	Primary products / spare parts	non-critical standard wear parts	high	co-opetition / competition	conflict	competition / co-opetition
		custom-made spare parts	low	cooperation	coexistence / cooperation	coexistence / cooperation
Time horizon	young primary product	medium	cooperation	competition	competition	
	old primary product	high	co-opetition	competition / coexistence	co-opetition / coexistence	

## **5. How should firms interact in aftermarkets?**

After the analysis of determinants of the relationship constellations in aftermarkets, we attempt to give recommendations to the players for their strategic positioning. The players have to accept the external determinants as given, although they can influence the intra-network determinants (e.g. cooperation, debilitate competitors), and the intra-firm determinants (e.g. strengthening of the own resources and competitive position) in their favor in order to achieve a competitive advantage. Due to the wide range of studied firms, from a wide variety of industries, is it not possible to give a specific recommendation for each individual firm. Instead, we intend to make general statements and recommendations which can be applied to a multitude of firms.

Each player should identify as accurately as possible its own strategic position in the market, and also make a realistic assessment of the strengths and weaknesses, resources and opportunities of the players they are up against. A firm should evaluate the role that the after-sales business should play in its overall competitive positioning, and estimate the changes required to operate successfully. The essence of a competitive strategy for a firm is to find a position where it can best cope with the opportunities and challenges of its particular market. Table 8 highlights the perceived roles of the different aftermarket players and illustrates the differences which impact their behavior.

Table 8: Perceptions of the aftermarket players regarding their network position

	<b>Perception of the OEM</b>	<b>Perception of the supplier</b>	<b>Perception of the customer</b>	<b>Perception of the competitor</b>
<b>The OEM's role</b>	<ul style="list-style-type: none"> <li>- Aftermarket is an important business segment</li> <li>- Considerable know-how, high quality</li> <li>- Must provide comprehensive spare parts assortment (including low-profit slow-moving items); hence a optimal spares supply strategy is important</li> </ul>	<ul style="list-style-type: none"> <li>- OEMs often try to dominate the after-sales business</li> <li>- Selection of the optimal type of business relationship (cooperation, co-opetition, competition) between supplier and OEM</li> </ul>	<ul style="list-style-type: none"> <li>- High quality, high price</li> <li>- First contact partner for all after-sales concerns</li> <li>- Service contract with the OEM</li> </ul>	<ul style="list-style-type: none"> <li>- OEM might be pure competitor or co-opetition (OEM sells spare parts to competitor)</li> <li>- Contractual agreement between OEM and competitor that after-sales service activities are transferred from the OEM to a competitor and financially compensated</li> </ul>
<b>The supplier's role</b>	<ul style="list-style-type: none"> <li>- Latent risk that a supplier becomes a competitor (depending on: fair treatment, trust, opportunism)</li> <li>- SCD should be avoided through good cooperation, transparency, fair benefit-sharing, joint development</li> <li>- The aim of OEMs is to have the same supplier in the primary product business and after-sales business (a replacement of suppliers is always associated with high costs and efforts)</li> </ul>	<ul style="list-style-type: none"> <li>- Decision for or against SCD depending on exclusiveness and market power of the supplier</li> <li>- Best know-how and delivery speed for their own parts and components</li> <li>- Configuration of the supplier's after-sales portfolio (only spare parts or additionally also services; only for their own components or for the whole machine)</li> </ul>	<ul style="list-style-type: none"> <li>- Is the supplier at all known</li> <li>- Offers the supplier service besides spare parts</li> <li>- Significantly cheaper than OEM, often better delivery service, better availability and better know-how</li> </ul>	<ul style="list-style-type: none"> <li>- Supplier can be pure competitor or co-opetition (supplier sells spare parts to competitor)</li> </ul>
<b>The customer's role</b>	<ul style="list-style-type: none"> <li>- Often customers are the biggest competitors (if they do maintenance by themselves)</li> <li>- High customer satisfaction and customer loyalty is important (e.g. through service contracts); the requirements and expectations of the customer are high regarding excellent after-sales services</li> <li>- Customer retention during the entire product life cycle (starting at primary product sales)</li> </ul>	<ul style="list-style-type: none"> <li>- The awareness of the supplier by the customer is critical for the success of SCD</li> <li>- Is the customer willing to establish connections with various suppliers (higher transaction costs)</li> </ul>	<ul style="list-style-type: none"> <li>- The customer determines the competition situation significantly, because he decides from whom he buys and how many business connection he is willing to establish to after-sales providers</li> <li>- Calculation of life cycle costs before buying a primary product is very important</li> <li>- Customers have sometimes a own spare parts stock and / or a own maintenance department</li> </ul>	<ul style="list-style-type: none"> <li>- Competitor offers the customer services and spare parts for products from various OEMs</li> <li>- Customer has to be convinced of the quality and competence of the competitor</li> </ul>

<p><b>The competitor's role</b></p>	<ul style="list-style-type: none"> <li>- Increased competition intensity and higher number of competitors within the last years</li> <li>- Is a cooperation with competitors (e.g. selling of spare parts) advantageous</li> </ul>	<ul style="list-style-type: none"> <li>- Which business connection should be established with the competitor (e.g. delivery of spare parts)</li> </ul>	<ul style="list-style-type: none"> <li>- Which experience and quality can the competitor provide</li> <li>- What liability in case of failure offers the competitor</li> <li>- Does the competitor offers service contracts</li> </ul>	<ul style="list-style-type: none"> <li>- Achievement of competitive advantages through specialization</li> <li>- Cooperation with OEMs and suppliers (to obtain spare parts from them)</li> </ul>
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## 5.1 OEM

The OEMs have to manage the balancing act of satisfying customers (e.g. price, quality, availability), building good relationships with suppliers to avert SCD (e.g. transparency, fair pricing and profit sharing), and fighting competitors who might have specialized in the lucrative field of fast-moving spare parts or machines with a large installed base. An excellent relationship management with all aftermarket players is a basic prerequisite to successfully meet all these challenges. Creating long-term customer loyalty and binding customers to the firm, for instance through service contracts or operator models is today more important than ever before. Therefore, the after-sales business should have a clear strategic alignment and a distinct specification of the goals (e.g. customer loyalty, profit, differentiation) should be made. The after-sales strategy should also include whether and to what extent a cooperation with competitors is desired, for example, to be able to offer an extended service network to customers. Furthermore, the OEM should define a spare parts supply strategy, taking obsolescence risk and capital lockup into consideration, as well as economies of scale and assurance of supply.

OEMs have the advantage of generally being the first contact made by the customers for their after-sales issues. But those customers also expect from OEMs a comprehensive service network, which together with the commitment to offer a full assortment of spare parts over a long period of time requires huge investments. The OEMs have extensive know-how, and partly patents, because they constructed the primary products, and thus benefiting when the

complexity of products increases through a higher proportion of electronic components, all of which can be used as a competitive advantage. The design and development of the primary product determines to a large extent the subsequent maintenance intensity, complexity, the in-house or outsourcing of production, and need for special tools, of the after-sales business.

OEMs should attempt to protect their aftermarket and erect entry barriers for their suppliers and competitors. Competitive differentiators include quality, availability, service network, pricing, leasing offers, relationship management, market power, control, contracts, extended warranties, and compatibility barriers. The modification of primary products is a way for OEMs to exclude rivals from the aftermarket. Even if they cannot lock out rivals permanently, a practice of frequent modifications can raise the costs for outsiders, resulting in fewer rivals. Extending warranty periods up to a lifetime service contract significantly reduces the total amount of aftermarket share available to competitors. Leasing contracts could include parts and service. Squeezing and constantly switching suppliers are antagonisms which do not help OEMs wishing to protect their aftermarket and averting SCD. Instead of these combative behaviors, fair financial and non-financial incentives together with a good management of suppliers relationships actively help to avoid disintermediation.

## **5.2 Supplier**

Suppliers must decide whether they dare to attempt SCD or not, depending on their exclusivity, size, market position and their visibility in the eyes of the customers. A major challenge for suppliers striving for direct participation in the aftermarket is the customers' awareness of their existence. The customers must know that the supplier offers spares and services at all. However, the case study firms reported that, with price and availability being equal, consumers will normally prefer parts provided by, or under the auspices, of the OEM. A win-win business cooperation between supplier and OEM might be that the OEM forward

customer orders directly to the supplier for fulfillment, for which he receives a commission. The financials of such cooperation may be more attractive than outright SCD, and in the end the customers get cheaper spare parts with faster delivery. Thus a supplier can establish an alliance with an OEM in order to compete against competitors. All case study firms (suppliers) practice SCD and most of them are currently expanding their service portfolios and service networks. A major competitive advantage of suppliers is their extensive knowledge about their own parts and components, which is especially appreciated by customers of complex products.

Once the supplier has decided to undertake SCD, he will have to make the strategic decision of whether to offer services as well as spare parts. Moreover, it should be decided whether the services will be offered only for proprietary components or for the entire machine, and if the supplier is able to offer these in longer-term contract form. One of the interviewed suppliers focuses mainly on services and offers besides basic services also value-added services which aim to strengthen the customers' competitiveness.

Furthermore, suppliers have to decide if they want to collaborate with competitors and sell spares to them.

### **5.3 Customer**

Customers should clearly define and communicate their preferences and priorities in the aftermarket taking into account the business environment and competitive situation. These might include willingness to pay, flexibility, capacity, service agreements, maintenance strategies (preventive, reactive, hybrid), scheduling of maintenance (e.g. customers in the construction industry want only in the winter preventive maintenance of their machines), availability requirements, delivery time, consignment warehouses, down time costs, failure criticality, warranty, liability, goodwill, and remaining usage time of exchanged components.



Because customers decide for what and to whom they direct their expenses, customers significantly determine the competitive situation and intensity in aftermarkets. They have enormous market power. In spite of this, customers might get a raw deal if they make their primary product purchase without knowing their needs for aftermarket products, and what it will cost to buy those products. They might accurately choose a primary product but become prisoners in the aftermarket, where they are locked-in. However, uninformed customers benefit from the presence of informed customers who consider total lifecycle costs when they purchase a primary product. In the presence of informed customers, an OEM will hesitate to charge supracompetitive prices for aftermarket products or attempt to eliminate rivals because of the risk of losing primary product purchases.

The case study firms (customers) are aware that an increasing proportion of the total costs must be allocated to the after-sales business, and thus a precise calculation of total life cycle costs at the moment of purchase of a primary product is vital. Customer behavior has become increasingly “professional”, comparing various offers and occasionally trying to fix subsequent after-sales costs in a contractual agreement (e.g. full-service contracts) at the purchase of the primary product. Service partners might be switched throughout the life cycle of a machine (e.g. beginning with the OEM, and moving later to a cheaper provider), and parts might be purchased directly from suppliers. Ever more customers are demanding fast response in case of failure, defect or disorder (excellent service level), and also requiring longer service intervals regarding preventive maintenance.

In the after-sales business, customers should weigh the trade-off between a commitment to a single firm and alternating relationships to several firms. The first option offers low transaction costs, a known quality and a clear warranty coverage. The contact to several business partners offers usually a better price-performance ratio. In the end, whether the customer is willing to buy non-original parts and service will be decided by the risk appetite of the customer. Customers must also consider whether or not to operate their own

maintenance departments. Advantages are that machines even from different OEMs can be serviced, knowledge is retained by the firm, faster response times are possible, and high motivation of employees is achieved. However, due to high fixed costs, an in-house maintenance department is only profitable if the utilization is correspondingly high. The business model in which the customer outsources its maintenance activities to other firms might alleviate this problem. Furthermore, customers must decide whether they want to keep their own spare parts inventory. The benefits are high availability, fast response time, and the possibility of a purchase bundling; the disadvantages are high capital lock-up and the risk of obsolescence.

#### **5.4 Competitor**

Competitors have the best business opportunities in aftermarkets if they offer a specialized portfolio. For instance they can focus on fast-moving spare parts, covering a small geographic area, focus on certain types of machinery or offer services for equipment from different OEMs which is used by one customer. If the competitor is an intermediary (e.g. dealer), he has the advantage that customers often contact him at first instead of the OEM in case of after-sales issues. To increase market share, competitors should proactively communicate to potential customers their comparative advantages, such as price, customer proximity, flexibility, trainings, or specialization on certain customer groups. Competitors have particularly good market opportunities, when customers are dissatisfied with the after-sales services offered by the OEM or supplier, and are looking for better alternatives.

A competitor should decide, based on its own strategic position, which business connection with the OEM and supplier is the most beneficial for him. This decision will mainly depend on whether spare parts are externally purchased, or are produced by the competitor. In some cases, a collaboration between competitor and OEM is beneficial for

both. For instance, if the OEM outsources some of its after-sales services to a competitor, and receives a financial compensation both parties will gain.

## **6. Conclusion**

Practitioners and researchers agree that the after-sales business plays a major role for an increasing number of firms across industries. The potentials of the aftermarket are not only exploited by OEMs but by an increasing number of firms: suppliers and various competitors recognize the high attractiveness. However, the path to a professional and lucrative after-sales business is rocky and requires good market knowledge - in particular because more and more firms operate within an environment characterized by a complex network of interlocking relationships. Therefore, to win high revenues and profits in aftermarkets, it is important to know the behavior and strategic positioning of other market players, and understand the determinants of market structure. In this study, by using twenty-nine cases, we have identified eight main determinants of aftermarket structure formation. We classified those determinants into two intra-firm, two intra-network and four external determinants. The theoretical background for our research is the social network theory and relationship research. Our analysis shows that different characteristics of the determinants results in different relationship types between the aftermarket players. In a subsequent step, we have given recommendations to each of the four main groups (OEM, supplier, customer and competitor) for their strategic positioning and competitive behavior. Given the complexity of the researched field and heterogeneity of the analyzed firms, we concentrated on the main determinants, the most common relationship types which occur, and generalized our recommendations to the aftermarket players.

## **6.1 Managerial implications**

This study offers practical guidance to after-sales managers. These are three-fold. First, through the identification of eight determinants of aftermarket structure formation, managers can estimate the evolving market structure. Based on different characteristics of the determinants, different types of relationships will arise and the respective relationships will determine the competitive structure in a market. Second, an after-sales manager needs to be aware that interactions between other actors in the market will have implications on the operations of his own firm. Thus, proactive steps are necessary to manage relationships on aftermarkets. Managers are able to influence relationships in their own favor. In particular, section 5 of this study provides suggestions to strengthen a firm's strategic position. Third, certainly it is important that firms analyze their specific competitive positions. Even more important is the knowledge about the strategic position and intention of other market players and their relations to each other. For instance, awareness of one's competitors will provide little advantages unless managers are able to properly anticipate the future competitive conduct of those firms, and initiate appropriate measures, especially in form of relationship management.

## **6.2 Theoretical contributions**

The paper points out a gap between the high importance of the after-sales business to many firms from various industries, and the lack of comprehensive and systemic research about aftermarkets and their structure formation in the literature. Although this issue has been widely acknowledged, only a few attempts have been made to develop theoretical concepts. In order to fill (at least partially) this gap, we identify, through the lens of social network theory and relationship research, eight main determinants of aftermarket structure formation and formulate recommendation to aftermarket players for their strategic positioning and

competitive behavior. This study is build on the research of Jönke, et al. (2012) who identify archetypes in aftermarkets, but do not analyze the variables resulting in a specific archetype. We fill this gap by studying the determinants of aftermarket structure formation.

In our research we specify in-depth the general approaches regarding industry structure and competitive strategy by Ansoff (1965), Chandler (1962), Mintzberg (1988) and Porter (1980) through focusing onto a specific market and a selected number of market actors. Furthermore, we broaden the results of legal publications in the field of aftermarket economics research (e.g. Borenstein, et al., 1995; Hovenkamp, 1993; Klein, 1993; Shapiro, 1995) which mainly concentrate on antitrust legislation, and only took the perspective of OEMs and customer welfare. In contrast, we analyzed general determinants of aftermarket structure formation and included all relevant market players.

### **6.3 Limitations and future research**

The research described in this paper has limitations, which must be acknowledged in terms of both the scope of the issues studied and the methodology used - at the same time these limitations create opportunities for future research. Most important, a quantification of the identified determinants is missing and we do not range the determinants due to their relevance and priority. A useful extension in future research projects to achieve quantification might be the application of the analytic hierarchy process (Saaty, 1990; Zahedi, 1986).

Our empirical investigation was carried out in only two countries (Germany and Switzerland). However, due to the heterogeneous case study sample our findings are neither industry- nor company-specific. Although, the findings are derived from a limited number of cases. A broader empirical research will help to verify our findings. The lack of external validity is still a disadvantage of case study research. We tried to overcome this shortcoming by triangulating the data collection through further observation and documentation.

Clearly, the structure of aftermarkets emerges over time. In our research we have taken a static perspective since, to reduce complexity, the time dimension is missing. If the time dimension is added, additional effects will emerge and can be analyzed. Future research should adopt a dynamic approach. This leads into the field of network dynamics.

Summing up, aftermarkets and their competitive situation have a high significance for many firms from a variety of industries. The scientific research in this field carried out to date is insufficient and requires intensification both on a theoretical and practical level.

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## Curriculum vitae

### Education

- 2001            Abitur at the Cecilien-Gymnasium in Düsseldorf
- 2002-2008     Studies of technical-oriented business administration (industrial engineering),  
University of Stuttgart, Study abroad in Finland and Poland
- 2010/2011     Visiting researcher at Imperial College London, UK
- 2008-2012     Doctoral student and research assistant at the Chair of Logistics Management,  
ETH Zurich

### Publications

- Wagner, S. M., Jönke, R., & Eisingerich, A. B. (2012). A strategic framework for spare parts logistics. *California Management Review*, 54(4), in press.
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