Coordination of Inter-Plant Exchange - Make Plant Leaders Part of the Solution

DISSERTATION
of the University of St.Gallen,
School of Management,
Economics, Law, Social Sciences
and International Affairs
to obtain the title of
Doctor of Philosophy in Management

submitted by

Michael Wiech
from
Germany

Approved on the application of

Prof. Dr. Thomas Friedli
and
Prof. Dr. Klaus Möller

Dissertation no. 5030

Difo-Druck GmbH, Untersiemau 2020

The University of St.Gallen, School of Management, Economics, Law, Social Sciences andInternational Affairs hereby consents to the printing of the present dissertation, without hereby expressing any opinion on the views herein expressed.

St.Gallen, May 18, 2020

The President:

Prof. Dr. Bernhard Ehrenzeller

Vorwort des Autors

Die vergangenen Jahre als wissenschaftlicher Mitarbeiter im Bereich Produktionsmanagement des Instituts für Technologiemanagement waren neben der fachlichen Komponente auch aus ganz persönlicher Sicht eine sehr intensive Zeit. Als Mitarbeiter und Gruppenleiter des Teams «Globale Produktion» konnte ich im Rahmen von vielfältigen Projekten tiefe Einblicke in die Unternehmenspraxis gewinnen. Letztlich bildete das so erlangte Verständnis für reale Probleme von global agierenden Produktionsunternehmen die Grundlage für das vorliegende Forschungsvorhaben. Deshalb möchte ich allen Projekt-, Industriepartnern und Interviewpartnern für die Zusammenarbeit danken. Hervorzuheben sind die zwölf Werksleiter und sechs Netzwerkmanager, welche für diese Dissertation teils mehrfach für Interviews und Nachfragen bereitstanden. Die hohe Bereitschaft Zeit für einen Doktorierenden zu finden, obschon voller Terminkalender, ermöglichte erst diese Arbeit.

Darüber hinaus gilt einigen weiteren Personen an der Universität St. Gallen mein besonderer Dank. Hervorzuheben ist mein Doktorvater Professor Dr. Thomas Friedli, der das Vorhaben bis Zuletzt mit Anregungen und Ideen begleitete. Durch die von ihm geförderte selbständige Durchführung von Projekten und die gegebene Freiheit bei der Themenwahl, wurde die Grundlage für diese Arbeit gelegt. Ein herzliches Dankeschön gilt Professor Dr. Klaus Möller für die freundliche Bereitschaft das Korreferat meines Dissertationsvorhabens zu übernehmen.

Außerdem möchte ich all denen danken, welche die Zeit am Institut für Technologiemanagement zu mehr als nur einer beruflichen Aufgabe gemacht haben. In Erinnerung bleiben gemeinsame Erlebnisse bei teils mehrtägigen Projektterminen, bei frühen und späten Fahrten in der Schweizer Bundes Bahn, den stets geschätzten aber intensiven Pausen am Töggelikasten und wertvollen Gesprächen am Institut. Hervorheben möchte ich Marian W., Christoph Be., Christian E., Lorenz S., Dominik R. und Philipp M. die ich bei gemeinsamen Projekten und zahlreiche fachliche Diskussionen schätzen lernte. Darüber hinaus danke ich Stephan K., Paul B., Manuela L., Steffen E., Julian M., Hendrik W., Marten R., Moritz C. und Christoph Bl.

Den grössten Dank möchte ich jedoch an meine Eltern richten, die mich stets unterstützten und meinen Lebens- und Bildungsweg erst ermöglicht haben. Ebenso danke ich meiner Freundin Anne für ihr Verständnis das dieses Forschungsvorhaben manche freie Minute in den letzten zwei Jahren in Anspruch nahm und für ihre Motivation in Stunden des Zweifels.

St. Gallen im Oktober 2019 Michael Wiech

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ABV	Attention-Based View
AS	Alternative Search
BU	Business Unit
CEO	Chief Executive Officer
COO	Chief Operating Officer
EBIT	Earnings Before Interests and Tax
e.g.	*exempli gratia* (for example)
EMEA	Europe, Middle East and Africa
et al.	*et alii*
HSG	*Hochschule St.Gallen*
i.e.	*id est*
IMN	International Manufacturing Network
ITEM	Institute of Technology Management
MNE	Multinational Enterprise
MNC	Multinational Corporation
NACE	*Nomenclature statistique des Activités économiques dans la Communauté Européenne*
OM	Operations Management
OPEX	Operational Excellence
POM	Production and Operations Management
RQ	Research Question
SCM	Supply Chain Management
SLR	Systematic Literature Review
SQDC	Safety, Quality, Delivery, Cost
TNC	Trans-National Corporation
WTO	World Trade Organization
UNCTAD	United Nations Conference on Trade and Development
ZWF	*Zeitschrift für wirtschaftlichen Fabrikbetrieb*

Zusammenfassung

Produktionsnetzwerke bieten global agierenden Industrieunternehmen verschiedene Vorteile. Wissenschaftler im Bereich „Operations Management“ heben hervor, dass sich auf der einen Seite durch die Konfiguration global verteilter Produktionsstätten Marktzugänge und Kostenvorteile generieren lassen. Auf der anderen Seite bietet die „richtige“ Koordination der Fabriken eines Produktionsnetzwerkes Flexibilitäts- und Lernopportunitäten. Jedoch zeigt die Praxis – viele Unternehmen scheitern daran die Vorteile zu generieren, welche mit Netzwerkkoordination in Verbindung gebracht werden.

Die vorliegende Arbeit wählt eine neue Perspektive um die Suche nach der optimalen Koordination von Produktionsnetzwerken zu unterstützen. Statt Fabriken nur als Baustein eines Produktionsnetzwerkes zu betrachten, integriert diese Arbeit die Perspektive des Werksleiters. Interviews mit zwölf Werksleitern verschiedener Unternehmen verdeutlichen den massgeblichen Einfluss dieser Individuen auf den werksübergreifenden Austausch innerhalb des Netzwerkes. Behindert wird genau dieser Austausch aus Sicht der befragten Werksleiter insbesondere durch eine fehlende Netzwerkstrategie, fehlende Ressourcen auf Werksebene, ungenügende Ähnlichkeiten zwischen den Werken, mangelnder persönlicher Kontakt zwischen den Werksleitern, Wettbewerb im Netzwerk oder ein fehlleitendes Bonussystem.

Die Ergebnisse der Werksleiterinterviews wurden in einem Beitrag im *Journal of Manufacturing Technology Management* veröffentlicht und bilden die Grundlage für den konzeptionellen Beitrag dieser Arbeit – der Entwicklung eines Frameworks um Werksleiter entsprechend der Rahmenbedingungen ihrer Produktionsstätte in den Austausch im Netzwerk einzubinden umso die identifizierten Barrieren zu überwinden.

Das Management-Framework wurde in vier Fallstudien mit global agierenden Produktionsunternehmen operationalisiert und dessen Anwendbarkeit verifiziert. Das Ergebnis ist ein praxisnahes Werkzeug um auf Basis von Werksfähigkeiten und operativer Leistung die Produktionsstätten eines Netzwerks zu klassifizieren. Zusätzlich werden entsprechend der Klassifizierung situationsgerechte Koordinationsmechanismen vorgeschlagen. Unter anderem wird dabei der Werksleiter von besonders leistungsfähigen Produktionsstätten in die Koordination des Gesamtnetzwerkes integriert.

Summary

It is generally recognized that International Manufacturing Networks (IMNs) offer various advantages. Scientists in the field of "Operations Management" emphasize that, on the one hand, market access and cost advantages can be generated through the geographic distribution of production sites. On the other hand, firms can benefit from flexibility and learning opportunities by coordinating these globally dispersed production facilities in the “right” manner. Practice shows, however, that quite a number of companies fail to generate particularly the benefits, which are associated with network coordination.

This dissertation takes a new perspective to improve the coordination of manufacturing networks. Instead of considering factories only as black boxes or building blocks of IMNs, this work goes beyond the plant boundaries and integrates the perspective of key decision-makers inside of the black boxes. This thesis nominates plant leaders as key decision-makers for IMNs. Interviews with twelve of these key individuals highlight the significant influence that plant leaders have on the topic of inter-plant exchange. Furthermore, the perspective of the interviewees show that it is precisely this exchange that is hindered by a lack of network strategy, a lack of resources at plant level, a lack of plant similarities, a lack of personal level-ties, competition in the network or a misguiding incentive system.

The results of the plant leader interviews were published in the *Journal of Manufacturing Technology Management* and form the basis for the conceptual contribution of this thesis - the development of a framework to involve plant leaders in inter-plant.

The management framework takes the context conditions of each production site into account and suggests corresponding coordination measures. Four case studies with global manufacturing companies form the basis to operationalize this framework and verify its real-world applicability. As a result, this thesis suggests a practical tool to classify the production sites of a network on the basis of plant capabilities and operational performance. Situation-specific coordination mechanisms are proposed according to this classification. Giving network coordination related authority to selected plant leaders is one important recommendation resulting from this management framework.

1 Introduction

"Competition has been shown to be useful up to a certain point and no further, but cooperation, which is the thing we must strive for today, begins where competition leaves off."

(Roosevelt, 1912)

Although Roosevelt's statement during a speech at Troy refers to a different context, it still holds for today's Operations Management (OM) domain and particularly for the management of International Manufacturing Networks (IMNs). Many firms promote competition between their manufacturing locations to optimise costs. However, in order to cope with complexity, uncertainty and other challenges that global operation management faces these days, a different approach towards cooperation among manufacturing units is needed. The following section introduces the research background and motivation in more detail. Furthermore, this chapter illustrates the research questions, the approach of this study, the underlying theory, the applied research framework and finally, the structure of this thesis.

1.1 Background and Motivation

For many years manufacturing value chains have become more international and globally fragmented (Brennan et al., 2015). A recent position paper concluded that "The days when Henry Ford could build a giant plant to make everything needed for an automobile under one roof are mostly long gone" (Block, Keller, Schrank and Whitford, 2012, p. 4). World trade is one key indicator reflecting this development (Ferdows, 2018, p. 392). Global trade of merchandise grew more than 300% from 1997 to 2017, according to the World Trade Organization (WTO) online database (WTO, 2018). The value chains of Trans-National Corporations (TNC) result in more than 80% of international trade (UNCTAD, 2018, p. 16). Value is created in networks between independent firms (e.g. Möller, 2006) and also between entities of the same firm (Rudberg and Olhager, 2003). The latter accounts for one-third of global trade in services and goods, which means that value creation remains within the firm boundaries (UNCTAD, 2018, p. 16). These numbers indicate the importance of intra-firm production networks (i.e., international manufacturing networks).

Shrinking transaction-cost by modern means of communication and decreasing freight rates are forces driving the trend of globalisation in manufacturing (Jacob and Strube, 2008). According to the controversial perception of Maswood (2017), neo-protectionist developments as recently promoted by the US president Trump have the potential to accelerate the growth of IMNs even further. Maswood (2017) demonstrates that tariffs introduced by the US in the 1980s led Japanese manufacturing firms to set up new factories in North America. The aim to evade trade barriers was, according to Maswood (2017), a primary driver for the emergence of manufacturing networks. Similarly, the current political developments lead to configurational changes in manufacturing organisations, potentially to foster the construction of new production facilities behind the trade walls:

> ”Trade wars are seen as a major 2019 threat factor to businesses, with trade wars seen to be affecting profits, thereby forcing companies to pursue relocation, supply chain restructuring, and so on.“ (Frost & Sullivan, 2019, p. 21)

Such unpredictable trends in the “increasing[ly] uncertain world” (Christopher and Holweg, 2011, p. 64) make the management of IMNs a remarkably complex and challenging task (Abele and Reinhart, 2011; Friedli, Mundt and Thomas, 2014). Decision-makers in IMNs face “an arduous list of independent variables to consider” (Ferdows, 2018, p. 394). At the same time, manufacturing firms have to cope with an ever-growing competitive pressure resulting from market entries of low-cost providers (Jacob & Strube, 2008, p. 8). Firms with a global manufacturing presence strive to benefit from the potentials of their manufacturing networks, but these potentials are not only related to cost. Quite the contrary: although global presence allows profiting from regional differences in factor costs (Jacob & Strube, 2008, p. 9), spatial separation of operation also comes with additional efforts and unavoidable costs compared to a single factory operation (Malmberg, 1995, p. 49). Therefore, aspects like internal learning or flexibility gains are becoming increasingly relevant for the management of IMNs. Firms are challenged to find and qualify people to carry out manufacturing work (Chatha and Butt, 2015, p. 607), that poses the challenge to spread knowledge across their entities. Especially, in the course of the discussion on relocations in general and, namely, to avoid trade barriers, the question of how firms can enable their factories in the North-America or in China to assume manufacturing for the local market arises. Operations management faces the challenging task of seizing the advantages of their network by creating cooperation and exchange between their globally dispersed plants. However, insights gained through various projects between the Institute of Technology Management (ITEM) and firms operating a manufacturing network revealed that plant employees and even key decision-makers in the factories pursue a primary local focus. A Delphi study confirmed that this “lack of a global view” (Klassen and Whybark, 1994, p. 385) is a major challenge for globally operating manufacturing firms. Notably, the result- and number-driven nature of production, which also strikes in the following manager statement transcribed by Long (2018) from an interview about subordinate cooperation, affects decision-makers on the plant level and guides their attention to local themes:

> “We are also under fire for ah, production numbers. It gets real tense to meet your numbers and there's a lot less room for error. We really focus on those numbers …we're extremely result-focused.” Long (2018, p. 73)[1]

[1] Statement from a managerial interview in Long (2018, p. 73).

A systematic understanding of how individuals on the plant level need to be integrated into the management of IMNs in order to achieve the network outcomes is still lacking for two main reasons.

First, despite the fact that scholars have explored the field of IMNs for three decades, "the number of publications specifically in leading OM journals focusing on the management of global operations is small" (Ferdows, 2018, p. 390). Historically, the IMN literature has focused on network configuration (i.e., structural decisions about the set-up of the network in terms of plant location, resource allocation and ownership of plants) (Cheng, Farooq and Johansen, 2015; Meijboom and Voordijk, 2003; Toni and Parussini, 2010). Although in recent years the initial focus of literature on configurational aspects has slowly shifted towards coordination (Cheng, Farooq et al., 2015, p. 407). However, recent studies underline that coordination-related aspects like the links between plants or mechanisms to manage the network entities remain vague (e.g., Norouzilame, 2018; Norouzilame and Wiktorsson, 2018, p. 1607; Sayem, Feldmann and Ortega-Mier, 2018).

Second, plants have traditionally been treated as black boxes in previous studies (Cheng, Farooq et al., 2015, p. 407). Besides recent attempts to shed some light on plant characteristics and intra-network knowledge sharing (e.g., Scherrer and Deflorin, 2017b; Szász, Rácz, Scherrer and Deflorin, 2019), the IMN stream still neglects to consider the human factor, even despite Feldman's early call to integrate "soft issues, that is, the behavioural aspects of production/operations management" (Feldman, 1988, p. 50). Instead, scholars address a "plants' willingness to transfer knowledge" (Scherrer & Deflorin, 2017b, p. 414) or refer to the motivation of plants (e.g., Cheng and Farooq, 2018). However, willingness and motivation are human characteristics, so the motivation and perspective of influential decision-makers on the plant level should be taken into account in order to understand the intra-network conduct of plants. As such, this thesis addresses manufacturing subsidiary managers (i.e., plant leaders who have a significant influence on the network-related behaviour of their unit) (Friedli et al., 2014; Gupta and Govindarajan, 1991). By integrating the perspective of plant leaders into the discussion on IMNs, the work at hand follows the proposition of Jaehne, Li, Riedel, and Mueller (2009) to extend the current perspective to an individual level in order "to understand how a value network works and where the problems of the relevant interfaces are hidden" (Jaehne et al., 2009, p. 2023).

1.2 Objectives and Questions

Due to the ongoing rise of globally dispersed intra-firm manufacturing operations, scholars and practitioners are increasingly devoting their attention to the coordination of manufacturing networks (Cheng, Farooq et al., 2015). In order to leverage the full potential of network operations, some recent studies point to the role, motivation and relation of key actors within IMNs (e.g., Scherrer & Deflorin, 2017b; Szász et al., 2019). This work argues that plant leaders hold a critical position as they have a significant impact on the conduct of their plant (see Chapter 3.1). Thus, as shown in Table 1, the central Research Question (RQ) of the thesis is how manufacturing firms can guide the attention of their plant leaders in order to foster inter-plant exchange. This question is based on the underlying assumption that firms promote exchange instead of competition (Luo, 2005) between their manufacturing plants in order to benefit from selected network capabilities (see Chapter 2.3).

Three sub research questions guide the process of answering the main research question of this thesis (see Table 1). The first question (RQ1) sets out to substantiate the understanding of IMN coordination. The purpose of this RQ is to identify which mechanisms have been developed to promote exchange between plants. Furthermore, it aims to capture existing approaches from the domain of IMN that address key decision-makers on plant level.

Table 1: Research questions

How can IMN management guide the attention of plant leaders to foster inter-plant exchange?	
RQ 1	What approaches towards IMN coordination exist, and how do these integrate the individual-level perspective?
RQ 2	What barriers exist that hinder plant leaders from engaging in inter-plant exchange?
RQ 3	How can network management integrate plant leaders into IMN coordination?

The purpose of the second question (RQ2) is to outline a complete picture of barriers to inter-plant exchange from an individual-level perspective. Thus, this question asks the perspective of plant leaders as key actors in IMNs, who determine the engagement of their facility in inter-plant exchange.

Finally, the last question (RQ3) aims to provide specific suggestions for network firms on how to improve the exchange between their plants by considering the perspective of the plant leaders. The purpose of this question is to examine how network management can promote inter-plant exchange by designing adequate rules and mechanisms.

The work at hand addresses each research question by using appropriate methodologies, as outlined in Chapter 1.5.

1.3 Research Approach

This study follows the perspective of business research as an applied social science (Ulrich, H., 1984; Ulrich, P. and Hill, 1976), which addresses the design and steering of firms as social systems (Ulrich, H., 1984, p. 168). Practical problems and relevant challenges in management practice constitute the starting point for business research (Ulrich, H., 1984). Although this research thesis engages in a pragmatic approach to advance the current level of knowledge in order to better understand practical challenges of manufacturing firms and provide decision support, it also has descriptive and theoretical objectives (Kubicek, 1977, p. 7; Schweitzer, 1978, pp. 2–9).

Specifically, growing complexity is a significant challenge for researchers in the context of global operations (Ferdows, 2018). This complexity prevents the possibility of entirely comprehending the subject. Ulrich, H. (1984) proposes for one to approach such complex social systems from a holistic perspective instead of going the way of natural science and analysing only limited excerpts of reality. Due to the complexity of global operations and thus, the limited chances for testing hypotheses to generate scientific progress (Kubicek, 1977; Tomczak, 1992; Ulrich, H., 1984), this work applies an iterative learning process (see Figure 1). Kubicek (1977) proposes to go back and forth between theory and empiricism (i.e., ask theory-guided questions to reality) (Kubicek, 1977, p. 14). This iterative research process aims to advance preliminary understanding and involves managers from practice in order to generate new theories (Gassmann, 1997; Kubicek, 1977; Tomczak, 1992). Within the process of creating the work at hand, various insights into the practice of IMN management and the reality of plant leaders provided answers to questions that were formulated based on a preliminary theoretical understanding. The critical reflection and abstraction of thereby generated findings from practice triggered another confrontation with the existing knowledge base, which in turn raised additional questions for practice. Each loop of this research process provides incremental advancements to the comprehension of the research subject (Kubicek, 1977; Tomczak, 1992). As such, since each research question exhibits slightly alters focus, the iterative process has also been applied sequentially for each research phase. The work at hand is the result of multiple iterations of the research process presented in Figure 1. Furthermore, this work combines both existing theories with empiricism, which leads to scientific rigour and relevant results, thereby providing economic and social value (Nunamaker, Briggs, Derrick and Schwabe, 2015).

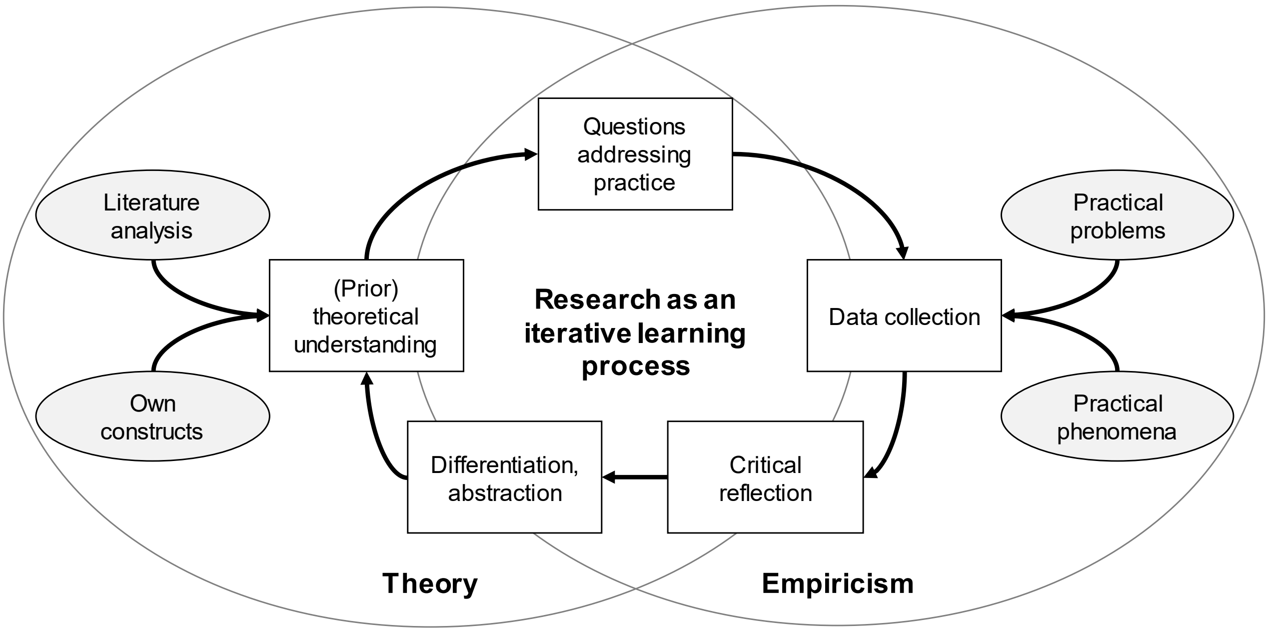


Figure 1: Research as an iterative learning process (adopted from Gassmann, 1997, p. 22)[2]

[2] Gassmann (1997) refers to Kubicek (1977, p. 14) and Tomczak (1992, p. 84).

In general, the research methodology needs to be aligned with the research approach and, in particular, with the research questions (Creswell and Creswell, 2018). In the context of the iterative learning process (see Figure 1), scholars suggest that qualitative research proves particularly suitable to recurrently address the practice with questions stemming from a prior theoretical understanding (Gassmann, 1999; Tomczak, 1992). Furthermore, qualitative research also provides a sound approach of handling the complexity that comes along with the management of manufacturing networks (Creswell & Creswell, 2018, p. 4). As shown in Table 2, this work applies a qualitative research approach. It is structured in one initial and three main phases, all of which apply suitable research methods.[3]

Table 2: Research phases and applied methods

#	Phase	Intention	Method (Empiricism)
0.	Initiate	Assess relevance	Interaction with practitioners and initial literature screening
1.	Describe and conceptualise the problem	Define IMN coordination and find overlap with individual-level (RQ1)	Literature review
		Capture individual-level perspective of plant leaders (RQ2)	Expert interviews (12 plant leaders)
2.	Design	Integration of individual-level into IMN coordination (RQ3)	Case studies (four manufacturing firms)
3.	Reflect	Synthesis findings from practice and theory (RQ 3)	

An initial research interest stemming from interactions with practitioners from multiple manufacturing firms raised the question of how IMN management should integrate the interests of individuals at the plant level. A preliminary literature screening indicated a research gap. The initial understanding of the research interest suggested that IMN research would benefit from a better understanding of how firms can guide the attention of their key actors. As such, this initial research phase suggested applying the Attention-Based View (ABV) as the scientific framework of this work (see Chapter 1.3).

The first phase comprised a comprehensive and structured literature review to gain an in-depth understanding of the IMN coordination concept and identify the role of plant leaders within this research stream. Besides providing an answer to the first research question, this phase also confirmed the lack of an individual-level perspective in IMN coordination. The perspective of key actors located on the plant-level provides further input in order to conceptualise the problem. Expert interviews with twelve plant leaders provided the basis for answering the second research question. The findings of the plant leader interviews were

[3] Among many sources, see for example Creswell and Creswell (2018) and Flick (2018) who provide a comprehensive overview of qualitative research methods. Further background information on each method is provided in the respective chapters of the work at hand.

submitted to a peer-reviewed journal contribution in September 2019 and accepted in May 2020 (Wiech and Friedli, 2020).

New questions and an initial concept emerged from the combination of the findings from IMN coordination-related literature and the plant leader interviews. These questions and an initial concept derived from the prior phases guided the case-study process. Four firms that operate an IMN provided the empirical basis for understanding how they integrate plant leaders into their IMN coordination. Furthermore, they provided the empiricism for developing a conceptual approach that integrates selected plant leaders in order to support the coordination of IMNs.

Finally, the last phase of this research critically reflected on the generated findings by discussing contradictions, confirmations and extensions to existing IMN research. As such, this last research phase also provided a comprehensive answer to the third and main research question.

1.4 Underlying Theory

The attention-based view, a theoretical approach from strategic research, was chosen to integrate the individual-level perspective into IMNs. It provided a theoretical framework and particular assumptions in order to approach the field of global operations and divert from the perspective of previous research.

Attention as a critical determinant for management received considerable interest in the recent past triggered by Ocasio's publication "Towards an attention-based view of the firm" (Ocasio, 1997). Attention has emerged as a new alternative explanation of firm behaviour, particularly in organisational science (Ocasio, 2011). Ocasio proposed to "explain firm's strategic decision making and adaption – key topics in strategy research" (Ocasio, Laamanen and Vaara, 2018, p. 156). Fifty years after the early work of Simon (1947), Ocasio complemented Simon's findings with a new perspective on the firm as a system of structurally allocated attention (Ocasio, 1997). Ocasio proposes that firms can actively regulate the attention of decision-makers, thus affecting the organisations' behaviour and adaption (Ocasio, 2011). In general, the ABV links the concept of attention closely with the term *answers and issues*:

> "Attention is here defined to encompass the noticing, encoding, interpreting, and focusing of time and effort by organizational decision-makers on both (a) issues; the available repertoire of categories for making sense of the environment: problems, opportunities, and threats; and (b) answers: the available repertoire of action alternatives: proposals, routines, projects, programs, and procedures." (Ocasio, 1997, p. 189)

Humans' cognitive ability limits the number of issues and answers to which they can attend (Simon, 1947). Human beings (e.g., decision-makers) activate a selective focus when confronted with more information than their cognitive ability can handle (Cyert and March, 1963, p. 108; Mintzberg, 1973, pp. 67–71). The issue of attentional focus is inherently linked to the managerial function of continually monitoring various sources and disseminating information within the organisation (Mintzberg, 1973, p. 97). Mintzberg (1973, p. 67) underlines the problem of information overflow. He presents the analogy of "the manager as a monitor" who "is continually seeking, and being bombarded with, information" (Mintzberg, 1973, p. 67). Hence, managers as human beings are forced to focus on selected answers and issues in order to cope with the sheer overwhelming quantity of information. Focus allows one to concentrate energy on specific issues and challenges, and therefore, the speed and quality of related decisions increases (Ocasio, 1997, p. 204). In order to increase decision quality, firms need to guide the attention of their decision-makers on relevant issues (Hoffman and Ocasio, 2001, e.g.,; McNamara and Bromiley, 1999; Ocasio, 1997, 2012). However, consideration must be given to the fact that attention can have both favourable and unfavourable results. Beside the advantages of and unavoidable need for a selective focus, it bears the risk of causing one to concentrate on insignificant issues, neglect certain information or oversee potential options (Barnett, 2008; McNamara & Bromiley, 1999).

The ABV and the associated concept of attention build on three interrelated premises of ""Focus of Attention", "Situated Attention" and "Structural Distribution of Attention" (Ocasio, 1997, p. 188). The first premise simply concludes that due to the limited attention capacity of decision-makers (Simon, 1947), they have to focus on specific issues and answers. This focus determines what decision-makers eventually do (Ocasio, 1997, p. 188). The second principle highlights the effects of context and situation on the focus of decision-makers (Ocasio, 1997, p. 188). Situation and context direct or trigger the focus of individual attention and affect what they do (Ocasio, 1997; Ross and Nisbett, 1991). Ocasio underlines that rather situational than individual characteristics explain the variance of attentional focus(Ocasio, 1997, pp. 190–191). The third premise of the ABV looks into the particular situation of decision-makers in organisations and highlights the effect of organisational structure (Ocasio, 1997, p. 188). Different activities within firms involve particular procedures and communications that shape the decision-makers' focus of attention (Ocasio, 1997, p. 191; Simon, 1947, p. 220). The organisational structures, the allocation of tasks and resources, and the definition of rules have two significant implications for the firm. First, they regulate the situational context in which decision-makers find themselves (e.g., local activities) (Ocasio, 1997, p. 191). Second, they shape how decision-makers attend to those situations (Ocasio, 1997, pp. 188–191). The ABV provides a top-down perspective (Ocasio, 2011, p. 1292), implying that firms can regulate the attention of their decision-makers through a particular design of the organisational structure.

Ocasio (1997, p. 192) introduces an "imaginative model of situated attention in firms to explain how firms behave." It incorporates the three principles of the ABV described above. The model (see Figure 2) is comprised of a set of mechanisms that relate several fundamental components and incorporate a temporal sequence. First, the firm receives input from the environment. Then it transforms "through attentional processing and decision-making, the inputs from the environment … into a set of outputs" (Ocasio, 1997, p. 193). Finally, these outputs are organisational moves (see Figure 2), and thus, the results of an intra-firm process or pattern (Ocasio, 2011). The solid lines in Figure 2 represent mechanisms related to the three ABV premises. The dotted lines present mechanisms that are not directly integrated into the model.

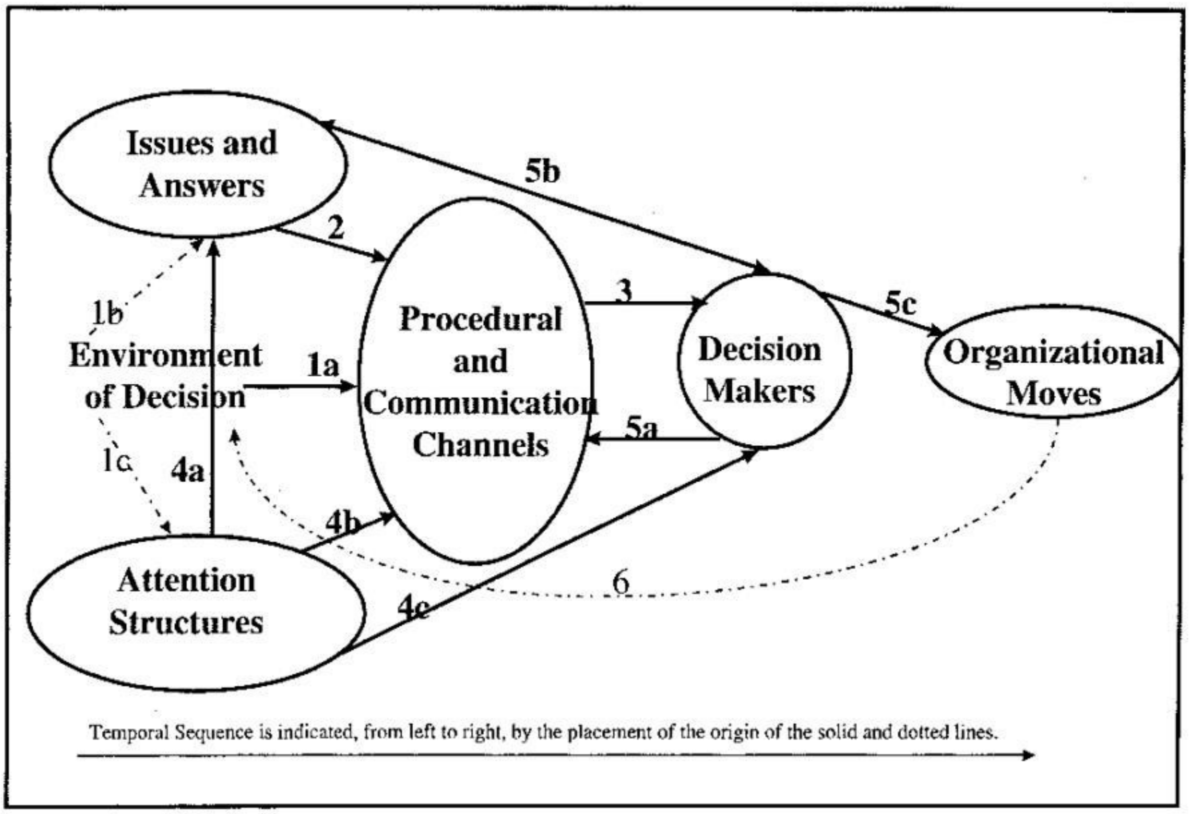


Figure 2: Model of situated attention and firm behaviour (reprinted from Ocasio, 1997, p. 192)

In the model, the internal transformation of environmental input into organisational moves builds on four components (see Figure 2):

- *Issues and Answers* also influence the distribution of attention, and thus, the processing of environmental input (1b, see Figure 2): "Issues and answers are the cultural and cognitive repertoire of schemas available to decision-makers in the firm to make sense of (issues), and to respond to (answers) environmental stimuli" (Ocasio, 1997, p. 194).

  Ocasio emphasises that this repertoire determines what issues decision-makers attend to or ignore (Dutton and Jackson, 1987). The model also underlines that the cultural embodiment of issues and answers plays a vital role in procedural and communication channels (2, see Figure 2).

Procedural and Communication Channels refers to the situational context of attentional processing (Ocasio, 1997, pp. 194–195). Ocasio (1997, p. 194) defines these channels as "the formal and informal concrete activities, interactions, and communications set up by the firm to induce organisational decision-makers to action on a selected set of issues" (Ocasio, 1997). Thus, these channels are directly involved in the transformation of environmental input (1a, see Figure 2). They furthermore define the interaction of decision-makers and the attentional focus of individuals (3, 5a, see Figure 2). Ocasio exemplifies these channels meetings, whereby location and type of these physical gatherings can affect the attentional focus of decision-makers (Ocasio, 1997, p. 195).

- *Attention Structures* is another essential component for distributing attention within the firm. Attention structures function as an orientation aid for decision-makers who need to find their way through a high number of possible issues and answers (4a, see Figure 2). "The firm's attention structures govern the valuation and legitimization of the repertoire of issues and answers available to decision-makers" (Ocasio, 1997, p. 199). Attention structures incentivise decision-makers and direct their attention to those aspects most relevant for the firm (Ocasio, 1997, p. 199). Attention structures also allocate decision-making activities to the procedural and communication channels (4b, see Figure 2) (Ocasio, 1997, p. 199). Therefore, it addresses the foci of particular functions, the assignment of resources and sets distinct procedures. In addition, Ocasio (1997, p. 199) describes that attention structures shape interests and identities that motivate decision-makers' actions (4c, see Figure 2).
- *Decision-Makers* are the individuals within the firm whose attention the model concerns in order to foster decisions and organisational actions. These individuals are characterised by their own agendas, particular interests and social positions (Cyert & March, 1963; Ocasio, 1997). The interaction of these individuals with distinct characteristics happens within the procedural and communication channels (5a, see Figure 2). The structure of those channels and personal characteristics of the decision-makers shape the final decision, and consequently, the organisational move (Ocasio, 1997).

Overall, Ocasio's model depicts several components and mechanisms that underline the concept of attention in the decision-making process. It provides several important implications for understanding firm behaviour as a result of individual attention. Furthermore, it presents specific levers for organisations aiming to guide the attention of their decision-makers in order to achieve particular organisational behaviour. The integration of a variety of perspectives from organisational research is undoubtedly one strength of the ABV as a metatheory (Ocasio, 2011).

Implications for this Research

1. *The way manufacturing networks respond to events or occurrences depends on the attentional focus of the network's decision-makers.*
2. *Plant leaders are crucial decision-makers in manufacturing networks with limited cognitive capacity. Therefore, they apply selective focus.*
3. *The focus of attention is dependent on individual characteristics and even more on the situational context.*
4. *Organisational structures determine the situational context. Thus, IMN management can guide the attention of their plant leaders through three levers: attention structures, issues and answer, and procedural and communication channels.*
5. *The potential outputs or benefits a firm can generate through operating an IMN (see Chapter 2.3) also refers to what issues the plant leaders as key decision-makers attend in their attentional capacity. Guiding the attentional focus of plant leaders is the task of IMN coordination.*

1.5 Research Framework

A theoretical, heuristic or conceptual framework provides an initial orientation for the research process (Kubicek, 1977, pp. 17–18). A heuristic framework is, according to Tomczak (1992, p. 84), a tentative model that describes the research phenomenon. It incorporates the underlying assumptions and views (Kubicek, 1977, pp. 17–18). As such, Figure 3 presents the research framework for the work at hand and outlines the relevant variables, relations and mechanisms (Tomczak, 1992, p. 84):

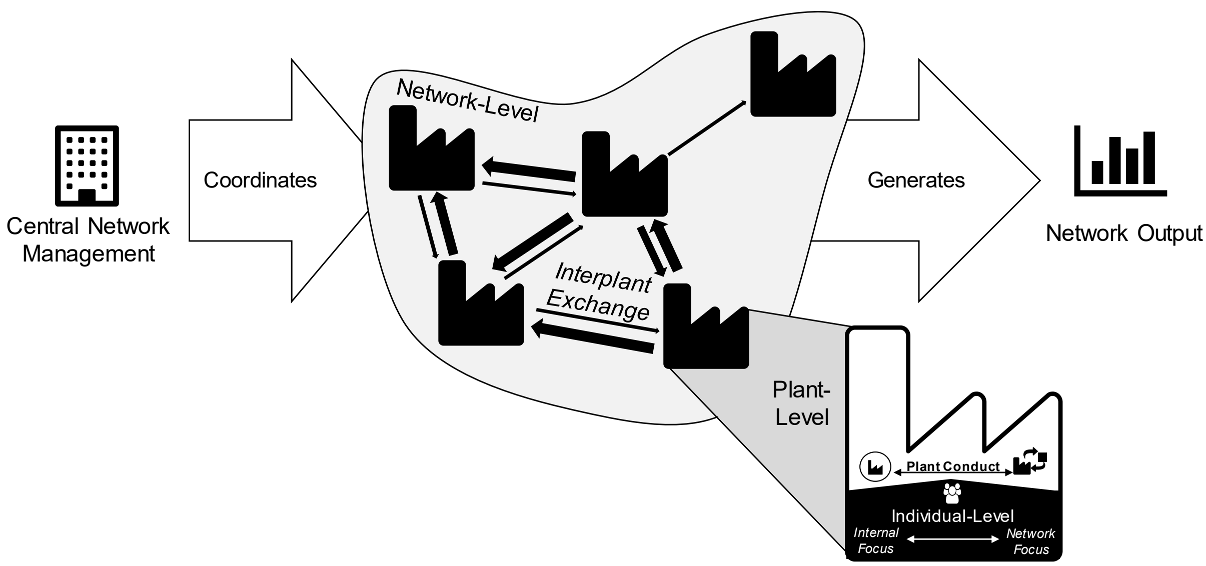


Figure 3: Research framework

This study's underlying research phenomenon is the coordination of globally dispersed manufacturing operations (i.e., of international manufacturing networks). As shown in Figure 3, the central network management coordinates the plants and the flows between them.[4] As a result, the network generates outputs that a firm with only one production plant could not achieve (Colotla, Shi and Gregory, 2003; Friedli et al., 2014; Miltenburg, 2009; Shi and Gregory, 1998; Thomas, Scherrer-Rathje, Fischl and Friedli, 2015). Network outputs like learning depend primarily on the degree of exchange between plants. However, studies provide evidence that not all plants participate or engage equally in inter-plant exchange (e.g. Scherrer & Deflorin, 2017b; Vereecke, van Dierdonck and de Meyer, 2006). Eventually, central network management can influence the degree of inter-plant exchange by selected measures, for example, by creating individual-level ties (e.g. Scherrer & Deflorin, 2017b). Key decision-makers within the plants (e.g., plant leaders) significantly influence their unit's willingness to participate in the intra-network flows (e.g. Burgess, 2005; Cabrera, Collins and Salgado, 2006). Thus, network coordination needs to incorporate the individual-level, and not only the plant- and network-level perspective commonly applied in IMN research (e.g. Cheng, Farooq et al., 2015). Figure 5 outlines that the attentional focus of key actors on plant level defines how the respective facility participates and contributes to inter-plant exchange. The assumption is that a strong internal focus of key decision-makers leads to a lower degree of interaction with other network units. On the other hand, a stronger focus on network topics of the individual-level is reflected in the corresponding conduct on plant level. Following Ocasio (1997), central network management can guide the attention of their decision-makers. Eventually, this leads to the underlying research question of this thesis (see Chapter 1.2): how network management can guide the attention of plant leaders to facilitate and promote inter-plant exchange.

1.6 Thesis Structure

The remainder of the work at hand is structured into seven chapters. The sections are interrelated and contribute to the research objective each.

Chapter 2 - International Manufacturing Networks and Coordination

The purpose of the second chapter is twofold. First, it provides an outline of the related research streams. It clarifies the basic terms and concepts associated with IMN and the research interest in general. Then, the second chapter presents the methodology and results of the conduct literature review on IMN coordination. In addition to identifying several shortcomings of the existing knowledge base, the comprehensive literature analysis also contributes to a better understanding of the relevant inter-plant flows. Furthermore, the analysis of existing approaches to coordinate these intra-network flows provides an essential basis for the conceptual design in Chapter 4.

Chapter 3 - The Plant Leader Perspective

[4] Not all firms have adequate structures in place to manage their IMNs (Friedli, Mundt and Thomas, 2014). However, firms striving to get the most of their global operation tend to afford a central network management organisation. For example, all four case firms presented in Chapter 5 have designated network management functions.

The third chapter sets out to derive the individual-level perspective directly from the identified key actors (i.e., the plant leaders). First, the chapter outlines why plant leaders are relevant decision-makers in manufacturing networks. Then, the chapter presents the applied methodology to query the perspective of 12 plant leaders on inter-plant exchange. Finally, the chapter presents the interview results and outlines several impediments to inter-plant exchange from the individual-level perspective.

Chapter 4 - Conceptual Design

The conceptual design builds on the findings from the plant leader interviews and incorporates some implications from the existing knowledge base (i.e., the literature review in chapter 2). The purpose of the fourth chapter is to provide a guiding framework for the subsequent data collection during the case study phase.

Chapter 5 - Case Studies

Before presenting the results of four different case studies, the fifth chapter briefly outlines the applied case study approach. The chapter introduces each case and presents the findings, following the same structure for each firm. The initial framework from the previous chapter not only guided the data collection during the case studies, but also was subject to refinement in the discourse with each case informant. As such, the findings from the application of the proposed framework and the refinements are also presented for each case in this chapter.

Chapter 6 - Cross-Case Analysis and Reflection

The sixth chapter reflects upon and compares the findings from the previous chapter, and revisits the knowledge base. Finally, the chapter proposes several mechanisms for coordinating an IMN, taking the individual-level perspective into account, and presents the revised management framework for guiding the attention of plant leaders according to their plant's situational context.

Chapter 7 - Summary and Outlook

The final section draws upon the entire thesis to outline the practical and theoretical contribution of the work at hand and gives a summary of the research outcomes. Furthermore, the last chapter includes a discussion of limitations and areas for further research.

2 International Manufacturing Networks and Coordination

This study is rooted in the domain of IMN, which stems from several research streams (Cheng, Farooq et al., 2015). Therefore, the following chapter introduces the main concepts of IMN research. It touches briefly upon linked research streams in order to outline the theoretical basis of the work at hand. Chapter 2.6 provides an in-depth analysis of IMN coordination, which aims to answer the first research question.

The findings presented in this chapter have been published in parts. Namely, the analysis of the existing knowledge base of IMN coordination and the individual-level perspective (see Chapter 2.6) has been incorporated into the theoretical discussion of the following publication:

- *Wiech, M. and Friedli, T. (2020). Using Plant Leaders' Perspectives to Overcome Barriers to Inter-Plant Exchange. Journal of Manufacturing Technology Management. (ahead-of-print).*

2.1 International Manufacturing Networks

The globalisation of manufacturing companies, that is, setting up dispersed production facilities all over the world, has shifted focus from a single plant to network organisation (Ferdows, 1989, pp. 3–4). Accordingly, research about the management of manufacturing networks gained attention in the late 1980s and became an established stream of (global) OM literature (Cheng, Farooq et al., 2015; Ferdows, 2018). The work at hand strives to contribute to OM research, which considers two research streams: "One deals with comparing operations practices under different external contingencies, i.e. contextual conditions. The other stream investigates IMNs" (Demeter, 2014, p. 325).

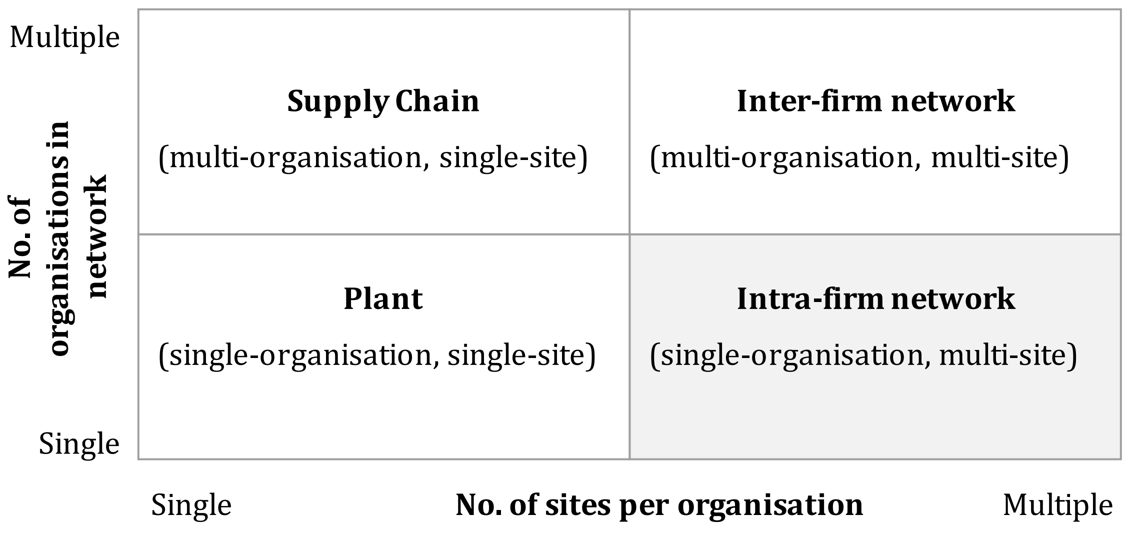


Figure 4: Types of value networks (adapted from Rudberg & Olhager, 2003, p. 35)

According to Rudberg and Olhager (2003, p. 29), manufacturing activities are no longer carried out by one single manufacturing facility or not even by one company, but in so-called value networks (see Figure 4). In order to classify the literature about value networks into four types (see Figure 4), they distinguish the number of (1) sites per organisation, and (2) organisations in the network (Rudberg & Olhager, 2003, p. 35). Therein, they define intra-firm networks as multiple sites operated by only one organisation. As a result, management has direct control over all plants (Shi & Gregory, 1998, p. 199). The perspective of managerial control is a crucial element to define IMNs as intra-firm networks (Cheng and Johansen, 2013, p. 5).

An international manufacturing network "is generally defined as a coordinated aggregation (network) of intra-firm plants/factories located in different places" (Cheng, Farooq et al., 2015, p. 393; Ferdows, 1989; Rudberg & Olhager, 2003; Shi & Gregory, 1998).

Apart from ownership and control, this definition stresses that plants are considered to be "fundamental building blocks" (Christodoulou et al., 2007, p. 5) of the IMN concept. Scholars in the domain of IMN regard the plant as an "integral component or, more importantly, the basic construct of an IMN" (Cheng, Farooq et al., 2015, p. 396, 2011). Again, this view reflects the difference to the supply chain domain (see Figure 5). Whereas IMN-related research pays attention to the internal nodes (i.e., the plants), supply chain research concentrates on the links between the nodes (Cheng, Farooq and Johansen, 2014, p. 172; Rudberg & Olhager, 2003, p. 30).

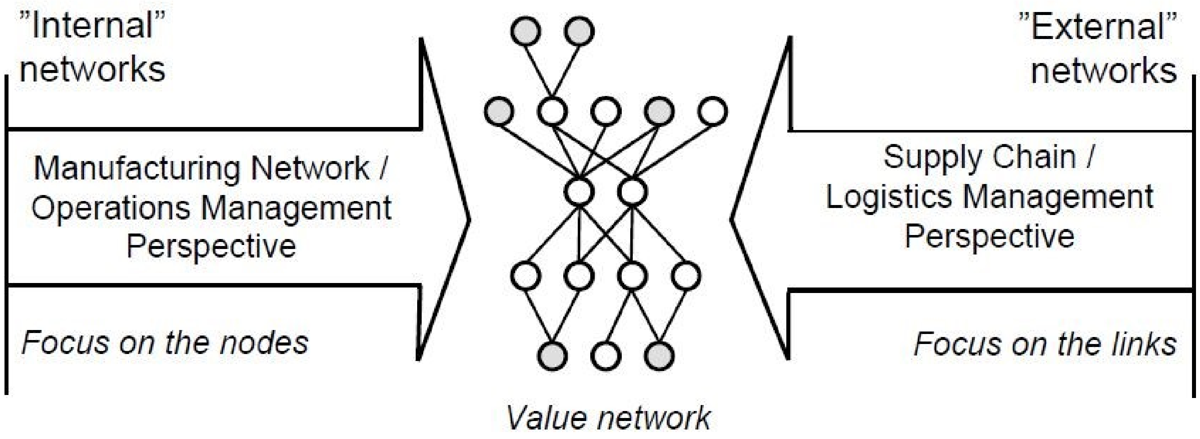


Figure 5: Different foci of research streams (reprinted from Rudberg & Olhager, 2003, p. 30)

Practice shows various forms of IMNs, and a wide range of factors determines an IMN (Feldmann and Olhager, 2019; Friedli et al., 2014). Besides the strategic orientation (Friedli et al., 2014), networks can be distinguished based on factors like geographic dispersion (Abele & Reinhart, 2011; Shi & Gregory, 1998), products, factory roles and others (Feldmann & Olhager, 2019). All of these characteristics have implications for the management of these networks.

2.2 IMN - Configuration and Coordination

Design and management of IMNs are linked to three main tasks: (1) definition of network strategy, (2) decisions about configuration and (3) decisions about coordination (Cheng, Chaudhuri and Farooq, 2016; Friedli et al., 2014; Hayes, Pisano, Upton and Wheelwright, 2005). Porter (1986) identified the latter two concepts as powerful levers for companies with multiple and dispersed factories to derive a competitive advantage.

Configuration refers to the structure of manufacturing networks (Colotla et al., 2003, p. 1189; Hayes & Wheelwright, 1984), and considerably more studies have covered the configuration rather than the coordination of IMNs (Cheng, Farooq et al., 2015; Pontrandolfo and Okogbaa, 1999; Szwejczewski, Sweeney and Cousens, 2016; Toni & Parussini, 2010). According to Friedli et al. (2014, p. 86), network configuration is linked to the term *manufacturing footprint*. As such, it specifies the number of plants, their geographic positions and the allocation of resources to them (Friedli et al., 2014, p. 86; Meijboom and Vos, 1997).

The literature on plant location decisions is extensive (Prasad and Babbar, 2000, pp. 221–222). This stream developed into the topic of strategic site roles and specialisations (see Chapter 2.4) as another subtopic of IMN configuration (Scherrer and Deflorin, 2017a, p. 230). It has received considerable attention for more than 20 years and is still the subject of recent scholarly publications (Cheng & Farooq, 2018; Cheng, Farooq, Johansen and O'Brien, 2019, p. 93).

The second concept, coordination of IMN management, is defined as "the infrastructural processes related to linking activities between plants" (Colotla et al., 2003, p. 1189; Hayes and Wheelwright, 1984). IMN literature covering coordination is scarce (Cheng et al., 2016, p. 551; Szwejczewski et al., 2016, p. 130), and no homogenous definition of network coordination exists (see Chapter 2.6.2). Several scholars associate the term network coordination with the general concept of network management and optimisation (Cheng et al., 2011; Fredriksson and Wänström, 2014; Netland and Aspelund, 2014; Pontrandolfo & Okogbaa, 1999; Rudberg & Olhager, 2003). Others link specific decision areas (e.g., autonomy, standardisation) to the concept of network coordination (Friedli et al., 2014; Scherrer & Deflorin, 2017a). For a detailed analysis of the coordination concept in IMN, the Systematic Literature Review (SLR) presented in Chapter 2.6 highlights various definitions and provides an overview of past research dealing with this topic.

Both concepts of configuration and coordination are interrelated (Cheng et al., 2011, p. 1314; Pontrandolfo & Okogbaa, 1999, p. 5). Thus, decisions related to either coordination or configuration should be embedded in a network strategy assuring a fit between these main concepts of IMN and the market demands (Friedli et al., 2014).

2.3 IMN - Benefits and Capabilities

The operation of multiple plants in distant places comes with diverse challenges. It is not only a complex and demanding task to operate a manufacturing network (Abele & Reinhart, 2011, p. 121), but Malmberg (1995) also points out unavoidable costs and coordination efforts compared to a single-plant operation:

> "When firm activities are split between multiple locations, however, increasing distances will make face-to-face contacts and physical flows much more time-consuming. Visual inspection will no longer be possible without travel. And, because managers and support staff cannot simultaneously be present in several locations, it may be necessary to hire additional staff and develop substitutes for informal communication. To some degree, these costs of spatial separation are unavoidable." (Malmberg, 1995, p. 49)

Despite of the downsides of globally dispersed manufacturing facilities, many companies demonstrate the potential success of this approach (see Chapter 1.1). If managed correctly, IMNs can provide certain advantages and secure the competitiveness of the firm (e.g., Cheng et al., 2011; Ferdows, 1989; Friedli et al., 2014; Jacob & Strube, 2008; Shi & Gregory, 1998).

Table 3: Overview of network capabilities (Colotla et al., 2003; Friedli et al., 2014, p. 72; Miltenburg, 2009, p. 178; Shi & Gregory, 1998; Thomas et al., 2015)

Network Capabilities	Description
Accessibility	Ability of the network to provide access to markets, to skills and knowledge, to low-cost production factors, to suppliers, to image factors or competitors.
Thriftiness	Ability to achieve economies of scale and scope as well as to reduce redundancies.
Learning	Ability to learn about external factors (e.g., markets, customers) and the transfer of knowledge (e.g., processes, best-practices) between network entities.
Mobility	Ability to transfer products, processes, people, production volumes and orders between network plants. Network's ability to cope with changing environments.

The following paragraph briefly introduces the potential network outputs.[5] The concept of network capabilities (see Table 3) goes back to Shi and Gregory (1998), who propose four strategic capabilities that can be seized by the operation of an IMN: resource accessibility, thriftiness ability, learning ability, manufacturing mobility (Shi & Gregory, 1998, pp. 209–210). Similarly, Miltenburg (2009, pp. 177–183) discusses the same four dimensions and refers to them as "network manufacturing outputs". Based on these network capabilities, or respective outputs, other scholars underline that network firms can define strategic targets

[5] Some of the following findings have been previously published in the *Zeitschrift für wirtschaftlichen Fabrikbetrieb* [ZWF] by Wiech, Benninghaus, Schlauri, Drost, and Friedli (2018).

for their network "by exactly defining and describing the desired state of these network capabilities" (Thomas et al., 2015, p. 1713).

Table 3 provides a brief overview of the four network capability dimensions. First, an IMN can provide access to a number of location factors, such as access to low-cost production factors or access to knowledge (Colotla et al., 2003; Thomas et al., 2015) Second, thriftiness addresses the cost dimension through economies of scale and scope and the reduction of duplication within the network (Shi & Gregory, 1998). Third, manufacturing networks provide learning opportunities by exchanging information and knowledge about various topics between factories (Colotla et al., 2003; Shi & Gregory, 1998). Cheng et al. (2016) highlight:

> "A plant, belonging to such a manufacturing network, is able to learn more about technology, customers, products or processes from other plants than it can learn by itself." (Cheng et al., 2016, p. 550)

Fourth, manufacturing mobility refers to the advantage a network can provide to cope with volatile customer demands and exchange rate fluctuations (Colotla et al., 2003). In order to leverage such mobility benefits, a network should provide the ability to shift products or production processes (Friedli et al., 2014).

Shi and Gregory (1998, p. 209) outline that IMN configuration and coordination are related to particular network capabilities. Network configuration is the critical decision dimension to secure access to markets, competitors, suppliers, low-cost production factors and more (Friedli et al., 2014; Miltenburg, 2009; Vereecke and van Dierdonck, 2002).

Coordination refers to the network's mobility, ability to learn and thriftiness (Colotla et al., 2003, p. 1191). Previous studies outlined that the network capability dimensions of thriftiness and learning are "mostly derived from network coordination" (Shi & Gregory, 1998, p. 209). The capability of mobility and flexibility within the network is related to both configuration and coordination (Brennan et al., 2015, p. 1259). The configuration enables structural flexibility (Christopher & Holweg, 2011).[6] For example, similar production lines in different plants enable the exchange of products on short notice, and thus allows immediate response to externalities (Brennan et al., 2015; Thomas et al., 2015). This coordination enables dynamic flexibility.[7] Manthou and Vlachopoulou (2001, p. 686) add that agile manufacturing strategies build on employee involvement and various dimensions of coordination. Activities of different plants need to be linked and managed to achieve this flexibility (Colotla et al., 2003, p. 1191).

The pursuit of network capabilities is subject to trade-offs (Colotla et al., 2003; Shi & Gregory, 1998; Thomas et al., 2015). For example, concentrating volumes in one plant may increase efficiency by economies of scale and reduction of duplication, but counteracts

---

6 See Brennan et al. (2015, p. 1259) for a list of studies on structural flexibility.
7 See Brennan et al. (2015, p. 1259) for a list of studies on dynamic flexibility.

the flexibility and lead time gains of several sites being able to produce a product (e.g., Thomas et al., 2015, p. 1716; Wiech, Benninghaus et al., 2018, p. 23). Therefore, strategic management of IMNs requires awareness about the potential benefits, but also builds on priorities about which capabilities to pursue in accordance with business and corporate strategy (Thomas et al., 2015, p. 1713; Wiech, Walter and Friedli, 2018).

Several scholars highlight the linkage between network and factory capabilities (Cheng et al., 2011; Colotla et al., 2003; Miltenburg, 2009; Thomas et al., 2015). According to their findings, strategic network management has to consider the contribution of individual sites to the network capabilities (Thomas et al., 2015; Wiech, Benninghaus et al., 2018). The next chapter, therefore, moves on to discuss the plant-level perspective with a focus on the roles that entities play within a network.

2.4 Plant Level and Roles

Research on IMN distinguishes between the plant and network levels (Cheng, Farooq et al., 2015, p. 396; Thomas et al., 2015). However, as mentioned in the previous section, both levels are interrelated, and research considers the linkages between both (Feldmann, Olhager, Fleet and Shi, 2013; Thomas et al., 2015). Whereas literature related to the network level mainly considers the configuration and coordination (see Chapter 2.2) of multiple plants in order to achieve the potential network benefits and capabilities (see Chapter 2.3), literature on the plant level deals with "location advantages of plants, site competences, plant roles, and knowledge flows among plants" (Cheng, Farooq et al., 2015, p. 403). Particular attention has been devoted to the topic of strategic plant roles, that is, "roles that manufacturing facilities may be playing within a corporate network" (Cheng, Farooq et al., 2015, p. 403). Though the focal unit of the plant role discussion is the plant level, it is also closely related to the network level (Feldmann and Olhager, 2013). Plant roles are useful for translating the overall network strategy into tangible guidelines for the plant level. As such, plant roles also refer to network coordination and configuration. Whereas some state that "plant roles are an integral part of the network configuration" (Feldmann et al., 2013, p. 5969), others emphasise the relevance of coordination as well (Mundt, 2012, p. 64). The following section outlines why this work considers it as integral to both configuration and coordination.

One of the first contributions that refers to plant roles is Skinner's (1974) focused factory concept. He outlines a factory that focuses on a limited product mix and outperforms a conventional facility in specific performance dimensions, for example, cost performance (Skinner, 1974, p. 114). Many plant role typologies have since followed (Benninghaus, 2019; Cheng, Farooq et al., 2015). For example, Benninghaus (2019, pp. 14–15) identified 12 different plant models. Possibly the most recognised plant typology was developed by Ferdows (1989, 1997). The plant role model presented in Figure 6 has "become the springboard for much research" (Cheng & Farooq, 2018, p. 6), and has already been taken up by 15 other publications (Cheng & Farooq, 2018, p. 8).

Figure 6 presents Ferdows' role model, which defines six plant types based on two dimensions: plant competences and strategic site reasons. The latter comprises three distinct reasons for operating a plant at a specific location: (1) access to low-cost production, (2) access to skills and knowledge and (3) proximity to market (Ferdows, 1997, p. 77). These three location factors outline why the plant role discussion is frequently associated with the configuration layer of IMN management. Discussions about location advantages often lead to footprint considerations, which are closely linked to network configuration (Friedli et al., 2014, p. 86).

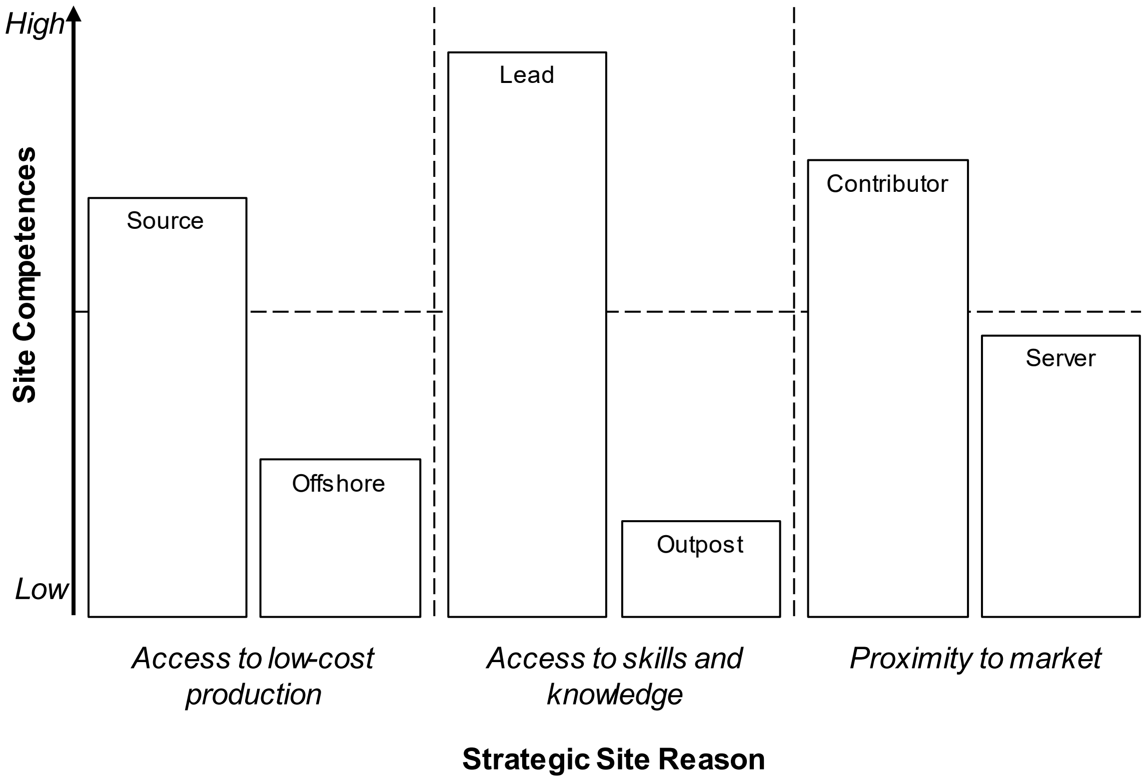


Figure 6: Ferdows' plant typology (adapted from Ferdows, 1997, p. 77)

Ferdows' model incorporates several site competences that are accompanied with responsibilities for different activities like production, supplier development or product development. Similarly, Feldmann et al. (2013) identify responsibility for technical activities (i.e., production, supply chain, development) as plant-competence dimensions to define a set of three distinct plant roles.

Maritan, Brush, and Karnani (2004) consider the autonomy of Ferdows' plant types and find that especially for planning decisions, the degree of autonomy differs between plant roles. Assigning plants with responsibilities and autonomy is typically associated with the coordination layer of network management (see Chapter 2.6.5). As such, it appears that the debate about plant roles integrates both the configuration and coordination perspectives of IMN management.

Overall, the topic of plant roles also holds important implications for the work at hand. It can be expected that the range of tasks and the autonomy of a plant leader is strongly related to the role that the own plant is playing within the network. Vereecke et al. (2006, p. 1746) find that plants roles have implications for the plant leader job at certain plant types, especially at those holding unique functions for the network, as they highly attract and intrigue plant leaders. Plant roles can even function as a reward mechanism for plant leaders (Mundt, 2012, p. 98). Specific plant roles are assigned with tasks and responsibilities that go beyond the specific facility. For example, the lead plant assumes duties and functions for the whole IMN (Deflorin, Dietl, Scherrer-Rathje and Lang, 2012; Ferdows, 1997). As such, plant roles also set the focus of the plant leader either on the individual plant or on performing activities for the network; it shifts respectively towards the IMN. This underlines the idea that the individual plant leader has to assume the role of the individual plant and act accordingly. It is up to the network management to align the personal agenda of the respective individuals to the plant's role or select them accordingly. Otherwise, it appears possible that the plant's conduct deviates from the assigned plant role. In conclusion, decision-makers of the plant level (i.e., plant leaders), need to be considered for the management of IMNs. The plant role discussion particularly shows that individual, plant and network are relevant and interwoven levels of IMN management.

2.5 Intra-Firm Cooperation and Individuals

Previous chapters presented the core concepts of IMN, which includes plant and network levels as the units of analysis. This chapter raises the question of whether the applied perspectives are adequate for understanding network-level outcomes. Therefore, this chapter briefly introduces findings beyond the IMN context. First, the following paragraph outlines research on infra-firm knowledge sharing, which constitutes one of the most prominent cooperative behaviours in MNCs, and also suggests considering the individual level. The second subchapter reviews the organisational mechanisms being discussed. This chapter provides vital implications for the subsequent literature review on IMN coordination.

2.5.1 The Interrelated Micro and Macro Levels

The rich body of literature on knowledge sharing emphasises the role of individuals and the importance of motivation. Though it is an extreme example, the following statement by a Chief Executive Officer (CEO) illustrates that motivation of individuals within subsidiaries is critical to creating inter-firm flows of knowledge: "We provide pretty much the same services in every location. But my regional managers would rather die than learn from each other" (Gupta and Govindarajan, 2000b, p. 71).

Many CEOs of manufacturing firms could likely provide a very similar statement by replacing *regional manager* with *plant manager*. As such, although this work is not limited to knowledge sharing behaviour of individuals, a brief glimpse into the knowledge related literature provides some interesting implications for the work at hand.

Following Foss, Husted, and Michailova (2010), the IMN learning capability can be regarded as macro-level outcomes of individual knowledge sharing behaviour (see Figure 7). Any explanation of macro-level outcomes "must involve micro-level constructs (e.g., individual attitudes, intention, goals, motivation, behaviour, etc), how these constructs aggregate up to a firm-level outcome, what are their firm-level antecedents" (Foss et al., 2010, p. 459). Hence, Figure 7 highlights that in order to understand macro-level outcomes, scholars need to incorporate the micro-level (i.e., the behavioural aspects of human beings) into their analysis. Gooderham, Minbaeva, and Pedersen (2010) state that "understanding firm-level phenomena, such as intra-MNC[8] knowledge transfer, requires a combined micro-macro approach" (Gooderham et al., 2010, p. 130). Both levels are interrelated: the macro-level sets the conditions for the micro-level, and the behaviour determines the macro-level outcomes.

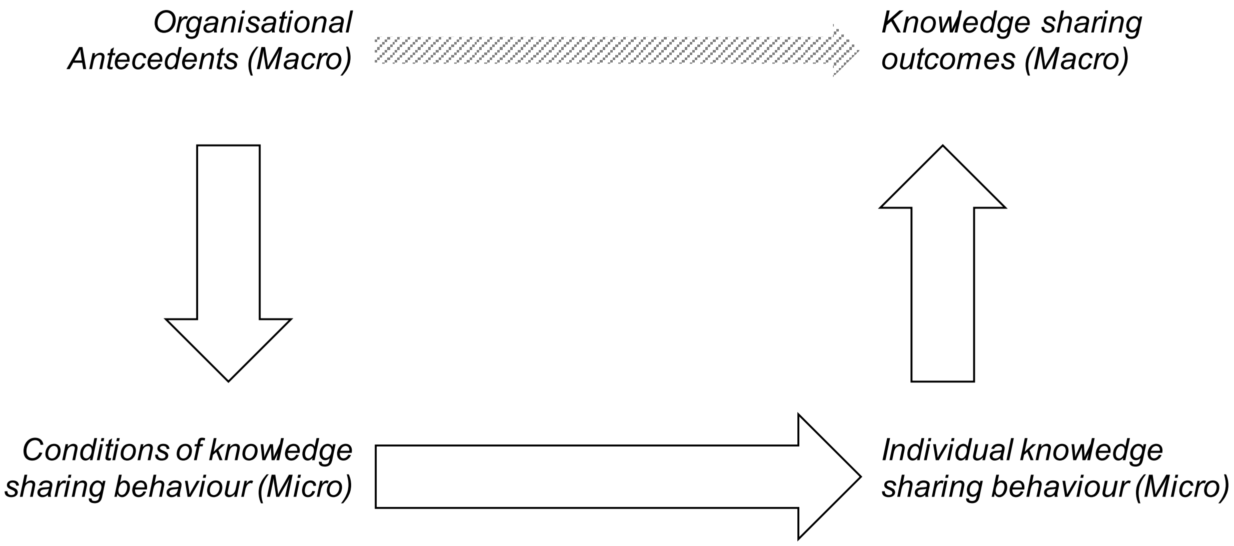


Figure 7: Micro and macro levels in the context of intra-firm knowledge sharing (adapted from Foss et al., 2010, p. 460)

It is somehow surprising that IMN literature considers network- and plant-level (see Chapter 2.4), but rarely goes below the plant-level (Cheng, Farooq et al., 2015, p. 776). As discussed by Wiech and Friedli (2020) in their publication on how to integrate plant leaders into IMN management, this work aims to integrate the micro level and its interrelation with the macro level into the context of IMN (see Figure 7). Therefore, the remainder of this work discusses the individual level when referring to the micro level. Network level refers to the macro level in the terminology of Foss et al. (2010).

Implications

[8] Multinational Corporation [MNC]

1. *In order to understand macro-level outcomes like the learning capability of an IMN, both macro and micro level need to be considered.*
2. *The macro level sets the context for the micro-level behaviour.*
3. *The micro-level behaviour defines the macro-level outcomes.*

2.5.2 Coordination and Individual Behaviour

The previous section underlined that the individual level has long been an integral element of research on knowledge sharing. The question of what motivates individuals to share knowledge or create certain cooperative behaviours has been the subject of numerous studies for decades, and has been discussed in the inter-subsidiary context. This chapter does not claim to portray even a small fraction of this rich body of literature. It provides a brief overview, depicts the impression that the debate is controversial and shows that context is of critical importance. Therefore, the context of IMN calls for a separate analysis.

Cooperation among employees can undoubtedly have positive effects on the firm. However, the reasons why individuals engage in cooperative behaviours are not only driven by overarching firm objectives. A recent literature review found "that current studies seem to have an overly positive view of reasons for sharing knowledge" (Sergeeva and Andreeva, 2016, p. 251). The decision of whether or not to participate in knowledge sharing is, however, sometimes driven by selfish reasons (e.g., for political benefits or due to competition) (Sergeeva & Andreeva, 2016). Burgess (2005, p. 328) underlines that exchange among individuals might not even get started because those who are in need might fear to be seen as incompetent when asking for support. Furthermore, individuals who possess valuable knowledge might not be willing, partly because they feel not to benefit from sharing (Mahnke, Pedersen and Venzin, 2009). Knowledge brings power or a position of privilege and superiority (Husted and Michailova, 2002, p. 65). Individuals might fear losing their position, which is especially relevant in competitive situations (Szulanski, 1996, 2000; Tsai, 2002).

The examples above show that at least two parties are involved in knowledge sharing: *sender* and *receiver* (Gupta and Govindarajan, 2000a; Hansen, Mors and Løvås, 2005).[9] On both sites, the willingness of individuals to participate in knowledge sharing or the support of others depends highly on personal characteristics (Cabrera et al., 2006), but is also contingent upon the organisational context (see Figure 7). Scholars find evidence that firms can foster certain behaviours by considering the individual-level and addressing individuals with suitable measures (i.e., link individual level with human resource management (Minbaeva, Mäkelä and Rabbiosi, 2012)). For example, the empirical study by Tsai (2002) provided evidence that flat hierarchies and individual-level ties facilitate interunit exchange:

[9] Husted and Michailova (2002) also identify a knowledge transmitter that is not necessary sender

> „Without effective coordination, knowledge may not spread evenly across units within the same organization. Reducing hierarchical constraints and increasing interunit social interaction are the directions that managers may pursue to encourage internal knowledge flows and enhance the capabilities of their organizations." (Tsai, 2002, p. 189)

The debate on how to coordinate individual behaviours to create, for instance, macro-level outcomes like inter-subsidiary knowledge flows remains controversial, namely regarding the virtue of incentives. Whereas Kohn (1993) is very sceptical about extrinsic motivation in the form of rewards like financial benefits, others studies find that employees were highly motivated through the application of incentives to engage in things like inter-unit knowledge sharing (Burgess, 2005; Cabrera et al., 2006). The quantitative study by Burgess (2005) found that extrinsic rewards were the most critical motivator for individuals to engage in cross-unit knowledge exchange:

> "The most salient barriers to employees' willingness to share and seek knowledge beyond their work group were as follows: (a) the lack of extrinsic rewards and (b) interdivisional competition and greater loyalty and identification with the division relative to the larger firm." (Burgess, 2005, p. 337)

Two scholars from Copenhagen also advise giving rewards (not necessarily financial) to individuals in order to overcome "knowledge sharing hostility" (Husted & Michailova, 2002, pp. 60–62). Particularly, in the context of interunit exchange, "company-wide incentives such as gainsharing, profit sharing and employee stock options will help in encouraging knowledge sharing" (Bartol and Srivastava, 2002, p. 73).
Other scholars propose fostering a mix of extrinsic and intrinsic motivation in order to create a fruitful knowledge exchange between sender and receiver (Choi, Kang and Lee, 2008, p. 749; Galia, 2008). The success of the exchange, however, does not only depend on the willingness of the sender, but is also a function of the receiver's competence and openness (e.g., Mahnke, Pedersen and Venzin, 2005).
Overall, the discourse about incentives remains characterised by conflicting interpretations and contradictory findings. Besides intrinsic and extrinsic rewards, researchers also discuss other mechanisms and factors that guide the behaviours of individuals within the firm. Suitable mechanisms can facilitate the purpose of knowledge transfer (Szulanski, 2000). The topic of individual autonomy has received some attention as a coordination mechanism to foster cooperative behaviour among individuals (e.g., Cabrera et al., 2006; Tsai, 2002). Furthermore, personal relations are widely regarded as an essential element to facilitate exchange between individuals and thus, between subsidiaries (e.g., Gupta & Govindarajan, 2000a; Tsai, 2002). „Greater interpersonal familiarity and personal affinity can be expected

to increase the openness of communication between the interacting parties" (Gupta & Govindarajan, 2000a, p. 479).

The statement above underlines that firms can influence the cooperative behaviour of their individuals by creating an environment of trust and openness (Abrams, Cross, Lesser and Levin, 2003; Gupta & Govindarajan, 2000a; Long, 2018; Michailova and Mustaffa, 2012). Scholars also underline the importance of context (e.g., Foss et al., 2010; Hansen et al., 2005; Luo, 2005; Sergeeva & Andreeva, 2016). Sergeeva and Andreeva (2016, p. 257) map the context of knowledge sharing by asking "(1) Who shares knowledge, (2) Why is knowledge shared, (3) Where is knowledge shared, [and] (4) What knowledge is shared?" Others highlight that external factors like environmental complexity, competitive pressure or firm internal aspects (i.e., subsidiary similarity and organisational antecedents) are relevant determinants to be considered when discussing cooperative behaviour of individuals (Luo, 2005).

Overall, the debate on how firms can coordinate the behaviours of their employees in order to create macro-level benefits is manifold. Multiple sources emphasise the importance of considering the context. Therefore, Chapter 2.6 discusses the context of IMN. It provides an overview of existing research on IMN coordination and questions how the individual micro-perspective has been adopted.

Implications

1. *Effective coordination can foster exchange and cooperation among individuals from different units of the same firm.*
2. *Context has a strong implication for sharing and cooperation among individuals. Therefore, key individuals within manufacturing networks are embedded in a distinct context with particular implication for IMN management.*

2.6 Systematic Literature Review on IMN Coordination

In recent years, scholars have shifted focus from IMN configuration to coordination. A systematic literature review on IMN coordination seeks to explore this recent trend. The analysis of existing literature devotes particular focus on a comprehensive understanding of the coordination concept and aims to find answers to the RQ1 (see Chapter 1.2), namely, how the existing IMN coordination studies integrate plant leaders or other key decision-makers. After a brief outline of the applied methodology, the following sections present the findings from the literature.

2.6.1 Literature Review Process

Reviewing literature related to the intended field of analysis represents an essential starting point for each research project (Baker, 2000, p. 219; Vom Brocke et al., 2009). A SLR attempts to structure the existing knowledge base (Rowley and Slack, 2004, p. 32) while providing rigour and relevant results (Thomé, Scavarda and Scavarda, 2016; Tranfield, Denyer and Smart, 2003).

A multitude of articles gives guidance on how to conduct a SLR (e.g., Baker, 2000; Cooper, 1988; Levy and Ellis, 2006; Okoli, 2015; Rowley & Slack, 2004; Thomé et al., 2016; Vom Brocke et al., 2009; Webster and Watson, 2002). Transparency in selecting and excluding sources for the review is crucial for the credibility of any literature review (Vom Brocke et al., 2009, p. 1). Therefore, this work followed "a clear guideline to ensure more transparency, reliability and reproducibility of findings" (Thomé et al., 2016, p. 12). Despite the application of principles to ensure objectivity, it should be noted that the search process, particularly in the third and fourth steps, was subject to an individual assessment by the researcher. Therefore, a certain degree of subjectivity is inherent not only to this, but any literature review (Okoli, 2015, p. 43).

An initial literature search was conducted in October 2018. According to the following five steps, a revised and extended[10] literature review followed in March 2019[11]:

1. **Database or journal selection**
   1.1. **Database selection:** Vom Brocke et al. (2009, p. 11) state that "one challenge definitely lies in identifying proper databases." To remedy this problem, the search was conducted in four databases to ensure comprehensive coverage of journals. These databases are *EBSCOhost* (Business Source Premier), *Science Direct*, *ProQuest* (ABI/INFORM) and *Emerald Insight*. Since each database provides altering advanced search options, A.2 presents the applied settings for each database.
   1.2. **Journal selection:** This review aims to meet a particular quality level and thoroughness of selected articles. Therefore, only peer-reviewed journals (Rowley & Slack, 2004, p. 32) and renowned conference proceedings[12] (Webster & Watson, 2002, xvi) are considered (see A.2). Nevertheless, focus on, and exclusion of, specific sources always brings the danger of ignoring relevant articles. Therefore, this review does not focus on a list of selected journals. Even though there are suggestions for leading journals in the field of OM (e.g., Cheng, Farooq et al., 2015; Petersen, Aase and Heiser, 2011), this search keeps a wide scope of journals in order to increase the chance of identifying relevant articles.
2. **Keyword search:**
   Planning and formulating the problem (Thomé et al., 2016, pp. 3–4) constituted the starting point for defining appropriate search terms. The problem definition (see Chapter 0) of the literature review at hand builds on comprehensive findings by other literature reviews in the field of IMN. Three recent reviews by Cheng, Farooq et al. (2015), Scherrer and Deflorin (2017a) and Ferdows (2018) inform this SLR. However,

[10] Additional search terms were applied and another database queried.
[11] One recent article was identified by chance after March 2019 and added to the sample.
[12] The advanced search of ProQuest allows to select for conference proceedings as document type.

unlike these rather broad IMN and operations reviews, the analysis conducted for this research focuses mainly on the field of IMN coordination.

First, this thematic focus determines the search term *coordination*, complemented by *co-ordination* due to inhomogeneous notations within the IMN literature (Meijboom & Vos, 1997; Rudberg & Olhager, 2003).

Second, in order to identify articles about *manufacturing networks*, different notions for the term *manufacturing network* were derived from the IMN literature.

- *Manufacturing Network** (Cheng, Farooq et al., 2015; Cheng & Farooq, 2018; Friedli et al., 2014; Scherrer & Deflorin, 2017b; Vereecke et al., 2006)
- *Production Network** (Abele, Meyer, Näher, Strube and Sykes, 2008; Ferdows, 2018)
- *Plant Network** (Vereecke & van Dierdonck, 2002)
- *Factory Network** (de Meyer and Vereecke, 2009)
- *Multi-Plant or Multiplant* (Chew, Clark and Bresnahan, 1990; Netland & Aspelund, 2014)

A list of 12 search terms resulted from a combination of the first two steps and formed the basis for the SLR (see Appendix A.1). Additionally, *wild cards*[13] were applied to account for the plural of the term *network*. For databases like *Science Direct,* which do not support wild cards, two distinct queries for *network* and *networks* were conducted. Furthermore, appendix A.2 outlines the applied search settings (search fields and document type).

3. Review of abstracts:

3.1. Only articles that cover the field of IMN coordination in multi-plant firms were included. Among them only those papers that deal "either with a corporation's global, multinational or international manufacturing operations, or the operations of subsidiaries where the link to foreign mother or sister companies is explicitly stated and part of the research" (Netland & Aspelund, 2014, p. 397).

3.2. Exclusion of papers merely focused on Supply Chain Management (SCM), logistics or without reference to the topic of IMN. The work at hand investigates intra-firm manufacturing networks where central management has direct control over the dispersed facilities (Shi & Gregory, 1998, p. 199). Therefore, articles that mainly or exclusively consider topics beyond a single manufacturing firm's boundary are not included.

3.3. Only articles published in the English language were considered.

4. Full-text review of remaining articles:

[13] Wild cards are characters like (*). «Wild cards allow you to construct a query with approximate search terms. Use a question mark (?) in a search term to represent any one character that falls between two other characters, and use an asterisk (*) to represent zero or more characters in the middle or at the end of a search string.» Emerald Publishing Limited (2019).

4.1. Exclusion of such research not directly linked to IMN coordination or without sufficient depth.

5. Alternative Search (AS) - append additional sources:

5.1. Enlargement of the sample by relevant articles cited in the "direct hits"[14]. Same in- and exclusion criteria apply as outlined in steps three and four. Furthermore, several articles were added based on discussions with other researchers.

The results of the literature selection and exclusion process are presented in the appendix (see A.3). The database query of all search terms resulted in 110 hits. The initial findings of the literature search showed a broad mix of concepts like "Supply Chain", "Global Production Networks" (e.g., Yeung and Coe, 2015) or "Federated Production Network" (Kádár, Egri, Pedone and Chida, 2018). It was sometimes ambiguous as to whether the identified articles would cohere with the intra-firm perspective chosen for the work at hand. In such cases, the article's content and potential contribution to the research questions clinched the decision for sample in- or exclusion. Furthermore, research articles entirely focusing on network configuration were also excluded. The review of abstract and a subsequent read through of the full-text of the remaining articles resulted in 24 relevant studies to the research interests. The search combination "coordination" and "manufacturing network" yielded the highest number of relevant studies (see A.3). Furthermore, the AS added another 32 relevant sources. Eventually, 56 articles formed the basis for the following analysis.

Though operations management literature has been addressing the subject of IMN for 30 years (Ferdows, 2018), it is remarkable that a high share of recent articles characterises the sample. More than 50% of all articles have been published since 2009, less than ten years ago. As such, the conducted SLR confirms the findings of Cheng, Farooq et al. (2015, p. 407) who state that IMN coordination has gained considerably more attention in recent years. Overall, the growing number of studies on IMN coordination underlines the relevance of this work's research topic.

2.6.2 The Term: IMN Coordination

In the context of IMN, the term coordination is often used; however, the definitions by scholars are somewhat imprecise and vary in focus and content. Mundt (2012) devoted one chapter of his doctoral thesis to "definitions and decision dimensions of manufacturing network coordination" (Mundt, 2012, p. 62). However, an increasing number of articles about IMN coordination have been published since then (Cheng, Farooq et al., 2015, p. 407). Thus, the following paragraph amends the findings of Mundt.

A review of relevant literature reveals various, and in part contradictory, definition attempts of the term IMN coordination. For example, several scholars link network management with

[14] «Direct hits» are all articles remaining after the applied filter steps (1-4.1)

the concept of coordination (Cheng et al., 2011; Fredriksson & Wänström, 2014; Netland & Aspelund, 2014; Pontrandolfo & Okogbaa, 1999). Conversely, Friedli et al. (2014) highlight that coordination is, alongside configuration and strategy, just one element of network management. In addition, other authors apply the terms network optimisation (Rudberg & Olhager, 2003) and the term integration (Acar and Atadeniz, 2015, p. 205) as inter-related and complementary to IMN coordination.

Though not congruent, many notions of IMN coordination go back to Porter, who was among the first to bring about this term in the context of international operations. He linked coordination to the question of "how like activities performed in different countries are coordinated with each other" (Porter, 1986, p. 17). Many recent studies about IMN coordination refer to this early concept and partially add substance (e.g., Cheng et al., 2011; Sayem et al., 2018; Szwejczewski et al., 2016). Cheng, Farooq et al. (2015, p. 405) and Cheng, Johansen, and Hu (2015, p. 785) define the aim of network coordination as the optimisation of the "physical and non-physical flows amongst the networks' plants". Scherrer and Deflorin (2017a) adopt this understanding of coordination. They see the management and design of inter-plant flows as specific topics of IMN coordination that can support the strategic objectives of a firm (Scherrer & Deflorin, 2017a, pp. 230–231). Many of the statements on IMN coordination displayed in Table 4 refer directly or indirectly to these inter-plant flows (see Chapter 2.6.3).

In addition to a description of inter-plant flows, most definitions imply tactical elements or, as Mundt (2012) states, institutional aspects. This tactical dimension (Cheng et al., 2011; Pontrandolfo & Okogbaa, 1999, p. 5) of IMN coordination refers to structural elements like policies, rules and mechanisms, which help to design and manage the inter-plant flows (Scherrer & Deflorin, 2017a; Szwejczewski et al., 2016). Furthermore, the tactical level of IMN coordination also comprises decisions about production planning and product allocation to plants of the network (Rudberg & Olhager, 2003; Szwejczewski et al., 2016). The latter represents probably the most apparent overlap between the concepts of network coordination and configuration (see chapter 2.2). Scholars are equivocal in defining IMN coordination and configuration. Whereas some researchers (e.g., Friedli et al., 2014, p. 47; Rudberg & Olhager, 2003) assign resource allocation to the coordination layer, others classify it as part of IMN configuration (e.g., Cheng et al., 2011; Meijboom & Vos, 1997). This overlap supports the conclusion that "the two aspects of configuration and coordination are strictly related" (Cheng et al., 2011, p. 1314; Pontrandolfo & Okogbaa, 1999, p. 5).

As shown in Table 4, various scholars link IMN coordination with the management of inter-plant flows, which was introduced to the domain of IMN by Vereecke et al. (2006). In their statements about IMN coordination, some name particular flows like the transfer of technology (Cheng et al., 2011; Cheng et al., 2016; Fredriksson & Wänström, 2014) or diffusion of knowledge (Netland & Aspelund, 2014). Other statements are less specific about the content of the flows and describe them merely as physical and non-physical (Cheng, Farooq et al., 2015; Cheng, Johansen et al., 2015; Scherrer & Deflorin, 2017a).

Table 4: Definitions of IMN Coordination

Authors	Statement about IMN coordination
Meijboom and Vos (1997, p. 790)	"Co-ordination refers to the question of how to link or integrate the production and distribution facilities in order to achieve the firm's strategic objectives."
Pontrandolfo and Okogbaa (1999, p. 5)	"Coordination is related to the management of such a network. Its aim is to have an efficient and effective planning of global production activities, involving primarily tactical decisions in different business areas and within several processes."
Colotla et al. (2003, p. 1189)	"Co-ordination as the infrastructural processes related to linking activities between plants."
Rudberg and Olhager (2003, p. 36)	"In a multi-site environment for a single organization, the term optimization is more appropriate…. Questions that need to be addressed include the allocation of products and volumes to plants, and the production and distribution of products and orders within the network."
Cheng et al. (2011, p. 1314) and similar in Cheng et al. (2016, p. 551)	"Coordination is related to the management of a network and refers to the question of how to link or integrate the facilities in order to achieve the firm's strategic objectives. Its aim is to achieve an efficient and effective plan for global production activities, which involves primarily tactical decisions in different business areas and within several processes. In addition, coordination is also concerned with technology transfer and diffusion, as well as within-network learning."
Fredriksson and Wänström (2014, p. 175)	"Coordination has mainly been concerned with technology transfer and diffusion (Rudberg and Olhager, 2003), which is to transfer production technologies between production units (Galbraith, 1990)."
Netland and Aspelund (2014, pp. 391–392)	"Coordination is about the management of the network; how to most effectively and efficiently share resources and knowledge between the dispersed plants."
Cheng, Johansen et al. (2015, p. 785) and similar in Cheng, Farooq et al. (2015, p. 405)	"Coordination, considered as an infrastructural process, refers to the management of a network and the question of how to link or integrate the production and distribution facilities to achieve the firm's strategic objectives. Its aim is to efficiently and effectively plan the physical and non-physical flows amongst the networks' plants (Pontrandolfo and Okogbaa, 1999)."
Szwejczewski et al. (2016, p. 125)	"The proficient coordination of a manufacturing network is enabled by the establishment of procedures that link or integrate factories in a network to fit with the achievement of the strategic objectives of a business (Cheng et al., 2011). Manufacturing network coordination can also include decisions on the inter-facility allocation of resources to enable the further development of individual site competencies (Meijboom and Vos, 1997). In addition, to facilitate the smooth coordination of manufacturing networks, companies often develop common policies that influence the design and the development of their manufacturing network structure and infrastructure (Hayes and Wheelwright, 1984; Leong et al., 1990), not only in terms of manufacturing technology and capacity, but also with respect to production planning, control and procurement (Rudberg and West, 2008)."
Scherrer and Deflorin (2017a, pp. 230–231)	"It answers: how the physical and non-physical flows between sites in the network are designed and managed, and how rules and mechanisms for interaction between the sites, the sites and headquarters, or the sites and central network management are designed and established."

Scherrer and Deflorin (2017a) add that IMN coordination considers the design and establishment of rules and mechanisms for these network flows. In his recent dissertation

Norouzilame (2018) also identifies the management of interplant flows a central point of IMN coordination. As such, the definition of IMN coordination applied for the work at hand is as follows:

IMN coordination concerns the management and design of physical and non-physical intra-network flows through distinct mechanisms.

In this sense, the research interest of this thesis is about how plant leaders can be motivated to engage themselves or their plant in these inter-plant flows. Thus, it is a coordination task for IMN management to guide the plant leaders. By considering the individual-level perspective, the questions of what specific inter-plant flows are relevant and how IMN management can coordinate these flows arise. The following subchapters elaborate on the kind of inter-plant flows and coordination mechanisms discussed in existing IMN research.

2.6.3 The Inter-Plant Flows

This work now turns in more detail to what is coordinated in IMNs (i.e., the physical and non-physical flows) (Cheng, Farooq et al., 2015, p. 785; Cheng, Johansen et al., 2015, p. 405; Scherrer & Deflorin, 2017a, pp. 230–231). Scholars point to flows between plants and headquarters and among plants (e.g., Scherrer & Deflorin, 2017a, pp. 230–231; Vereecke et al., 2006, pp. 1737–1739). Hereinafter, the latter is referred to as inter-plant flows.

Studies in the sample consider inter-plant flows in two ways. Attempts to define the concept of IMN coordination provide conclusions on the inter-plant flows, and the research interest of the studies is related to one or more particular inter-plant flows. For example, studies of Ferdows (2006) or Scherrer and Deflorin (2017b) are clearly devoted to the intra-network knowledge flows. However, the research focus of other studies is more ambiguous. In order to classify studies, the following indicators were applied:

- A question or several questions of a survey-based study refer to a particular inter-plant flow
- The case analysis of a study considers a particular inter-plant flow
- The mathematic approach of a study aims to improve a particular inter-plant flow

As shown in Table 5, the sample studies deal with physical, non-physical or both intra-network flows. Furthermore, four sub-dimensions for physical, and two sub-dimensions for non-physical flows have been identified.

The high share of studies concerning the physical flow of materials, goods and components confirms the origin of IMN coordination, which stems from research related to logistics, physical distribution and optimisation (Cheng, Farooq et al., 2015, p. 406). Rudberg and Olhager (2003, p. 36) also underline that optimisation of product allocation and product flows within the network are especially relevant in the intra-firm context. As such, several studies of the sample discuss mathematical optimisations of this flow dimension or consider it as a variable in their model (e.g. Acar & Atadeniz, 2015; Tsiakis and Papageorgiou, 2008; Yuan, Low and Yeo, 2012). Other scholars point out that the flow of information is a prerequisite to optimise and plan the physical flows of material (Cheng et al., 2016, p. 567; Rudberg and West, 2008). Furthermore, Cheng et al. (2011) stress the importance of considering this flow dimension in order to understand the linkages between manufacturing plants that shape the intra-network relationships.

Table 5: Physical and non-physical flows in the sample

IMN Flows		**Authors**
Physical	People	Cheng et al., 2016; Cheng & Farooq, 2018; Cheng, Madsen and Liangsiri, 2010; Demeter and Losonci, 2019; Ferdows, 2006; Sayem et al., 2018; Szász et al., 2019; Vereecke et al., 2006; Wæhrens, Cheng and Madsen, 2012
	Financial	(Vereecke et al., 2006)[15], (Jaehne et al., 2009)[16], Luo, 2005
	Technology, activity & equipment	Cheng et al., 2010; Fredriksson and Jonsson, 2019; Fredriksson & Wänström, 2014; Lang, Deflorin, Dietl and Lucas, 2014; Taggart, 1998; Wæhrens et al., 2012
	Material, goods & components	Acar & Atadeniz, 2015; Azevedo and Sousa, 2000; Bhatnagar, Chandra and Goyal, 1993; Bitran, Marieni, Matsuo and Noonan, 1985; Chen, Lin and Wu, 2014; Cheng et al., 2011; Cheng et al., 2016; Cheng & Farooq, 2018; Cheng & Johansen, 2013; Kemmoe, Pernot and Tchernev, 2014; Lebreton, van Wassenhove and Bloemen, 2010; Lim, Tan and Leung, 2013; Nigro, La Diega, Perrone and Renna, 2003; Rudberg & West, 2008; Sayem et al., 2018; Yuan et al., 2012
Non-physical	Knowledge	Boscari, Danese and Romano, 2016; Cheng et al., 2010; Cheng et al., 2016; Cheng & Farooq, 2018; Cheng & Johansen, 2013; Deflorin et al., 2012; Demeter & Losonci, 2019; Ferdows, 2006; Fredriksson & Jonsson, 2019; Lang et al., 2014; Netland & Aspelund, 2014; Noruzi, Stenholm, Sjögren and Bergsjö, 2018; Rudberg & West, 2008; Scherrer & Deflorin, 2017a, 2017b; Szász et al., 2019; Taudes, Trcka and Lukanowicz, 2002; Vereecke et al., 2006; Wæhrens et al., 2012
	Information	Azevedo & Sousa, 2000; Cheng et al., 2016; Cheng & Farooq, 2018; Jaehne et al., 2009; Kádár et al., 2018; Lebreton et al., 2010; Nigro et al., 2003; Rudberg & West, 2008; Scherrer & Deflorin, 2017a

[15] Only mentioned, not focus of analysis
[16] Mention financial flows as important in a supply chain context

In their quest to find a typology of manufacturing facilities, Vereecke et al. (2006) intensively discuss various flows between plants and between plants and headquarters and identify the following physical flows:

> "The physical flow of components, semifinished goods or end products, financial flows, and 'flows' of people moving around in the network are other types of network relationships (Bartlett and Ghoshal 1989)." [17](Vereecke et al., 2006, p. 1738)

Scherrer and Deflorin (2017b) and Scherrer and Deflorin (2017a, p. 231) also refer to these four types but "did not find evidence of financial flow being important for manufacturing network coordination." Table 5 confirms that only a few studies mention the financial type of flow in the context of IMN.[18] Furthermore, no article has a distinct research focus on this type of flow. Even the discussion of financial flows by Luo (2005, p. 74) lacks an apparent reference to the manufacturing context. Thus, the analysis of the sample literature illustrates that financial flows are not considered relevant for the coordination of intra-firm manufacturing networks (Scherrer & Deflorin, 2017a, 2017b).

As seen in Table 5, IMN literature devotes some attention to the flow of technology and equipment or the physical transfer of manufacturing activities. The cluster analysis of Taggart (2002) touches upon this inter-plant flow in his attempt to operationalise coordination based on four variables. One of them assesses the "technological transfer between subsidiaries" (Taggart, 1998, p. 333). Even though mentioned as a network flow in several other articles (e.g. Scherrer & Deflorin, 2017a; Vereecke et al., 2006), it is almost exclusively discussed in studies that consider the relocation and transfer of production. In this sense, studies consider both the actual technology and the relocation of capabilities required for the operation of this technology (Cheng et al., 2010; Fredriksson & Wänström, 2014). Therefore, the intra-network flow of technology is closely linked to the non-physical flows, namely to the flow of knowledge.

A similar link between the flow of people and the flow of knowledge can be observed. Exchange of people between plants represents a means or transferring knowledge in the majority of studies (e.g. Cheng et al., 2010; Ferdows, 2006; Scherrer & Deflorin, 2017b; Szász et al., 2019; Wæhrens et al., 2012). Scholars describe a general link between coordination and the flow of people by "the extent to which coordination exists in the network through managers traveling between the units" (Vereecke et al., 2006, p. 1739).

Others specifically outline the link between the flow of knowledge and people: "lastly, the people-exchange dimension refers to the extent to which manufacturing staff from one plant visits other plants in the company for the purpose of exchanging knowledge" (Szász et al., 2019, p. 299). In addition, Scherrer and Deflorin (2017b, 405-406) point to an unusual flow of people, namely experts (e.g., the lead plant travelling to solve ad-hoc problems of other

[17] Bartlett and Ghoshal (1989) are not included in the sample due to the search restrictions outlined in Chapter 2.6.1

[18] Jaehne et al. (2009) mention financial flows in a SCM context

plants). Together, these studies suggest that management of IMNs needs to coordinate the flow of people in order to distribute knowledge in the network efficiently.

The literature on IMN coordination mainly considers two non-physical flows. The first is the intra-network flow of knowledge, which refers to "expertise (e.g., skills and capabilities) or external market data of strategic value" (Gupta & Govindarajan, 1991, p. 773).[19] The second is the flow of information, which is of administrative nature like "inventory levels, purchasing requirements, forecasts, production plans, etc." (Vereecke et al., 2006, p. 1738). As shown in Table 5, considerable attention has been devoted to the distribution of knowledge within the network. Studies discuss the flow of knowledge for the purpose of production relocation (e.g., Cheng et al., 2010; Fredriksson & Jonsson, 2019; Wæhrens et al., 2012) and for the general purpose of intra-network learning (Cheng et al., 2011, p. 1314; Porter, 1986, p. 18; Sayem et al., 2018, p. 3). A popular example is Ferdows (2006), who proposes particular mechanisms for exchanging production knowledge between dispersed manufacturing plants. The flow of information, however, enjoys less attention. Most research about information flows is linked to the flow of goods by facilitating the coordination of the latter (Cheng et al., 2016; Cheng & Farooq, 2018). Distribution and sharing of information between plants and between plants and headquarters are important for production planning and scheduling (Rudberg & West, 2008; Taudes et al., 2002, p. 151). Furthermore, scholars point out that specific information flow from plants to headquarters is essential to support strategic decisions and the general management of IMNs (Scherrer & Deflorin, 2017a).

Overall, IMN coordination considers the physical flow of material, people and technology as relevant. Financial flows are widely neglected and thus of minor importance in the context of manufacturing networks. Conversely, scholars have also devoted attention to the non-physical flows of knowledge and information. Flows like knowledge and people or material and information are interrelated. Thus, IMN studies consider one flow as a means to facilitate another.

Implications

1. *IMN literature discusses various physical and non-physical flows between the plants and between the headquarter and the plants.*
2. *Relevant inter-plant flows in the context of IMN coordination are:*
    a. *Physical: material, people and technology*
    b. *Non-physical: information and knowledge*
3. *Selected flows are highly interrelated (e.g., knowledge and people).*

[19] Gupta and Govindarajan (1991) are not included in the sample as their study is not focused on the IMN context (instead MNCs in general). However, their research provides a basis for many IMN coordination studies (e.g. cited by Olhager and Feldmann (2018)).

2.6.4 Research on IMN Coordination

"However, in comparison to the other aspects of IMN management, literature around coordination of IMNs has still great potential to get improved."
(Norouzilame & Wiktorsson, 2018, p. 1607)

The previous chapter has outlined the relevant physical and non-physical flows in the context of IMNs. Some of these flows refer to or directly represent the main research directions within the existing knowledge base. Cheng, Farooq et al. (2015) identify three streams within the wide-ranging topics of IMN coordination related literature: "the introduction of practices related to IMN coordination, the transfer of production technologies and knowledge, and the optimisation of physical distribution" (Cheng, Farooq et al., 2015, p. 4058). Other scholars split the IMN coordination literature likewise (Norouzilame, 2018; Norouzilame & Wiktorsson, 2018), however, as shown in the statement at the beginning of this section, critically reflect the quality of existing research. The following sections gives a brief overview of the identified IMN coordination literature, and thus, might explain why scholars still see room for improvement in this domain.

A substantial number of studies deal with the optimisation of physical distribution (i.e., the inter-plant flow of material, goods and components) (see Table 5). In particular, production planning and scheduling, capacity and order allocation, and the distribution of products have attracted the attention of many scholars (Cheng, Farooq et al., 2015, p. 411). Bhatnagar et al. (1993) were among the first to discuss issues of production planning in a multi-plant firm. In order to improve the firm's performance, they propose to deal "with the critical issues of nervousness, lotsizing and safety stock" (Bhatnagar et al., 1993, p. 20). A few years later, Pontrandolfo and Okogbaa (1999) took these findings into account and developed a logistics framework for the coordination problem of globally dispersed manufacturing firms. Other studies stemming from logistics research are mostly based on mathematical models (Cheng et al., 2016). In particular, to model such networks multi-agent systems are applied as "nodes and interactions between them as edges" (Váncza et al., 2011, p. 804). Several optimisation approaches investigate where or how to allocate products (Nigro et al., 2003; Tsiakis & Papageorgiou, 2008; Yuan et al., 2012) and how to optimise resource utilisation (Lim et al., 2013). Applying a mixed-integer programming model, Acar and Atadeniz (2015) find evidence that the integration of production planning in a globally dispersed firm leads to lower costs. This research stream on IMN coordination provides only limited implications for the work at hand. First, these mainly mathematical optimisation approaches fail to cope with the complexity of real-world IMNs (Cheng, Farooq et al., 2015, p. 411). Second, decisions on where to produce or how to steer the material flows within the network are made by central planning units. Thus, this topic is less relevant for the plant leader as a key-decision-maker.

A relatively high share of the sample investigates the transfer of knowledge and technologies between the network plants. In the context of network capabilities (see Chapter

2.3), this popular topic of IMN coordination particularly addresses the learning capability. Scholars conclude that ”much attention has been paid to the diffusion of knowledge and production experience focusing on learning from other plants in a network” (Sayem et al., 2018, p. 3). One of the first to do so was Ferdows (2006), who published the probably most cited study in this field of IMN coordination research. His work contributes a typology of production know-how and suggests four different transfer mechanisms dependent on the “speed of change” and the “form of know-how” (Ferdows, 2006, p. 5). Rudberg and West (2008) present the case of Ericsson, who has successfully introduced a particular transfer mechanism. They apply the practice of “competence Groups … for continually increasing the skills of the personnel, via the standardized transfer (and feedback) of knowledge throughout the organization” (Rudberg & West, 2008, p. 99). Lang et al. (2014) also look into the transfer of knowledge between plants. They find that knowledge transfer is not always beneficial for the plant and that the performance also depends on the complexity of the related production processes (Lang et al., 2014, p. 1896). Previously, a similar group of authors found the lead factory concept to be advantageous for intra-network knowledge dissemination compared to an archetype network. These results, though contingent on certain conditions, were mainly driven by virtues in the knowledge transfer (Deflorin et al., 2012), but in a later single case study, they found that lead plants have higher knowledge inflows than outflows (Scherrer & Deflorin, 2017b). The same article also describes the typical content of knowledge exchange between plants (Scherrer & Deflorin, 2017b, p. 405) and suggests prerequisites for knowledge flows in manufacturing networks. The latest article in this series identifies such plant capabilities needed to fulfil a knowledge sending role in the network (Szász et al., 2019).

Furthermore, two exceptional situations of knowledge transfer emerged quite recently as a research stream in the field of IMN coordination. The first situation is about the rollout of a lean-initiatives or improvement programs across all plants of a globally dispersed manufacturing firm. The recent publications by Boscari et al. (2016), Demeter and Losonci (2019), and Netland and Aspelund (2014) contribute to this emerging field of research. The second situation deals with the relocation of production and the associated transfer of knowledge. Cheng et al. (2010, p. 16) propose a framework to ”choose right means to transfer production know-how on the shop floor.” In a similar context, Wæhrens et al. (2012) investigate how the specific tools (i.e., templates and principles) support the transfer process. Considering the relocation of products as well, another article looks into the requirements of the sending and receiving plant with regard to manufacturing and supply chain flexibility (Fredriksson & Wänström, 2014). Furthermore, a recent study also looks into the transfer of manufacturing activities and analyses the relationship “between knowledge management context variables and transfer performance” (Fredriksson & Jonsson, 2019, p. 201). Overall, the research on knowledge exchange between manufacturing plants holds some implications for the work at hand. Though not particularly prominent in IMN literature, the individual level plays a vital role in the exchange of knowledge between subsidiaries (see Chapter 2.5). As such, the knowledge stream in IMN coordination research provides at least a basis or integrating the plant leader into the discussion.

Apart from the two presented main topics, several articles that are difficult to classify in one homogenous group, deal with IMN coordination. According to Cheng, Farooq et al. (2015, p. 405) the third group of IMN coordination studies is about “the introduction of practices related to IMN coordination.” Other scholars, however, identify other configuration practices as another topic in the IMN coordination research: ”generally, the discussions on coordination seem to focus on the configuration practices” (Sayem et al., 2018, p. 3). There are selected examples of studies for both proposed categories. For example, Rudberg and West (2008) present the practice of Ericsson to illustrate a successful approach in coordinating global operations. Conversely, the typologies by Rudberg and Olhager (2003) and Taggart (1998) link configuration with coordination and thus underline that both topics are “strictly related” (Cheng et al., 2011, p. 1314; Pontrandolfo & Okogbaa, 1999, p. 5). However, it seems excessive to identify a third or fourth group of IMN coordination studies based the small number of sample articles dealing with one of the above-mentioned additional themes. Furthermore, additional topics of IMN coordination emerge from the sample. Scherrer and Deflorin (2017a, p. 231) find that IMN research has devoted some attention to the decision responsibility distribution in the network. Several studies among the sample present evidence that manufacturing affiliates exhibit different degrees of autonomy (e.g., Maritan et al., 2004; Meijboom & Vos, 1997; Norouzilame & Wiktorsson, 2018; Taggart, 1998; Vereecke et al., 2006). Furthermore, scholars discuss the decision autonomy distribution between plants and headquarters in general (Norouzilame & Wiktorsson, 2018; Olhager & Feldmann, 2018). The example of a Mexican automotive supplier demonstrates the organisational implementation of such different plant autonomies (Lara, Trujano and García-Garnica, 2005).

Other articles of the sample take a technological perspective and elaborate on how recent advancements might facilitate various aspects of coordination in operations management (Mourtzis, 2016; Váncza et al., 2011). Only a few scholars seek to analyse how IMN coordination affects the performance of plants or the network. Whereas the case study of Sayem et al. (2018) suggests an effect of coordination methods on the competitive priorities of a firm, Cheng et al. (2016) could not find any direct effect of inter-plant coordination on plant performance.

In summary, the research focus of the sample on IMN coordination is wide-ranging, from the physical distribution over knowledge transfer to plant autonomy and various other themes. The results in this section indicate that IMN coordination research has not yet devoted attention to the individual level or the role of critical decision-makers. However, several articles discuss measures for coordinating an IMN. Therefore, the next chapter moves on to discuss the identified coordination mechanisms and tactics.

2.6.5 IMN Coordination Mechanisms and Tactics

Management of IMN and coordination of inter-plant flows presents a challenging task. Firms operating globally dispersed plants are faced with the question of how to coordinate their intra-firm networks. IMN research points out several coordination levers. This institutional perspective (Mundt, 2012) builds on policies (Jaehne et al., 2009, p. 2019; Szwejczewski et al., 2016, p. 125), mechanisms and rules (Scherrer & Deflorin, 2017a, pp. 230–231), and tactical decisions (Cheng et al., 2011, p. 1314). Norouzilame (2018, p. 17) identifies two distinct IMN coordination issues: "(1) The governance of a network and the autonomy level of network plants (2) The management of internal flows and their interdependencies among the plants" (Norouzilame, 2018, p. 17). However, this differentiation appears problematic as network governance and plant autonomy also concern the management of inter-plant flows. The definition of IMN coordination in Chapter 2.2 outlines that improved inter-plant flows are an objective of IMN coordination. To achieve this outcome firms can apply numerous mechanisms and tactics as the following statement underlines:

> "To facilitate the smooth coordination, companies typically develop common policies regarding manufacturing structure and infrastructure. … standardised guidelines for manufacturing and related activities in order to better coordinate their manufacturing network operations." (Jaehne et al., 2009, p. 2019)

Table 6 presents four categories of mechanisms and tactics for coordinating a network of manufacturing plants. It outlines decision dimensions that managers of multi-plant networks need to consider - in particular, the need to coordinate the physical and non-physical flows (see Chapter 2.6.3). This categorisation is informed by the list of common, formal and informal coordination mechanisms by Martinez and Jarillo (1989, p. 491) and former contributions in the IMN domain (Mundt, 2012, pp. 60–64; Sayem et al., 2018, pp. 3–4; Scherrer & Deflorin, 2017a, p. 231).

Centralisation and autonomy attracted considerable attention in the IMN literature (see Table 6). Gupta and Govindarajan (1991, p. 785) define decentralisation "as the extent of decision-making authority that is delegated to the general manager of a subsidiary by corporate superiors" (Gupta & Govindarajan, 1991, p. 785).[20] It refers to a critical challenge for central IMN managers who have to determine "which decisions the sites may make themselves, and which decisions are to be made at other levels in the network" (Friedli et al., 2014, p. 59).

[20] Gupta and Govindarajan (1991) are not included in the sample as their study is not focused on the IMN context (instead MNCs in general). However, their research provides a basis for IMN studies on centralisation (e.g., cited by Olhager and Feldmann (2018)).

Table 6: Studies focussing on IMN coordination mechanisms and tactics (adapted from Wiech & Friedli, 2020)

IMN coordination mechanisms and tactics	**Author**
Centralisation and autonomy	Acar & Atadeniz, 2015; Cheng et al., 2011; Demeter & Losonci, 2019; Maritan et al., 2004; Netland & Aspelund, 2014; Norouzilame & Wiktorsson, 2018; Olhager & Feldmann, 2018; Sayem et al., 2018; Vereecke et al., 2006
Formalisation and standardisation	Maritan et al., 2004; Meijboom & Vos, 1997; Rudberg & West, 2008; Sayem et al., 2018
Incentives and motivation	Luo, 2005; Mascarenhas, 1984; Nigro et al., 2003; Szász et al., 2019
Means of non-physical transfer	Boscari et al., 2016; Cheng et al., 2010; Deflorin et al., 2012; Demeter & Losonci, 2019; Ferdows, 2006; Lang et al., 2014; Norouzilame & Wiktorsson, 2018; Noruzi et al., 2018; Rudberg & West, 2008; Sayem et al., 2018; Wæhrens et al., 2012

Figure 8 illustrates three distinct degrees of centralisation in manufacturing networks. According to Olhager and Feldmann (2018), decision-making location can be either centralised on network level or decentralised on plant level. Furthermore, in between the two endpoints of the centralisation-decentralisation continuum, a third option is to integrate both levels, thus bringing decision-makers from plant and network together. They conclude that “these three approaches are three fundamental and distinctly different alternatives for managers in deciding on the distribution of decision-making authority and responsibility” (Olhager & Feldmann, 2018, p. 12).

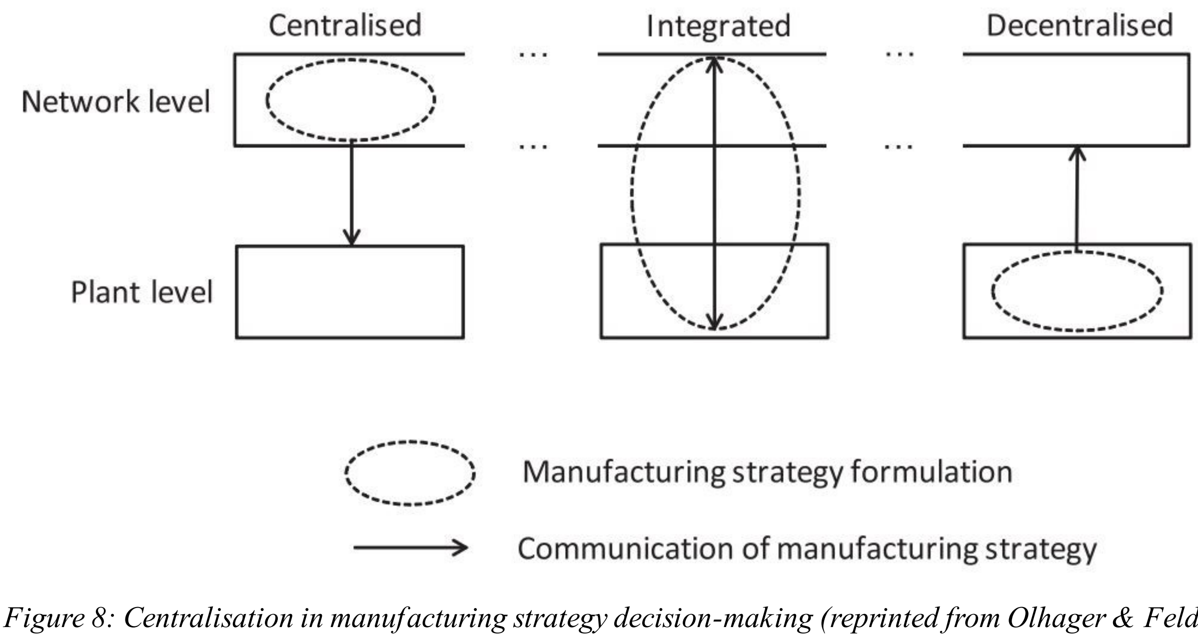


Figure 8: Centralisation in manufacturing strategy decision-making (reprinted from Olhager & Feldmann, 2018, p. 10)

Acar and Atadeniz (2015) demonstrate the advantages of centralising planning decisions, thus decreasing the degree of autonomy for plants. Centralisation of "planning and decision making for the global supply network results in more effective allocation of resources due to improved visibility of global capacity, provides better customer service performance with less investment, and is particularly more beneficial when demand uncertainty is high" (Acar & Atadeniz, 2015, p. 217). However, the IMN literature does not support a categorical recommendation towards centralisation of all decisions. For example, based on four cases, Sayem et al. (2018) find that plant autonomy is beneficial to support specific competitive priorities. The choice for a particular degree of centralisation "seems to be contingent upon the manufacturing environment" (Olhager & Feldmann, 2018, p. 12). According to their findings, high product volumes lead to a choice for centralisation, while the decentralised approach is applied for low product volumes (Olhager & Feldmann, 2018, p. 12). A study from the domain of multi-nationals, (i.e., not focused on manufacturing networks) found that "the more control the headquarter exercised on its subunits, the less the subunits were willing to share knowledge with other units" (Tsai, 2002, p. 186). By contrast, IMN scholars tend to promote more headquarter control (Cheng et al., 2011; Cheng & Farooq, 2018; Colotla et al., 2003). They suggest that certain decisions should not be left to plant leaders but must be assigned to designated persons in a central function "who can proactively coordinate the network's nodes and flows" (Cheng et al., 2011, p. 1328). Norouzilame and Wiktorsson (2018) also discuss IMN centralisation policies and argue that selected plants can overtake coordination activities while enjoying a higher degree of autonomy than other plants.

Maritan et al. (2004) analyse the decision autonomy of manufacturing facilities concerning production, planning and control based on the plant types defined by Ferdows (1997). They find evidence that "autonomy over key decisions are indeed different for plants with different strategic roles" (Maritan et al., 2004, p. 501). Based on these finding, other scholars like Vereecke et al. (2006) tested the degree of autonomy of different plant types. They discovered significant differences among the plant types only with regard to the decision dimension of "plant design". Furthermore, Demeter and Losonci (2019, p. 221) consider plant autonomy regarding lean initiatives as an element of the organisational context. In addition, Cheng et al. (2011) find that specific strategic site reasons come with different degrees of general plant autonomy. They identified that plants in proximity to the customer enjoy higher individual plant autonomy. This complements the work of Meijboom and Vos (1997), who found a link between site autonomy and site competences: "apparently, an interdependency exists between the autonomy of the local plant, on the one hand, and its level of sophistication on the other" (Meijboom & Vos, 1997, p. 802).

The studies mentioned above provide strong implications for practice; in particular, that different plants of one network can have varying degrees of autonomy. As shown in Table 6, several studies on IMN coordination also discuss formalisation and standardisation. However, these subjects seldom represent the research focus. Instead, studies tend to discuss it as a contextual factor for knowledge transfer or link it to the dimension of autonomy. One exception is the study of Rudberg and West (2008), who stress the importance of this dimension by presenting a best-practice example of an international company that “created clear and standardized guidelines for manufacturing and related activities as the means to better coordinate their manufacturing network operations” (Rudberg & West, 2008, p. 92). Furthermore, a recent study on IMN coordination also lists standardisation as “formal mechanisms of coordination. A typical example of formal mechanisms of coordination includes the exchange of standard documents” (Sayem et al., 2018, p. 4). Their multi-case study underlines that formalisation and standardisation facilitate the exchange of knowledge within the network. Several studies that focus on intra-network knowledge exchange also mention formalisation and standardisation (Boscari et al., 2016; e.g. Cheng et al., 2010; Ferdows, 2006; Wæhrens et al., 2012) or identify standardisation as a contextual factor that facilitates knowledge transfer (Scherrer & Deflorin, 2017b). Furthermore, scholars link formalisation and standardisation to the dimension of autonomy (Maritan et al., 2004; Meijboom & Vos, 1997). According to Maritan et al. (2004), decision authority on standards defines plant autonomy. Conversely, a high degree of standardisation and formalisation limits the autonomy of plants, thus indicating a high degree of network centralisation. From an individual-level perspective, standardisation is a means to limit autonomy. As such, for the research interest of this work, the autonomy dimension appears to be of primary importance.

A few articles that discuss IMN coordination mechanisms and tactics address incentives and other approaches to motivate specific behaviours. An early study by Mascarenhas (1984) investigates how the compensation system affects “manufacturing interdependence” among subsidiaries. However, the study did not find any significant effect. Another seminal article sets the basis for the discussion on plant roles. According to Gupta and Govindarajan (1991), it is the strategic role of the subsidiary that determines the incentive structure. Furthermore, two studies of the sample outline that the incentive system is an essential structural element for fostering cooperation among network plants (Luo, 2005; Szász et al., 2019). Incentive systems can support the willingness to disseminate knowledge in the network (Szász et al., 2019, pp. 302–303). In order to achieve such behaviour, IMN management has to implement “incentive systems and structures within the organization that favour knowledge sharing“ (Szász et al., 2019, p. 302). However, incentives do not only promote cooperation, but can also lead to competition between entities of one firm. One scholar highlights the particular importance of an incentive system for “promoting and fostering internal competition among foreign subunits” (Luo, 2005, p. 86). He addresses the concept of coopetition, which goes back to Brandenburger and Nalebuff (1996), and suggests that units of such firms compete on various aspects, but at the same time cooperate on other dimensions. Furthermore, Luo (2005, p. 87) attributes the task of determining the degree of coopetition and implementing respective measures to a team of executives located at the headquarters. Transferred to the particular context of IMN coordination, it is the task of the centrally located network management function to determine competition and cooperation between the manufacturing plants of the network and implement mechanisms like incentives in order to achieve the aspired degree of coopetition. One particular study of the sample looks into the performance effects of both competitive and cooperative strategies concerning the specific problem of production planning in a multi-plant network. This simulation-based research by Nigro et al. (2003) shows that both policies can be advantageous depending on the operative objectives of the firm and other contingencies. The IMN literature reveals that coordination of multiple plants requires one to strategically determine the degree of coopetition and set incentives accordingly. Even though only few IMN coordination related studies refer to the topic of incentives, the concept of motivating people through incentives like financial rewards is undoubtedly relevant for the research interest of the work at hand.

Since many IMN studies investigate the flows of knowledge (see Chapter 2.6.3), research also analyses and proposes various means of knowledge exchange (see Table 6). These studies frequently refer to other coordination mechanisms like standardisation as prerequisites or enablers for knowledge and information flows (e.g., Boscari et al., 2016; Wæhrens et al., 2012). Thus, this distinct category for means of non-physical transfer concerns the combination of various coordination mechanisms and tactics. Several articles discuss suitable forms of exchange for different types of knowledge (e.g., Ferdows, 2006) or different contextual situations (i.e., production relocation or multi-plant lean implementation) (Boscari et al., 2016; e.g. Cheng et al., 2010; Demeter & Losonci, 2019; Wæhrens et al., 2012). Some case studies present insights from practice and underline particular informal and formal coordination mechanisms for the transfer of knowledge (Sayem et al., 2018). Norouzilame and Wiktorsson (2018) link three IMN coordination mechanisms with the non-physical flows. They suggest to disseminate, transfer and synchronise information and knowledge within the network.

Furthermore, research also looks into the unique role of selected plants (i.e., the lead plant as knowledge disseminator) in the network (Deflorin et al., 2012; Lang et al., 2014). The individual-level perspective is also not prominent in the studies presented in Table 6, but related studies indicate that individuals play an important role in the exchange of knowledge across plant boundaries. Therefore, this coordination category is particularly relevant for the work at hand.

In summary, the IMN literature discusses four interrelated categories of mechanisms and tactics (see Table 6). These categories also represent the main decisions that network management faces in order to coordinate their IMN. Autonomy, incentives and means particularly facilitate knowledge exchange and appear to be a relevant dimension in the context of guiding key decision-makers.

Implications

1. *Studies on IMN coordination discuss tactics of autonomy, standardisation, incentives and means of non-physical transfer.*
2. *In the context of the individual-level perspective, namely autonomy, incentives and means of non-physical transfer are relevant.*
3. *A tendency towards centralisation and hierarchal structures within the IMN literature contradicts the willingness to engage in inter-plant exchange of individuals.*
4. *In order to benefit from network outputs like learning, the incentive system should promote inter-plant exchange.*
5. *IMN management can facilitate knowledge and information exchange by creating adequate prerequisites and through various means.*

2.6.6 Level of Analysis

IMN research takes different angles to throw light on manufacturing networks (e.g., Cheng, Farooq et al., 2015; Thomas et al., 2015). However, most studies do not consider the individual level, which is particularly relevant for the coordination of IMNs.

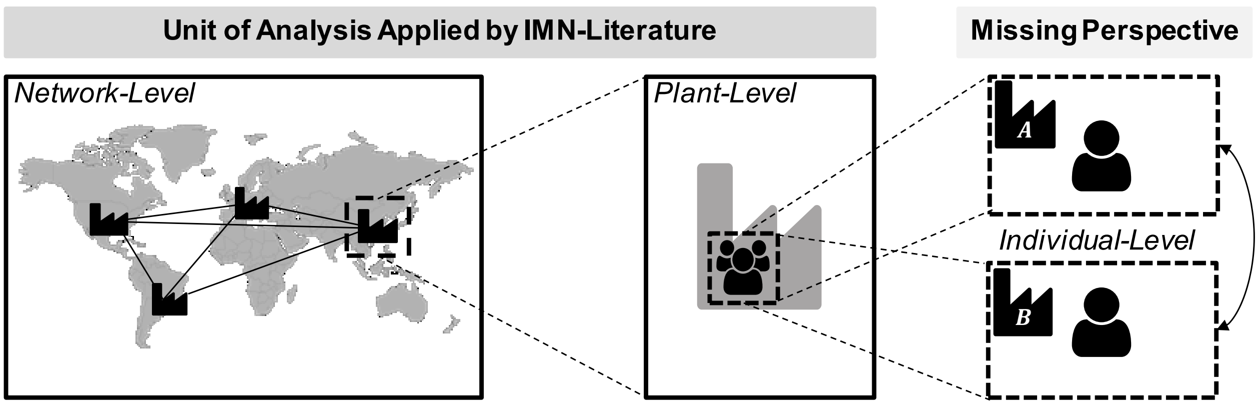


Figure 9: Applied and missing perspectives in IMN literature

Figure 9 outlines that IMN literature mainly adopts two distinct perspectives: plant level and network level (Cheng, Farooq et al., 2015, pp. 400–407; Thomas et al., 2015, p. 1711). The latter perspective considers the network as a whole by adopting a macro perspective (Cheng et al., 2011, p. 1315; Thomas et al., 2015, p. 1711), whereas the first level of analysis primarily focuses on plants as the "fundamental building blocks" (Christodoulou et al., 2007, p. 5) of IMNs. The plant perspective represents the origin of IMN research, which stems from studies on plant location decisions and shifts towards research on plant roles (Cheng, Farooq et al., 2015, pp. 401–403). Although both research perspectives began to intertwine in recent years (Cheng et al., 2011, p. 1315, 2015, p. 412; Thomas et al., 2015, p. 1711), most of IMN literature still widely applies a high level unit of analysis by addressing plants as "black boxes" (Cheng et al., 2011, p. 1315). In order understand IMN coordination, it is vital to consider what happens inside the plants (Cheng, Farooq et al., 2015, p. 407), what the inter-personal relations are (Jaehne et al., 2009, pp. 2021–2023; Scherrer & Deflorin, 2017b, p. 413) and how individuals like the plant leader, (i.e., senior managers inside the plants) affect the inter-plant flows and cooperation (Luo, 2005, p. 72). Although it is not the focus of Luo's research, he considers the individual-level perspective as an important research topic:

> "The individual level analysis (i.e., senior managers in subunits) is not included but merits future research (e.g., how country managers' vision and merits may influence inter-unit cooperation and competition)." (Luo, 2005, p. 72)

Although, some recent studies have started an "attempt to open up the black box by considering plant characteristics" (Cheng, Farooq et al., 2015, p. 407), overall only a few articles go beyond plant and network perspective. The recent study by Szász et al. (2019) is one example that investigates specific plant characteristics. In order to analyse the disseminative capabilities of plants, they look into four dimensions including culture, structure (e.g., incentive system), technology (e.g., knowledge and information systems) and notably into the human and social interactions. Netland and Aspelund (2014, p. 402) provide another contribution to the individual-level analysis. They highlight the behavioural aspect of plant leaders in adopting multi-plant improvement programs. They describe the phenomena of superficial adoption, which arises due to firm pressure and personal career ambitions. The motivation of key decision-makers inside the plants (i.e., plant leaders) is also considered (or at least mentioned peripherally) by other scholars. Vereecke et al. (2006) are an example of the latter, and they observe that plant roles that possess high autonomy, have strong motivational effects on plant leaders. Scherrer and Deflorin (2017b, p. 406) explore a "willingness to participate in knowledge transfer" only with regard to plant age. However, they also highlight that individuals drive the knowledge exchange by either seeking help for a particular problem or by sending employees to other plants for a learning opportunity. In order to facilitate knowledge sharing in the network, "managers should establish individual-level ties between representatives from different plants" (Scherrer & Deflorin, 2017b, p. 413). The similar proposal to "extend the supply network with a 2nd level" by Jaehne et al. (2009, p. 2022) also refers to the social and inter-personal relations in the network that create interfaces between plants, and thus facilitate the respective knowledge exchange. This raises the question of how network management can foster the willingness of plant leaders to establish individual ties. Furthermore, it remains unclear how network management can incorporate the conduct of individuals inside the plants to coordinate the inter-plant flows. Unbalanced incentives or mechanisms could guide plant leaders to implement superficial network exchange or make their plant participate in the inter-plant flows without the intended effects, resulting in similar phenomena as described by Netland and Aspelund (2014) for multi-plant improvement programs. These unanswered questions and unsolved challenges require a third level of analysis, which is illustrated as the individual-level in Figure 9.

In summary, past research on IMN has applied plant and network perspectives. In order to address the challenges of IMN coordination, literature needs to adopt a new perspective. Recently, some scholars shifted the level of perspective and started to look into the plants. However, they have still not applied a comprehensive "human or social view" (Jaehne et al., 2009, p. 2022). More IMN research on motivation and challenges of key decision-makers within the network nodes could generate relevant and novel insights.

Implications

1. *Research on IMN coordination mainly applies a plant- or network-level perspective.*
2. *These perspectives reach their limits when discussing behavioural aspects of plant cooperation within the network.*
3. *Several scholars mention that the individual-level analysis (i.e., a level below the plant perspective) merits research potentials.*
4. *Senior managers on the plant level are key actors who influence the plant's conduct with regard to network cooperation and inter-plant exchange.*

2.6.7 Summary and Conclusion

This review has attempted to provide a brief insight into the limited but growing body of literature on IMN coordination. The following section aims to summarise the findings from the existing knowledge base and sets out to provide an answer to the first research question (see Chapter 1.2).

Overall studies on IMN coordination are still scarce compared to research on IMN configuration. However, an increasing number of publications on coordination-related issues during the last years underline the importance of this research field. Contrary to early studies on IMN coordination, the growing attention devoted to this field also provides more practicable definitions. Derived from more recent studies, IMN coordination can be defined as the management of physical and non-physical flows within the network based on appropriate mechanisms and tactics (see Chapter 2.6.2). The previous sections examined two critical elements of this definition. First, section 2.6.3 identified the relevant physical and non-physical flows. Second, section 2.6.5 reviewed in detail appropriate mechanisms and tactics of IMN coordination.

The physical flows of material, people and technology (equipment) and the non-physical flows of information and knowledge are relevant for the coordination of IMNs. These flows also represent the exchange dimensions between plants.[21] Furthermore, the literature review

[21] And partially also between plants and headquarters (e.g., Scherrer and Deflorin, 2017a).

revealed that several inter-plant flows are highly interrelated (e.g., flow of people as a means to transfer knowledge). In order to steer and optimise these inter-plant flows, previous research identified four coordination mechanisms or tactics. First, literature outlines that the assignment of decision autonomy between plants and between plant and headquarters is one important IMN coordination mechanism. Second, through standardisation, network management may also limit decision autonomy of plants or plant management. Third, some studies propose or analyse means to facilitate knowledge exchange across plant boundaries. Fourth, some scholars touch upon incentives or rewards to motivate engagement and willingness to participate in the intra-network flows. Since most IMN studies focus on one coordination mechanism only, research lacks a comprehensive discussion on the combination of all steering mechanisms to improve the related network capabilities.

Another stream within the IMN coordination literature looks into mathematical optimisation material flows and product allocation (i.e., physical distribution) (see Chapter 2.6.4). However, these studies provide only limited implications for IMN management practice as "IMN optimisation is a much more complex task beyond merely modelling, optimising and simulating" (Cheng, Farooq et al., 2015, p. 411). IMN research faces a dilemma because the high number of variables forces scholars to simplify and abstract the complex reality of global operations (Ferdows, 2018). Oversimplification limits the applicability of the research outcomes, and yet the review of the applied research perspective indicates that IMN research tends to simplify or abstract reality too much. The widely applied plant- or network-level perspective fails to consider the individuals within the plants. Despite some recent studies pointing to the importance of key actors on plant level for the management of IMNs, plants are generally considered as black boxes (Cheng et al., 2011, 2015). Though various studies underline that a new perspective, namely the individual-level perspective is required, IMN coordination literature does not yet systematically integrate this perspective.

In conclusion, the conducted literature review answers the first research question in two steps, as follows:

What approaches towards IMN coordination exist, ...

1. *IMN coordination considers the design and management of intra-network flows.*
2. *The relevant flows (i.e., the exchange between plants) are of physical nature (material, people and technology) and non-physical nature (information and knowledge).*
3. *In order to manage and guide these inter-plant flows, IMN literature discusses mechanisms and tactics (namely autonomy, incentives and means) to foster the non-physical exchange.*

... and how do these integrate the individual-level perspective?

1. *IMN studies apply a network- or plant-level perspective.*
2. *Some studies refer to individual-level aspects or point to the potential research merits.*
    a. *Individual-level ties between representatives from different manufacturing plants*
    b. *Willingness and motivation of plants and the respective individuals engage in inter-plant exchange*
3. *However, existing IMN coordination approaches do not systematically account for the individual-level.*

3 The Plant Leader Perspective

"The factory director is more than a manager of an economic enterprise. He is also the leader of a socio-political community." (Walder, 1989, p. 249)

The statement by Walder (1989) highlights the unique role of plant leaders, who are representatives of the individual-level perspective in manufacturing networks. As the previous chapter has shown, this is a perspective that still lacks in this research domain. This chapter first argues why plant leaders are particularly relevant representatives of the individual-level in IMNs. Therefore, the first section introduces the plant leader role. Second, in order to retrieve the perception of the individual-level on inter-plant exchange, this work engaged directly with plant leaders. Twelve in-depth interviews with plant leaders provide a better understanding of the central problems and challenges that impede inter-plant exchange from the individual-level perspective. As such, this chapter addresses the second research question (see Chapter 1.2). Before presenting the results of the plant leader interviews, Chapter 3.2 outlines the methodological approach to query the plant leaders' perspective. Finally, this chapter concludes with a brief summary of the findings and highlights the main implications for the domain of IMN.

The findings presented in this chapter have been published in parts. The introduction of plant leaders as critical decision-makers in IMNs (see Chapter 3.1), the methodological approach (see Chapter 3.2) and the findings from the interviews including the transcribed statements (see Chapter 3.3) are specific components of the following publication:

- *Wiech, M. and Friedli, T. (2020). Using Plant Leaders' Perspectives to Overcome Barriers to Inter-Plant Exchange. Journal of Manufacturing Technology Management. (ahead-of-print).*

3.1 Plant Leaders as Key Decision-Makers

Despite the fact that plant leaders and their daily work routines have not been subject to a lot of systematic research (Smith, Plowman, Duchon and Quinn, 2009), this work considers plant leaders as critical decision-makers in manufacturing networks. This sub-chapter aims to underline why plant leaders should be integrated into the research and practice about the management of IMNs.

3.1.1 Tasks and Requirements

In many ways, the plant leader position is demanding, because, as shown in Table 7, plant leaders are responsible for a variety of tasks. The job descriptions by the Society for Human Resource Management (SHRM)[22] and the similar one by the online job portal "snag." emphasise the operations responsibility of plant leaders for the entire facility. Furthermore, the role description in another magazine adds target achievement and capital expenditure

[22] According to its own statement "the world's largest HR professional society" SHRM (2019a).

responsibility (F.M.C.L., 2002). The classification of plant leaders as middle management[23] (Smith et al., 2009) gives a more detailed account of the associated tasks. Stemming from the job functions of industrial middle management (Hautaluoma, Dickinson and Inada, 1992, p. 209), the remit of plant leaders can be described as planning, coordinating, supervising, negotiating, investigating, staffing, evaluating and representing.

Table 7: Descriptions of the plant leader role

Source	Statements about Plant Leaders
F.M.C.L. (2002)	"The responsibility of running the factory, managing the company`s capital expenditure and achieving production targets, lies firmly on the factory manager`s shoulders."
Lin and Vassar (1992, p. 19)	"All factory managers are faced with the questions of which operational aspects to focus on and which to reduce control over."
SHRM (2019b)	"The plant manager position directs and manages all plant operations with overall responsibilities for production, maintenance, quality and other production-related activities."
Smith et al. (2009, p. 430)	"Manufacturing plant managers are middle managers who operate at the intermediate level of the corporate hierarchy, two or three levels below the CEO (Dutton et al., 1997; Wooldridge and Floyd, 1990); they supervise supervisors but are supervised by others (Dutton et al., 1997)."
snag. (2019)	"Plant managers are the people who watch over and organize the daily operations of manufacturing plants and similar places. Plant managers oversee employees, production and efficiency, to make sure the plant is running smoothly, quickly, efficiently and safely."
Walder (1989, p. 249)	"The factory director is more than a manager of an economic enterprise. He is also the leader of a socio-political community. This community often contains thousands of people, and in some cases tens of thousands. He is responsible not only for their income, but for their welfare and that of their dependants… In many ways, the factory manager is akin to a village head, or the mayor of a small town or city. During his tenure of office, the manager develops an attachment to the unit, a vested interest in its growth and prosperity."

Implementing corporate strategy is inherent to the job of middle managers (Hautaluoma et al., 1992; Smith et al., 2009). They are vital in implementing and communicating network strategy (Friedli et al., 2014; Wiech & Friedli, 2020) to the employees within the plant: "Managers at the subsidiaries are also considered as agents that deliver the message between the headquarters and the employees." (Abdullah and Liang, 2013, p. 662). In doing so, plant leaders are involved in organisational politics (Smith et al., 2009, p. 430), which underlines "the political aspect of the plant manager's role" (Smith et al., 2009, p. 430). Furthermore, administrative and political competencies are also needed for the arduous number of

[23] This classification is worthy of discussion (see Chapter 3.1.2).

relationships in which plant leaders are embedded (Feldman, 1988; Staughton and Johnston, 2009). Besides the close relation to employees within their facility (Smith et al., 2009), it is part of the job to build relationships of strategic nature with people outside of their plants and even outside of their firm (Staughton & Johnston, 2009). For example, they build relationships with managers of other subsidiaries. Abdullah and Liang (2013) outline that plant leaders or subsidiary managers have a crucial mediating role in the exchange between sub-units. As such, plant leaders assume the role of internal boundary spanners for intra-network knowledge exchange (e.g., Minbaeva and Santangelo, 2017).
In all these operational, strategic, political and relational duties, plant leaders enjoy considerable autonomy. Distance between plant and headquarters limits the control authority of central functions (Malmberg, 1995). Even though centralization and standardization of specific tasks puts a limit to the local authority of plant leaders (Friedli et al., 2014; Gupta & Govindarajan, 1991; Olhager & Feldmann, 2018), some aspects of the plant leader's position, like responding to urgent shop floor problems, are inherently linked to careful considerations and autonomous decisions by the manager.[24] Concerning inter-plant exchange, plant leaders mainly take a mediating position.

Plant leaders are supervisors and hold responsibility for all tasks related to the operation of a manufacturing facility. Furthermore, they are involved in strategy implementation and firm representation. They mediate the engagement of their plant with other network units.

The observation by Lin and Vassar (1992) outlined in Table 7 presents a practical application of the attention-based view (see Chapter 1.4). Plant leaders need to focus their attention in order to cope with the magnitude of duties and information. In fact, plant leaders are confronted with a variety of tasks and challenges on a daily basis (Smith et al., 2009). The combination of both responsibilities for many different topics and considerable autonomy in exercising this responsibility demands strong character. The plant leader task is "not merely technical in nature" (Hum and Leow, 1992, p. 21). A clear majority of operations managers disagrees with the following statement: "the management of factories is essentially a task for engineers" (Hum & Leow, 1992, p. 21). The survey results and the statement by Hum and Leow (1992) indicate that the plant leader job requires both considerable managerial skills in addition to thorough operations expertise. Furthermore, the plant leader assignment clearly demands commitment and willingness to work long hours (Lee, Burcher and Sohal, 2004, p. 418). The comparison of a plant leader to a city mayor by Walder (1989) (see Table 7) also shows that the plant leader job is more than a normal management position. In many cases, this aspect of the job forges a strong attachment to the manager's own plant (Walder, 1989). Mundt (2012) even observes that a plant leader's identification with his or her own facility can be stronger than his or her bond

[24] Further examples for autonomous decisions by plant leaders are presented in Chapter 3.3

to the parent firm: "site managers considered themselves as independent entrepreneurs rather than as representatives of a global company" (Mundt, 2012, p. 81).

3.1.2 Corporate Level

The assignment of plant leaders to a particular level in the corporate hierarchy is equivocal. Smith et al. (2009, p. 430) justify the classification as middle management based on the fact that plant leaders work "at the intermediate level of the corporate hierarchy, two or three levels below the CEO." Though plant leaders are indeed supervised by and report to the corporate level (Dutton & Jackson, 1987), in many cases they hold significant responsibility for staff (snag., 2019; Walder, 1989) and budget (F.M.C.L., 2002; Walder, 1989). Geographic dispersion of plants leads to limited control and thus gives plant leaders an inherent level of autonomy. Therefore, depending on plant size, the job of plant leaders may not be considered as middle but top management. The view that plant leaders are top management is supported by Feldman (1988), who refers to plant leaders as senior managers. The interviews conducted in the course of this work with 12 plant leaders of various firms (see Chapter 3.3) also revealed an "it depends" result in regard to the middle or top management classification. The interviews confirmed that plant leaders are supervised by at least one higher level (Dutton & Jackson, 1987). However, some plant leaders see themselves as part of the top management, at least within the operations function of the firm. For example, one plant leader explained that he reports directly to the Chief Operating Officer (COO), and that his plant leader position is one of the highest rungs on the corporate ladder (A.1). In particular, plant leaders of so-called "lead plants" (e.g., Deflorin et al., 2012; Ferdows, 1997) enjoy considerable internal reputation and autonomy (Cheng & Farooq, 2018; Vereecke et al., 2006, p. 1746). Their responsibility goes beyond the plant boundaries, and in many cases, lead plants are responsible for setting process standards for the entire network (Feldmann et al., 2013). Such overarching tasks also increase the plant leader's autonomy. Vereecke et al. (2006, p. 1746) observe that this plant category intrigues plant leaders. At another site, the interviewed plant leaders revealed that within one network or firm, plant leaders are not necessary on the same hierarchical level. Leaders of specifically small or emerging plants are considered middle managers. Thus, this work refers to the hierarchical level as follows:

Plant leaders are classified as middle or high-level managers contingent upon their extent of responsibility, which mainly depends on the plant's characteristics (e.g., the number of employees) and the firm's policy.

3.1.3 Unit of Responsibility

Practise shows that firms organise their manufacturing facilities differently (see Chapter 5). The first case example of this work exemplifies that the plant organisational structure can vary even within one firm. Namely, the organisational structure of single-focused plants is different from locations with multiple operations (i.e., plants within a plant or "shared factory" (Lützner, 2017)). According to the case firm's definition, site managers are responsible for the entire location, whereas plant leaders only supervise a particular operation that is located at a site. The distinction of plant and site manager becomes irrelevant for unshared manufacturing facilities.

Similar to the definition of the online platform snag. (2019), this work does not differentiate whether a plant leader oversees the whole or only part of a facility: "plant managers might oversee an entire location, or just a section of the operation" (snag., 2019). In the context of this work, the question is whether the manager can interfere with the behaviour of the plant, respective to the operations unit in the associated manufacturing network. For example, in the first case it is not the site manager who drives the plant's network conduct. Instead, it is the responsibility of two plant managers responsible for different operations located at the same site to decide about (e.g., the participation in knowledge exchange with other peer plants). Thus, these two managers are considered as plant leaders for this work.

As the terms plant and site are not always clearly distinguishable, this work uses plant leader as a synonym for site or plant leader. Both the plant and site leader can be relevant as long as their responsibility concurs with one of the following definitions:

A plant leader is...

1. *responsible for the entire operation of a manufacturing location, or*
2. *responsible for a distinct operation located at a shared-factory.*

3.1.4 Summary

Overall, the previous sections underline that plant leaders play a significant role, and various aspects give reasons for their relevance as key decision-makers in the management of IMN:

- The remit of the plant leader function comprises a variety of different tasks
- Plant leaders hold significant responsibility for all operational activities within a manufacturing unit
- They are involved in strategy implementation and firm representation
- A plant leader's job is inherent to a considerable degree of autonomy
- Plant leaders are mediators for exchange between plants of the same network
- Decisions by plant leaders can have a significant effect on both the network level and other plants of the network
- Plant leaders are on an intermediate or high level of firm hierarchy

Finally, this sub-chapter points out that the high-level perspective of IMN literature (see Chapter 2.6) addressing plants as black boxes (Cheng et al., 2011, p. 1315) lacks to pay adequate attention to individuals such as plant leaders.

3.2 Perceived Barriers from a Plant Leader Perspective

The next section turns to the perception of the key decision-makers as identified in the section before. To gain an understanding of the barriers that hinder inter-plant exchange in manufacturing networks, the following sections shed light on the perspective and motives of plant leaders and their engagement in intra-network flows. Before presenting the findings from 12 plant leader interviews, it is necessary to clarify the methodological approach.

3.2.1 The Term: Barrier

First, identification and analysis of barriers in any context require clarity about the term *barrier*. Günther and Scheibe (2005), who proposes an approach to identify barriers in a different context, choose not to use the German term *Barriere*, but instead apply the term *Hemmnis*[25] and even name the approach *Hemmnisanalyse*. The meaning of the German term *Barriere* implies more considerable difficulties to overcome the associated obstacle than *Hemmnis* (Hermann, 2011, p. 7). Günther and Stechemesser (2010, p. 39) define *Hemmnis* as a disruptive factor which slows, hinders or blocks the decision process, but can eventually be overcome. *Impediment* is a corresponding English term according to the Oxford Online Dictionary and Merriam-Webster. However, other scientific attempts that conduct a similar analysis use the English term *barrier* (e.g. Hansen, 2009; Scott and Yih-Tong Sun, 2005). The Macmillan Dictionary defines *barrier* as “anything that prevents progress or makes it difficult for someone to achieve something” (Macmillan Education). Since this definition is hardly distinct from the nature of *Hemmnis* as defined by Günther & Stechemesser, this work combines both and deems the term *barrier* to be synonymous with *impediment*.

A barrier can eventually be overcome, but slows, hinders or blocks something. Thus, this work aims to identify themes that slow, hinder or block inter-plant exchange from a plant leader perspective.

3.2.2 Approach to Identify Barriers

This work follows a systematic approach to identify impediments to inter-plant exchange. It adapts methodology from previous research, but partly deviates due to the context and focus of the work at hand.

Klassen and Whybark (1994) chose to apply the Delphi method (Linstone, Turoff and Helmer, 1975) to identify high-level “barriers to the management of international operations” (Klassen & Whybark, 1994, p. 385). Other scholars apply similar approaches to identify barriers in different domains (e.g., Ghazilla et al., 2015; Scott & Yih-Tong Sun, 2005). However, due to the clear focus of this work on the perspective of plant leaders, it refrains from obtaining input from different functional experts (Linstone et al., 1975; Okoli and Pawlowski, 2004). Instead, direct input from plant leaders provides the empirical basis

---

[25] «Hemmnis» can be translated as impediment

for deriving the perspective of these individuals. The nature of this research on plant leaders as key decision-makers (see Chapter 3.1) points to these individuals as input providers for the barrier analysis.

Günther and Scheibe (2005, p. 155) consider (1) the identification and localisation of impediments, (2) the evaluation of the relevance, and (3) the development of strategies to overcome identified impediments as objectives for their systematic barrier analysis. This thesis pursues the first two objectives through semi-structured interviews with plant leaders. The idea of evaluating the relevance of the identified impediments based on a questionnaire (Günther & Scheibe, 2005) has been abandoned for two reasons. First, the required number of participants for reliable and significant results would have involved a disproportionate effort. Second, the additional explanatory power of the questionnaire approach was considered too low. Therefore, the first step of the applied approach was the data collection through semi-structured (see Chapter 3.2.3) interviews followed by the analysis and evaluation of this data (see Chapter 3.2.4), combining objectives (1) and (2). Finally, a discussion of strategies to overcome the identified barriers, which corresponds to the main objectives of this work (see chapter 1.2), constitutes the last step (3) of the approach, as suggested by Günther and Scheibe (2005).

3.2.3 Semi-Structured Interviews

The explorative nature of the barrier analysis affects the choice for the data collection method. This research project applies semi-structured expert interviews in order to identify barriers from the individual-level perspective. The following argues why this method is particularly useful in the context of this research and introduces the cornerstone of the chosen procedure.

Edwards and Holland (2013, p. 5) stress that the methodologic approach depends to a large extent on the research context. Therefore, this work retrieves information directly from these individuals because it focuses on plant leaders as key decision-makers in IMNs. Conversely, the choice to engage directly with plant leaders also affects the methodological choice. Scholars suggest the semi-structured interview method is particularly suitable if managers are to be addressed: “semistructured interviewing works very well in projects where you are dealing with managers, bureaucrats, and elite members of a community – people who are accustomed to efficient use of their time” (Bernard, 2013, pp. 182–183).

In addition to the given target group, the choice for semi-structured interviews also depends on the explorative character of this research and the limitations imposed by the IMN knowledge base (see Chapter 2.6). Application of an open concept like semi-structured interviews is particularly suitable for understanding interdependencies and specifying a problem (Atteslander, 2010, pp. 139–142). Therefore, this method is frequently applied in qualitative and explorative research (Atteslander, 2010, p. 139; Bernard, 2013, p. 181; Flick, 2018, p. 216; Saunders, Lewis and Thornhill, 2012). It is the objective of this work to capture different plant leaders’ standpoints without guiding their attention on particular issues. Confronting plant leaders with a predefined list of barriers bears the risk of concentrating on less relevant factors and therefore missing other vital impediments. Furthermore, the limited theoretical foundation in IMN literature (see Chapter 2.6) does not support formulating a catalogue of predefined barriers that could be incorporated into a standardised questionnaire as suggested by Günther and Scheibe (2005).

Table 8: Guideline for plant leader interviews (adapted from appendix of Wiech & Friedli, 2020)

Main Theme	Sub-Item
Introduction *(Individual)*	Career and background
Introduction *(Firm and Plant)*	Extent of responsibility (one or several sites)
	Number of people in own plant
	Central manufacturing network function
Inter-plant exchange	Content of exchange/cooperation: what and how
	Role of own plant within the exchange
	Perception of problem-solving or firefighting requests
	Differences in exchange/cooperation between plants
	Barriers to inter-plant exchange
	Specific collaboration barriers
	Perception of inter-plant competition and effects
Plant Leader	Engagement and role of plant leader in inter-plant exchange
	Inter-personal relations to other plant leaders and effects
	Incentives and motivation
	Typical career path of plant leaders
Central Network Management	Perception of centrally coordinated inter-plant mechanisms
	Recommendations/expectations

In order to provide some guidance to the data collection, a brief collection of themes for the interviews informed by existing IMN literature and prior discussions with practitioners was developed (see Table 8). The guideline was refined by an extensive discussion[26] with another experienced researcher[27] in this field, but the application of this guideline did not follow a strict order. It was used "in a flexible, non-bureaucratic way – that is as a thematic guideline and not as if it were a questionnaire to be administered" (Meuser and Nagel, 2009, p. 33). As outlined in Wiech & Friedli, 2020, this approach was adopted based on the belief

[26] One face-to face meeting with focus on the questionnaire beside an e-mail communication about relevant literature.
[27] Post-doc from another Swiss university who does research on behavioural topics in operations management.

that the plant leader's "viewpoints are more likely to be expressed in an openly designed interview situation than in a standardized interview or questionnaire" (Flick, 2018, p. 216). The interviews were structured into five parts that contain 17 distinct points (see Table 8). After an initial introduction into the professional background of the interviewee, specific key facts of the plant leader's firm and plant were discussed. This part was kept short for those interviews in which the researcher was already informed about the firm or knew the interviewee (i.e., from previous projects). The third part considered inter-plant exchange and the general conditions as perceived by the interviewed plant leader. This was followed by a discussion of the individual plant leader's role. The last part briefly touched upon the role of central network management and the plant leader perspective on potential measures for fostering inter-plant exchange.

In general, semi-structured and explorative interviews capture what the interviewees consider worth mentioning or relevant concerning the addressed topic (Honer, 1994, pp. 624–625). Therefore, an analysis of the plant leaders' statements draws a picture about what they consider relevant in the context of inter-plant exchange. Following the ABV (see Chapter 1.4), it can also indicate their attentional focus. Therefore, the researcher initiated the discussion about each point with open questions that "may be answered on the basis of the knowledge that the interviewee has immediately at hand" (Flick, 2018, p. 227). For some points of the guideline, the open question was followed by a more precise inquiry. These secondary questions were informed by other research and, thus, "hypotheses-directed" (Flick, 2018, pp. 227–228). For example, plant leaders were asked about impediments to inter-plant exchange in general. Then, if they did not touch upon the topic themselves, they were asked to assess four typical barriers with regard to collaboration in firms (Hansen, 2009).

Table 9: Overview of conducted semi-structured interviews

Date	Type	Duration	Documentation
02.05.2019	On-site	60 min	Verbatim transcript
16.04.2019	On-site	60 min	Verbatim transcript
12.04.2019	On-site	70 min	Verbatim transcript
03.04.2019	Call	45 min	Verbatim transcript
28.03.2019	Call	40 min	Verbatim transcript
26.03.2019	Call	45 min	Verbatim transcript
18.03.2019	Call	35 min	Meeting minutes
27.02.2019	Call	30 min	Meeting minutes
25.02.2019	On-site	35 min	Verbatim transcript
18.02.2019	Call	30 min	Verbatim transcript
15.02.2019	Call	50 min	Verbatim transcript
07.02.2019	Call	30 min	Verbatim transcript

Purposive sampling (Bernard, 2013, pp. 164–167; Flick, 2018, pp. 180–182) provided the basis for selecting interview participants. In order to control the sample (Voss, Tsikriktsis and Frohlich, 2002), the following selection criteria, consistent with the research objective, were applied:

- The firm of the potential interviewee operates at least three internationally dispersed manufacturing facilities (Wiech & Friedli, 2020)
- The potential interviewee is currently or was previously responsible as a plant leader in the sense discussed in Chapter 3.1 (responsible for the operation of a distinct manufacturing unit) (Wiech & Friedli, 2020)

A total of 16 plant leaders were asked to participate in the semi-structured interviews, of which 12 agreed and completed the interviews. Table 9 presents an overview of all conducted interviews, which were conducted between 7 February 2019 and 2 May 2019 with two plant leaders from case firms I and II (see Chapter 5), and the rest from other firms. As shown in Table 9, eight interviews were conducted via phone, and four were on-site. The interviews were scheduled for 45 minutes, but the actual duration varied from 30 to 70 minutes. An audio recording of each interview and a subsequent verbatim transcription was created for all but two interviews. In these two cases, the meeting minutes provided the only documentation due to technical issues with the recording (see Table 9). Since participating plant leaders were granted anonymity and confidentiality, these transcripts and verbatim records were not made available in the appendix.

All interviews were conducted in German. Therefore, the quotes presented in the following sections have been translated. Each interviewee gave his blessing to publish the anonymised quotes. The analysis also incorporates secondary data from the internet and information gathered during previous projects with four employers of the interviewed plant leaders.

3.2.4 Coding and Analysis of Interviews

This work applies “coding as a heuristic” (Saldaña, 2016, p. 9) to guide the analysis of 12 plant leader interviews. Several aspects of the transcribed interviews and memory notes were coded in order to identify the plant leader perspective on inter-plant exchange.

The code definition of Saldaña (2016) provides the basis for the single or multiple word codes applied by this work: ”A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data“ (Saldaña, 2016, p. 4).

The assignment of codes to the interview transcripts was performed manually. In order to prevent research bias, no coding was conducted until all interview data was collected (Miles and Huberman, 1994). Coding was performed with the qualitative analysis software Atlas.ti, which not only helps to assign code to text but also facilitates the analysis and comparison of different interviews. *Atlas.ti* also supports the assignment of codes to audio records. However, the author experienced that this feature is less suited for comparing and analysing large quantities of similar data (e.g., interviews). Therefore, codes were assigned to the transcribed text of the interviews, or the minutes were taken from memory.

An iterative, multi-step approach was chosen to assign codes to single or multiple words in a row, to sentences, or even to paragraphs of the interviews. The process built on two main steps (Wiech & Friedli, 2020):

1. In order to categorise the large quantity of data into central themes, all interviews were coded using descriptive (Saldaña, 2016) (i.e., selective) codes (Strauss and Corbin, 1990). Codes that describe what was said were formulated and assigned to all interviews. After multiple sequences of going through the interviews and reassigning the codes, similar ones were aligned and clustered. This resulted in a hierarchical depiction of the code groups and codes (see Appendix B.1).
2. During the second step of coding, only statements about impediments to inter-plant exchange were considered. Therefore, codes were assigned to statements that portray the perception of the interviewees regarding the effect of particular factors (e.g., competition, incentives, heterogeneity, transparency and personality type). The emerged codes (see Appendix B.2) then provided the basis in the search for similarities or contradictions.

It should be noted that coding in general, but particularly applied descriptive coding is subject to criticism as it "will not reveal very much insight into the participant's mind" Saldaña (2016, p. 102). However, descriptive coding was mainly applied to structure, consolidate and facilitate the processing of a large amount of text data in order to provide a starting point for the in-depth analysis. Nevertheless, critics point to the inherent subjectivity of the coding method. Scholars conclude that ”all coding is a judgment call" (Sipe and Ghiso, 2004, p. 482) or emphasise "that category-building involves our subjectivities, our personalities, our predispositions, our quirks" (Sipe & Ghiso, 2004, p. 483). In order to minimise the shortcomings of the chosen method, multiple sequences of reading through and reassigning codes were conducted. Furthermore, a second researcher verified the reproducibility of the applied codes by cross-checking one interview.

3.3 Results

This chapter synthesises the results from 12 interviews with plant leaders from nine different manufacturing firms. Seven broad themes emerged from the analysis. Before an in-depth presentation and discussion of the findings (see Chapter 3.3.3 to Chapter 3.3.9), some attention is devoted to the general structure of the sample and its particularities (see Chapter 3.3.1).

3.3.1 Sample

In the course of this work, interviews with 12 plant leaders were conducted (Wiech & Friedli, 2020). Table 10 presents some general information about the firms, the facilities and the interviewed plant leaders. The interviews are indexed by a capital letter referring to the firm and a numeration starting from "1" for each plant leader of the respective firm (see Table 10. The following analysis applies this index for quotations and references.

The sample covers a broad industry spectrum (Wiech & Friedli, 2020). Table 10 depicts the company's industry classification based on the second revision of the *Nomenclature statistique des activités économiques dans la Communauté européenne* (NACE) (European Commission, 2008) and according to the ORBIS database entry of each firm. The vague character of this classification guarantees anonymity and confidentiality, which most interviewees demanded due to some sensitive questions or statements that openly critique practices in the firms (Wiech & Friedli, 2020).

The sample firms operate a wide range of production processes and produce different volumes of products. Thus, it comes as no surprise that the degree of standardisation and automation also varies widely. For example, one of the interviewed plant leaders (B.1) oversees a facility that operates high-temperature furnaces to produce graphite blocks. Long lead times characterise this heavy-industry production. The first-tier automotive suppliers in the sample operate quite different productions with large volumes, high degree of automation and low cycle times (e.g., H.2). Furthermore, the fibre composite production of the aircraft component firm (F) is again very different due to a high manual labour share and relatively small output numbers compared to the automotive examples within the sample. Table 10 also indicates the network size of the respective firm. It shows how many plants were part of the respective subnetwork and how many were owned by the firm overall. Subnetwork refers to the idea of Ferdows, Vereecke, and de Meyer (2016, p. 63). They propose to create smaller subnetworks within the firm to cope with growing complexity. Plants of the same subnetwork have presumably more in common, and thus inter-plant exchange between plants of the same subnetwork is higher than between plants of different subnetworks. The number of plants within one subnetwork indicates the potential degree of inter-plant exchange and thus the scope of IMN coordination (see Chapter 2.6.2). The network size varies significantly within the sample. One sample firm operated about 280 production facilities worldwide, and a central network steering department oversaw this complex structure. The firm had defined clusters of similar plants and operated these as distinct subnetworks. On the other end of the spectrum, the much smaller company F operated multiple plants that served distinct business segments and produced different outputs. The plants were not embedded in a congruent network (Ferdows et al., 2016). Additionally, this particular firm did not have a central function for network management. The diverse sample provides insights from plant leaders that were steered by a central network function and from plant leaders that were not used to a central manufacturing network management function. Overall, the sample entails a wide range of different maturity levels from small networks with only three plants, to vast networks (e.g., firm H) delayered into several subnetworks with a distinct network management unit.

The network size indicates the firm's maturity concerning global operation and network management. It can be expected that firms with a high number of plants have devoted more attention to the management of their IMN. The following statement by one interviewee confirms differences in the professionality of network management between his previous and current employer:

> "Yes, firm x [previous employer] was much bigger. There were more than 20 plants in my subnetwork. Everything worked differently. There was a designated OPEX-Team they could send out to each plant." (translated; C.1)

Therefore, Table 10 also outlines the maturity of the firms, that is, it indicates whether they have one or several designated positions for the management of their IMN. Without such central network management teams or positions, it can be assumed that aspects like knowledge exchange between plants have not yet been systematically structured. Concerning this matter, the conducted interviews cover a balanced sample (see Table 10) of firms with and without such a function. Table 10 also highlights some key facts about the plant leader and the facility itself, including the professional experience of the plant leader. Some interviewees have been responsible for another plant in the same (F.1, H.1 and H.2) or a different firm (C.1, F.2). For example, in the case of H.1, the interviewee was responsible for a plant in Japan and later for the lead plant of the same subnetwork in Germany. During the interview, he provided insights from his experience during both assignments in Germany and Japan. His role concerning inter-plant exchange varied between both assignments. As such, he provided new insights. In addition, plant leaders who assume additional responsibility in a central function also provided a different perspective from plant leaders who solely focus on running their own facility. Presumably, involvement in a central management position changes the plant leader's focus and potentially affects the answers provided during the interviews. Therefore, Table 10 also outlines whether the interviewee was involved in a central function with additional responsibility for the overall network during previous assignments or at the time of the interview. For example, both H.1 and H.2 were working in the central network steering unit before the interview took place. Other interviewees (D.1, F.1, G.1 and I.1) participated in the operations or divisional management board and, therefore, had to consider overall network topics beyond their plant.

The seventh column of Table 10 provides an overview of the plant size of the interviewed plant leader. The interviewed plant leaders were responsible for 270 to 1,700, mainly manufacturing-related, employees. These numbers provide at least some indication of the plant's strategic importance to the network. Confidentiality limited the presentation of plant revenue or the plant's share of firm revenue in this study. However, some plants in the sample generated several hundreds of millions of Euro revenue per annum. Namely, the bigger plants in terms of employees (see Table 10) generated a considerable share of the related network's revenue. In these examples (H.1, H.2), the interviewed plant leaders hold significant responsibility for overall firm success, thus underlining the role of plant leaders as key decision-makers (see Chapter 3.1).

Table 10: Overview of plant leader interviews (adapted from Wiech & Friedli, 2020)

#	Firm		Plant Leader				Location
	NACE Rev. 2 class	*# plants firm/ network*	*Central network steering*	*Experience as plant leader in # of plants*	*Involved in central management*	*# of employees on site*	
A.1	Manufacture of other parts and accessories for motor vehicles (29.32)	40/16	Yes	1	No	500	Germany
B.1	Manufacture of other electrical equipment (27.90)	31/5	No	1	No	285	Germany
C.1	Manufacture of air and spacecraft and related machinery (30.30)	/3	No	2	Yes	295	Switzerland
D.1	Manufacture of medical and dental instruments and supplies (32.50)	/14	Yes	1	Yes	550	Switzerland
E.1	Manufacture of jewellery and related articles (31.12)	7/3	No	1	No	500	Serbia
E.2	Manufacture of jewellery and related articles (31.12)	7/3	No	1	No	800	India
F.1	Manufacture of air and spacecraft and related machinery (30.30)	8/	No	2	Yes	800	Austria
F.2	Manufacture of air and spacecraft and related machinery (30.30)	8/	No	2	No	570	Austria
G.1	Installation of industrial machinery and equipment (33.20)	6/2	Yes	1	Yes	270	Germany
H.1	Manufacture of other parts and accessories for motor vehicles (29.32)	280/13	Yes	2	Former	400 / 1700	Japan / Germany
H.2	Manufacture of other parts and accessories for motor vehicles (29.32)	280/8	Yes	3	Former	1300	Germany
I.1	Manufacture of other electrical equipment (27.90)	/6	Yes	1	Yes	875	Switzerland

Table 10 also displays the location of the interviewee's plant. All of the interviewed managers work for firms headquartered in German-speaking areas (Austria, Germany or Switzerland). The locations of their current or previous assignments as plant leaders were less geographically biased, but a majority is located in the German-speaking area of Austria, Germany and Switzerland. Furthermore, the headquarters of all firms were in this area. Plant leaders located in Serbia, India and Japan complement the sample. The view of a foreign subsidiary, especially if located in a low-cost environment and seen as a receiving site (Scherrer & Deflorin, 2017b), provides an unique perspective about inter-plant exchange.
Overall, the diverse sample of plant leaders with different experiences who are responsible for different sized plants that produce a wide range of different products and are located in various countries, provides new insights into the practise of plant management and the perspective on inter-plant exchange. Nevertheless, the sample exhibits two main limitations (Wiech & Friedli, 2020). First, the sample size limits the generalisability of the results. Second, selection bias is another (potential) weakness, as all firms of the sample are headquartered in German-speaking areas.

3.3.2 Perception of Own Role in Inter-Plant Exchange

"I can bring together the right people, make a call or send an email. I am the enabler for the contact." (translated, C.1) (Wiech & Friedli, 2020)

The theoretical discussion of the plant leaders' role as key decision-makers in IMNs is limited due to the small number of studies (see Chapter 3.1). Thus, the interviews aimed to provide additional insights into the plant leader's role, particularly about their influence on inter-plant exchange.
When asked about the kind and means of exchange between network units, the interviewed plant leaders revealed that they see themselves involved in many inter-plant relations, notably, in the non-physical inter-plant flows (see Chapter 2.6.3). The plant leaders mentioned different tasks in the exchange of administrative information and knowledge.
Concerning information exchange, plant leaders mainly play a participating role. The majority stated that they themselves participate and exchange production-related information in regular meetings, which are commonly hosted by a central function[28] (B.1, C.1, D.1, F.1, F.2, G.1, H.1 and H.2). These meetings are typically remote and serve the purpose of reporting the most critical KPIs and production plans. According to the interviewees, this kind of exchange takes place regularly every few weeks (F.1, F.1 and H.2) or months (B.1, D.1, G.1 and H.2). Few examples of the sample did not mention any structured approach. One exception is the network of C.1, in which the exchange of administrative information is irregular and embedded into the divisional board meetings.[29]
Some firms of the sample demand attendance of all plant leaders belonging to the same

[28] COO or staff unit for network management.
[29] Plant leaders are part of the division board in firm C.

network during those meetings. As such, these periodical meetings also serve as an important platform to create transparency between plants in the network (see Chapter 3.3.7).

> "… the monthly exchange, sometimes via Skype. It is about to understand – what happens in the other plants, where can we share information that might be beneficial for the other plant. It is about safety and accidents, but can also be about production KPIs or other experiences." (translated, D.1)

Overall, the plant leaders' answers demonstrated that structured or semi-structured information exchange is the most prominent inter-plant flow that receives considerable attention from the interviewed subsidiary managers. The prominence of this flow is probably linked to the involvement of direct supervisors or representatives from the central management or even the highest management level (e.g., for B.1, F.1, and F.2). Eventually, participation in intra-network information exchange is requested and recognised by supervisors. As such, these meetings are also regular occasions for attracting attention. Chapter 3.3.9 goes into further detail about the career ambitions of plant leaders.

In contrast to the participating role in information exchange, the interviews revealed that plant leaders undertake additional tasks concerning inter-plant knowledge exchange. The majority of all interviewees stated that they actively organise intra-network knowledge exchange. As shown in Table 11, plant leaders are faced with different tasks when involved in the organisation of inter-plant knowledge exchange.

Several interviewees mentioned a participative role in the inter-plant knowledge exchange (A.1, D.1, E.1, E.2, H.1 and H.2). Similar to what is seen with the information exchange, but less frequent (once or twice a year), these plant leaders participate in formal meetings usually organised by central management. The plant leaders expressed that among others, best-practice sharing and continuous improvements are on the agenda of these meetings. In several cases, best-practices were also discussed on a level below the plant leader in peer groups between respective experts from different plants (A.1, B.1, H.1, H.2 and I.1). In the course of this, the plant leader's task is of an organising (i.e., delegating) nature. As seen in Table 11, plant leaders are faced with the task of delegating, especially in less structured knowledge flow situations when plants request ad-hoc support from their counterparts. The approached plant leader, if willing or able to support, has to organise the exchange and deploy (i.e., delegate) people from his or her own plant. In other words, plant leaders bring together the right people. As such, these findings support Abdullah and Liang (2013), who pointed to the mediating role of subsidiary managers in the exchange between network units.

During the interviews, several plant leaders expressed that answering the request for support is always a balance between own plant and overall firm interests (C.1, D.1, F.1, F.2 H.1, H.2 and I.1). The trade-off between plant-internal objectives and overall-firm success is a recurring theme in the following sections. Several plant leaders reported that the request to support another plant is sometimes instructed by central operations management and not a request between equals (i.e., a request from another plant) (e.g., F.1, F.2 and I.1). The interviewees perceived that the success of cross-plant support actions also depends on who is requesting - another plant or central management. Chapter 3.3.3 addresses this particular issue.

Table 11: Statements about plant leader role in inter-plant knowledge exchange[30] (adapted from Wiech & Friedli, 2020)

#	Tasks	Statement
A.1	• Initiate	"If I think about our plant, we had a plant leader who did not engage into the network topic. Certainly, structure of operations also was a bit different. The plant was isolated. It was a bit like a Gallic village."
B.1	• Initiate	"We carry out two reciprocal visits per year and organise some kind of exchange meeting… If it was not me to organise this or at least push it to be organised, it would not take place… It is clearly a topic that I have to insist on as the leader of the unit. Otherwise, it tails off. There is the example of my predecessor. He also did it. And then, we changed positions, and during the first two years, I was not even aware that it is me to organise this exchange. Thus, it simply did not take place."
C.1	• Initiate • Exemplify	"Yes, I believe it is a particularly important role … to act as a role model… I can bring together the right people, make a call or send a mail. I am the enabler for the contact."
C.1	• Delegate	"I get a problem description and based on that I will have to put a team together, which then has to go to the plant."
F.1	• Initiate • Exemplify	"It depends on the acting manager. Do you have a "local thinker" or somebody who thinks, "Is this the right decision for the company? … If I do not exemplify the right decision from a corporate perspective, then I should not expect my employees to do so…. I have seen in my old firm. We had two plants, and it [inter-plant exchange] started to work not before the plant management changed."
H.2	• Initiate • Exemplify	"I think as plant leader; I have to start it. You have to create a mindset in order to generate the pull for this exchange."
I.1	▪ Delegate	"… if problems occur we do short-term assignments. We send somebody, situational, depending on the problem: Who could be the best support? You try to get these people to go, to solve the problem and to do training."

In addition to the task of delegating employees, two more distinct responsibilities emerged from the statements presented in Table 11. In particular, the following anecdote S*elf-Organised Knowledge Exchange* highlights the crucial role of plant leaders to initiate exchange between plants. The example underlines that the plant leader is of utmost import for inter-plant exchange, at least in firms that refrain from steering these topics centrally.

[30] Illustrative examples, translation based on interviews in German language.

Example: ***Self-Organised Knowledge Exchange***[31]

Firm B operates a network of more than 30 facilities characterised by several cross-plant value streams. For instance, the initial step of mixing and forming takes place in a German factory. Afterwards, material is shipped to a French plant, and there is subject to a thermal process. Next, the material is transported back to the German plant for final thermal treatment. Knowledge exchange between both plants suggests itself due to the bilateral value stream and similarities.

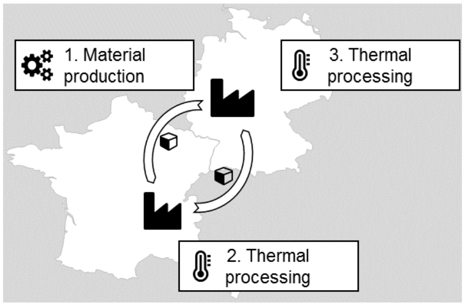


Figure 10: Reciprocal material flow and subsequent process steps

However, the following statement shows the role of the plant leader as the organiser of exchange and how focus on different topics can abate fruitful exchange:

"We carry out two reciprocal visits per year and organise, some kind of exchange day… If it was not me to organise this or at least push it to be organised, it would not take place. People are busy with local problems. In the end, the shirt is nearer than the trousers. This means such topics fade into the background. It is clearly a topic that I have to insist on as leader of the unit. Otherwise, it tails off. I experienced it myself. I always participate, even if it is solely technical exchange, just to emphasise the importance. There is the example of my predecessor, he also did it. And then, we changed positions and in the first two years I was not even aware, that it is me to organise this exchange. Thus, it simply did not take place. At some point I asked whether it would not make sense to have some kind of exchange. Everyone responded: yes, in the past we already did it!" (translated, B.1)

Besides their role to initiate inter-plant exchange, the statements in Table 11 also underline that plant leaders see themselves as role models, not only, but particularly for inter-plant exchange. The interviewees were aware of having a bearing on the unit's willingness toward inter-plant exchange. Especially for production transfers, motivation and willingness to cooperate of all involved employees, including the plant management from the sending plant is a crucial challenge (B.1, G.1, and I.1). Several of the interviewed plant leaders stated that they regularly deal with the transfer of production technology or even entire production lines (B.1, G.1, H.1, H.2, and I.1). Such transfers are resource-intensive for both the receiving and the supporting plant. Workers need to be qualified, knowledge and procedures need to be standardised and transferred (e.g., Cheng et al., 2010). The interviewees underlined that the plant leader of the sending site acts as an organiser of this exchange, which also involves the deployment of own experts (e.g., G.1, I.1).

These findings shed new light on other studies that refer to the willingness of a factory to participate in knowledge exchange (Scherrer & Deflorin, 2017b). The interviews underline that plant willingness is a function of "the subsidiary managers' willingness and ability to adopt either a local or a global perspective" (Gupta & Govindarajan, 1991, p. 777). Thus, the plant

[31] Exemplified.

leader's mindset plays a crucial role in inter-plant exchange and even can constitute a barrier (Wiech & Friedli, 2020). Section 3.3.9 complements this discussion on plant leader mindset.
Taken together, the interviews confirm the hypothesis that plant leaders are key decision-makers for IMNs, namely for inter-plant exchange. On the one hand, plant leaders mainly participate in the information exchange. On the other hand, many undertake a much more active role in the intra-network knowledge exchange. Besides participation, they also initiate these exchanges and delegate people. Thereby, the plant leaders confirm that the physical flow of people is primarily a means to exchange knowledge:32 "That means, generally, the possibility and the method to transfer knowledge is simply via competent experts" (translated, B.1).
Finally, the findings also underline that plant leaders can facilitate inter-plant exchange by exemplifying the willingness to cooperate with other plants (Wiech & Friedli, 2020). Thereby, they motivate their employees and define how their plants are embedded within the network. Despite many plant leaders being well-aware about their vital role in inter-plant exchange, the next section outlines that the plant leader's attentional focus is a typical cause for the lack of inter-plant exchange.

3.3.3 Focus and Scarcity of Resources

"We are focused on low-cost production, we cannot always deal with other issues…"[33]
(translated, E.2) (Wiech & Friedli, 2020)

During the interviews, the topic of focus was repeatedly mentioned. The statement above highlights the perspective of one interviewee who was responsible for the Indian facility of an Austrian firm. He took a defensive position and explained why the intra-network exchange was of low priority to him and his facility. Another interviewee, commenting on his attentional focus, simply stated: "I have to do my job; I must keep my plant running" (translated, F.2) (Wiech & Friedli, 2020).
Both statements above are exemplary, and several others underlined this plant-internal focus to reason their limited engagement in inter-plant exchange (see Table 12). First and foremost, Table 12 highlights that many plant leaders are primarily focused on running the operations of their own plant. To some extent, this focus was to be expected in consideration of the plant leader's role (see Chapter 3.1), which mainly involves responsibility for operational tasks of his or her own plant. However, it was somewhat surprising how clear and unambitiously half of all interviewed plant leaders declared that they devote all of their attentional focus towards the operation of their plant (Wiech & Friedli, 2020). It appears

[32] However, in contrast the flows that have been discussed in the IMN literature (see Chapter 2.6.4), the interviews with F.1 and F.2 reveal that the flow of people within the network is not always only a mean to transfer knowledge. In their network, people are regularly exchanged between plants to cope with staff shortages or high loadings.
[33] Statement continues: "…Of course we take care of our employees, their safety and the environment with adherence to all statutory regulations."

that for many interviewees inter-plant exchange only exists in the periphery of their focus. This attitude confirms that plant leaders perceive inter-plant exchange at least to some part as "unnecessary or secondary to their jobs" (Luo, 2005, p. 86). Several interviewees also saw this focus as a reason for the limited exchange within their network (A.1[34], B.1, C.1, E.1, E.2, F.1 and F.2). Overall, this observed focus on intra-plant topics confirms the relevance of the main research question of this thesis (see Chapter 1.2). Namely, how firms can draw advantages from their globally dispersed manufacturing operations (i.e., benefit from intra-network flexibility and learning) (see Chapter 2.3) if the critical decision-makers inside the plants are not paying attention to these topics.

Reasons for the observed internal-plant focus on topics far from inter-plant exchange are manifold. The statements in Table 12 indicate several aspects. The limited attention capacity of key decision-makers as outlined in the attention-based view (see Chapter 1.4) can clearly be observed for a part of the interviewed plant leaders. Notably, the statements by B.1, E.2, F.1 and F.2 indicate a heavy workload and pressure caused by shop floor issues. Their high capacity utilisation limits the engagement with topics other than internal plant ones. Limitation in resources was one frequently mentioned explanation by plant leaders for why they were not able turn towards the field of inter-plant exchange (Wiech & Friedli, 2020). For example, F.2 emphasises that additional resources are required to ease his overloaded situation (see Table 12): "if you want it [inter-plant exchange] to be lived and sustaining, then you need to provide resources" (translated, F.2) (Wiech & Friedli, 2020).

F.2 demanded sufficient resources on plant level as a premise for efficient and sustainable inter-plant exchange. Many plants were under fierce cost pressure (e.g., E.1, E.2) or highly loaded (e.g., F.2) and therefore, headcount was at a minimum. This scarcity of resources might be an explanation for the plant leaders' overload and their inability to focus on additional topics like inter-plant exchange.

Besides lack of time and insufficient resources to cope with the workload, the interviewed plant leaders also mentioned another aspect with regard to their focus. Both F.1 and F.2 explained that exchange with their North American counterparts is practically non-existent due to a lack of overlap in products and customers (see Table 12). Similarly, G.1 perceived a clear differentiation from other plants of the same firm (see Table 12) and therefore focused on his business. In contrast to the first aspect of exclusive focus on the own operation due to overload, these statements do not imply a *cannot* or *overload attitude*. Instead, it reflects a deliberate focus on the own plant. Based on arguments like heterogeneity (see Chapter 3.3.6), these plant leaders reason their reservation towards the engagement in inter-plant exchange. Chapter 3.3.4 is devoted to this aspect.

Not all interviewees had an internal focus. D.1 stated that he spends about 50% of his time on local topics and the remaining 50% on network-related issues and inter-plant exchange.

[34] The plant leader referred to the situation under the ruling of his predecessor. Formerly, the plant was a "Gallic village" within the manufacturing network.

D.1 indicated that the situational context, (i.e., the high capabilities located at his plant), allows for him to also consider the network.

Table 12: Statements about plant leader focus[35] (adapted from Wiech & Friedli, 2020)

#	Focus & Reason	Statement
B.1	• Local • Overload	"People are busy with local problems. In the end, the shirt is nearer than the trousers. This means such topics fade into the background."
C.1	• Local • Mission	"… it is the first step to align the organisation, with regard to responsibilities, so that the plant network becomes the focus of attention."
E.1	• Local • Mission	Network topics are not in the centre of attention. Our plant in Serbia is focused on cost-efficient production, namely for labour intense processes.
E.2	• Local • Mission	We are focused on low-cost production; we cannot always deal with some projects from the head office. Of course, we take care of our employees, their safety and the environment with adherence to all statutory regulations.
F.1	• Local • Overload	We are in a unique situation. For two years, we had strong divisional growth. I estimate 15-20% per annum. Hence, in order to cope with this immense growth, our focus is course mainly on the operations **Question**: That means, inter-plant exchange is currently not the most important topics to you, instead you focus on your daily operations business? **Answer**: Yes!
F.1	• Local • Heterogeneity	And the focus [of foreign plants] is directly on the local customers.
F.2	• Local • Overload	I think everyone has its own topics, which is what you focus on.
F.2	• Local • Overload	On the other side, you have to know we are completely overloaded. We have many challenges in our plant, and if you want it [inter-plant exchange] to be lived and sustaining, then you need to provide resources.
F.2	• Local • Overload	Yes, our focus is on the daily business and also on achieving our budget goals. It takes a lot of energy to keep a plant running.
G.1	• Local • Heterogeneity	**Question:** There is no exchange with other plants beyond the division? **Answer:** Yes, because we focus on production of electronics… I do not interfere with the other networks.[36] It is not my business.
I.1	• Local	And today, I am simply fully focused on here [the plant]. Sometimes it would be nicer to see the other plants and their status…

As shown in Table 12, several interviewees alluded to the notion of not being focused on network exchange due to their plant's mission. E.2 and F.2 felt, due to their plant's strategic objective to provide low-cost production for the firm, less compelled to engage in inter-

[35] Illustrative examples, translation based on interviews in German language.
[36] The interviewee underlined that there is exchange on a high divisional level.

plant exchange. Though plants with a low-cost mission typically do not hold many capabilities relevant to other network units (Demeter and Szász, 2016), their openness towards inter-plant exchange is vital for network success, for example, by seeking innovative solutions or support from other network units or by providing production workforce to overloaded factories of the network. These findings point out that plant roles can serve as an excuse for internal focus and thus limit inter-plant exchange.

3.3.4 Network Mission and Strategy

"The fish rots from the head down. If the management does not clearly state what it wants, in a sense: I want cooperation, transparency, and exchange. Then you rather have a competitive situation." (translated, H.1) (Wiech & Friedli, 2020)

The statement above illustrates another critical barrier to inter-plant exchange. One-quarter of the interviewed plant leaders mentioned that the lack of a clear vision for the network and lack of openly communicated expectations regarding the involvement of plant management are reasons for not engaging in inter-plant exchange. One interviewee outlined that organisational alignment is the first step and that network management needs to accentuate network thinking ahead of inter-plant competition through formulating a network strategy: "…it is the first step to align the organisation, with regard to responsibilities, so that the plant network becomes the focus of attention"(translated, C.1).

A manufacturing network mission or strategy depicts the overriding network objectives (see Chapter 2.3). It creates transparency about the objectives that a firm wants to achieve with its network operation (e.g., Friedli et al., 2014; Thomas et al., 2015). However, many firms are not even aware of the potential benefits that an IMN offers, nor do they systematically manage their network or define and communicate a network mission (Friedli et al., 2014). B.1 observes that it is much easier to create sympathy for intra-network exchange in all plants if the central network management devotes itself to this topic.

The following statement also indicates that the communication of general-network objectives is vital to clarify expectations and thus, achieve cooperation between plants: "If expectations are clear. One has to contribute to the network. People are intelligent enough to do so" (translated, H.1) (Wiech & Friedli, 2020) .

G.1 and I.1 especially, who regularly cope with production transfers of lines that have been ramped up in their facilities, stated that it is essential to create transparency about the network goals in order to understand the big picture. Namely, to motivate and persuade their employees in performing relocations and supporting other plants. G.1 underpinned the need to be transparent about any delegated exchange from network management. If he gets the order to send someone to another plant, he will act supportive as long as he understands the reason and feels that it is important for the whole firm: "To know what you do and why you do it. This leads to support by everyone and that people pull together" (translated, G.1) (Wiech & Friedli, 2020).

Overall, the interviews show that plant leaders are supervised supervisors (Smith et al., 2009, p. 430), and therefore are aware of the general management challenge of motivating and persuading people. Thus, plant leaders expect a similar degree of clarity and transparency from the management level above. Therefore, the interviewed plant leaders point to a rather fundamental finding that another OM scholar summarises as follows:

> "Deploying policies throughout the company and developing a shared vision or mission can help focus the employees of a company and support the achievement of strategic goals." (Voss, 1995, p. 7)

This section has shown that the lack of a clearly defined and communicated network mission impedes inter-plant exchange.

3.3.5 Lack of Centralism and Excessive Centralism

"... my attitude is: if the pull comes from the foreign plant, they want to have something and can make use of it, then clearly it will not be blocked!" (translated, I.1) (Wiech & Friedli, 2020)

A recurrent theme in the interviews was a sense amongst interviewees that too much centralism (i.e., a central unit that forces the plant leaders to participate in inter-plant exchange) could be counterproductive. This view surfaced mainly in relation to supporting other plants for ad-hoc problem-solving. However, concerning regular exchange between plants, the informants mainly appreciated intervention and steering by central network management. The divergent opinions were linked to two questions: (1) who initiates, and (2) what triggers the exchange.

As shown in Table 13, the interviewees differentiated between requests from other plants (i.e., the initiative for exchange comes from the plant level) and requests that are imposed by central network management. Some interviewees refer to the first as pull (A.1, E.2, H.2 and I.1), whereas the central initiative can be described as a push towards exchange. This differentiation complements the existing IMN knowledge base. Scholars fall short of reality by assuming "that it does not matter who asks a sending plant to transfer its knowledge" (Scherrer & Deflorin, 2017b, p. 414). The interviews also point to four different starting points (i.e., triggers) for inter-plant exchange – (1) material flows, (2) production transfers, (3) ad-hoc problems, and (4) regular knowledge exchange.

Table 13: Statements about initiation and triggers of inter-plant exchange[37]

#	Initiator & Trigger	Statement
B.1	• Central • Material flows • Regular exchange	"For one thing, expert meetings but also plant leader meetings. Basically, what I set myself as an individual goal. However, the organisation of it would be better off in central hands."
D.1	• Plant • Ad-hoc	"…or if there is one to one exchange, it is mostly about support. For example, last week I got a request from China, they had a problem with their production and somehow needed support."
G.1	• Central • Production transfer	"We transfer 3-4% of our growth to x[38] every year. That is totally normal for the employees."
H.1	• Central • Plant • Regular • Ad-hoc	"It is one of the main tasks of the lead plant, also to support and foster exchange among each other. It does not fall into place on its own."
I.1	• Plant • Ad-hoc	"…if problems occur we do short-term assignments. We send somebody, situational, depending on the problem. Clearly, if something is imposed that he [plant leader] does not see himself, then for sure it is much more complicated than if the plant requests it."

Material Flows:

First, some informants identified value streams across plants as triggers for inter-plant exchange, namely for information and knowledge. The example *Self-Organised Exchange* presented in Chapter 3.3.2 suggests that consecutive production steps distributed among different plants evoke a natural interest and need for exchange. Similarly, A.1 mentioned that exchange with an upstream plant was triggered by supply-related topics. B.1 emphasised that quality topics and process knowledge were the main content of inter-plant exchange with another facility, which was located up- and downstream at the same time (see Chapter 3.3.2). Furthermore, D.1 and H.2 explained that material and supply relations with upstream plants triggered exchange without specifying the content of it. However, due to the low number of statements, only limited conclusions can be drawn on the initiation of this material-flow related exchange. The example of B.1 shows that if this relation is not initiated and organised by a central authority, there is a high risk that it stops if the plant management team changes. A.1 also noticed a positive effect of central management involvement in getting this material-related exchange of information and knowledge started. Overall, as only few interviewees discussed the material flow-induced exchange, an

[37] Illustrative examples, translation based on interviews in German language.
[38] Anonymised.

apparent barrier with regard to the initiator cannot be determined. However, it seems that this kind of inter-plant exchange benefits from a central initiation.

Transfer of Production:

Second, transfer of production is a frequently mentioned trigger for intense exchange between plants (B.1, E.1, G.1, H.1, H.2 and I.1). Regardless of whether the equipment is transferred from one plant to another or an additional production line is set up without physical transfer of machines, such cross-plant projects entail an intense exchange of knowledge between the receiving and sending plants. The statement by I.1 below emphasises that such transfer implies a far more significant than average plant to plant exchange: "It is clear if we set up a new production line in Asia during the next two years, contact will be much more intense" (translated, I.1).

In general, decisions on the location of production and thus initiatives for transfer are not made by plant leaders, but central network management. Therefore, the question of who initiated this kind of exchange is less relevant. Nevertheless, reluctance to share knowledge and unwillingness to support the transfer by the host location have been described in literature about outsourcing (e.g., Bandyopadhyay and Pathak, 2007) or production relocation (e.g., Knudsen and Madsen, 2014). Furthermore, the knowledge sharing literature has also devoted some attention to this topic:

> "A knowledge source may be reluctant to share crucial knowledge for fear of losing ownership, a position of privilege, superiority; it may resent not being adequately rewarded for sharing hard won success; or it may be unwilling to devote time and resources to support the transfer." (Szulanski, 1996, p. 31)

E.1, as the leader of a mainly receiving plant, observed similar challenges as outlined by Szulanski (1996) for the parent facility in Austria. This facility has sent much knowledge and relocated many production lines to the site of E.1. On the contrary, G.1 and I.1, as plant leaders of sending plants, did not perceive a lacking motivation to engage in transfer projects for themselves, but observed minor reservations within their workforce. They saw it as part of their role at a high-cost location to ramp up production and transfer it to other plants: "We transfer 3-4% of our growth to x[39] every year. That is totally normal for the employees" (translated, G.1).

G.1 also points to the necessary personal attitude of the plant leader, who has to see the big picture and needs to accept the transfer of production lines and the build-up of knowledge in other plants. According to him, the issue is not in who initiated the transfer. These decisions are an initiative of central management. Several interviewees emphasised that

[39] Anonymised.

reasons and expected benefits have to be openly shared. Lack of clarity about the plant's mission and the plant leader's role results in insufficient conviction, and thus, constitutes a primary barrier for individuals in their support and promotion of inter-plant exchange (see Chapter 3.3.4).

Ad-Hoc Problem Solving:

Third, the question of who initiates the inter-plant exchange becomes more relevant after the transfer project. Often, the receiving plant cannot solve complex production issues and problems with the new equipment by themselves, at least at the beginning. In many cases, contributions of sending sites continue as ad-hoc support (e.g., B.1, G.1 and I.1). Even without a prior transfer project, operational problems are one of the primary triggers for inter-plant exchange (A.1, B.1, D.1, E.1, G.1, H.1, H.2 and I.1). The following statements emphasise how problems that cannot be solved by the employees of the receiving plant trigger at least communication between those seeking help and more competent units:

> "The intensity of cooperation or communication essentially depends on the kind of problems you have. In Japan, we had things under control. Therefore, I barely spoke to the people in [the German lead plant]." (translated, H.1)

Problems trigger the need for providing support and, thus, exchanging knowledge between network plants. Commonly, such requests are directly discussed between the plant leaders of the help-seeking and competent plants. However, the interviews of F.1, F.2, C.1 and I.1 showed that central authorities (i.e., network management) tend to get involved and mandate a plant with the task of supporting. A shared view amongst interviewees was that this involvement constitutes excessive centralism. Most of the interviewed plant leaders believe that pull from the plant in need is a better option in the context of ad-hoc support. First, the statement of D.1 points out that decision speed is a critical point, and direct communication between plant management accelerates the process (see Table 13). Furthermore, F.1 emphasises that the involvement of a central authority gives rise to political games that complicate the exchange relationship. He observed that central push bears the risk of creating reluctance in providing support for the plant in need. Conversely, I.1 mentioned the motivation and willingness of the receiving facility (see Table 13). Central management involvement may also create reluctance from the receiving site and, in general, make things "much more complicated than if the plant requests it" (translated I.1). However, I.1 sees a lack of target-orientation if the receiving sites do not face some consequences, even for pull initiatives:

> "…instead they [other plants] have to pay me for the employees… it has to hurt them a little, then hopefully they will benefit. If it was for free, virtually only a call – we have

to come, and it perishes somewhere in the apportionment. Then again, the benefit would also be questionable." (translated, I.1)

Regular Knowledge Exchange:

Most interviewees reported that centrally organised best-practice meetings as a form of regular knowledge exchange facilitated inter-plant-exchange (A.1, B.1, D.1, F.1, F.2, G.1, H.1 and H.2). They shared the unanimous opinion that organisation and initiation of best-practice exchange are in good hands with a central authority. This kind of exchange should not rely on the initiative of individual plant leaders. Even B.1, who himself initiated a regular knowledge exchange with a peer plant stated that such meetings are better off in the hands of a central authority (see Table 13). Others pointed out that this kind of exchange belongs in the responsibilities of the lead plant management (D.1, H.1 and H.2). The suggested role of the lead plant management as the organiser of the best-practice exchange comes with additional authority, similar to central network management.

According to A.1, plant-pull comes into play after the best-practice introduction (i.e., the regular exchange meeting). To make use of the inputs gathered from other plants, a powerful pull by each unit is required for implementing the ideas locally. For example, the plant of A.1 was among the first in the network to operate a worker-assistance system. He was willing to show and explain this feature in detail to all interested plants that asked for an introduction. Nevertheless, he emphasised that best-practice exchange meetings formed the basis for spreading the word about this idea and intriguing other plant leaders. Therefore, it can be concluded that the lack of centrally orchestrated best-practice and continuous improvements exchange hinders the cross-plant knowledge flows.

In summary, various triggers and two distinct initiation-levels for inter-plant exchange emerged from the interviews. Lack of centralism constitutes an impediment for most triggers. However, the plant leaders also perceived a high degree of centralism as an impediment for ad-hoc problem-solving exchange. The plant leaders' statements suggest that whomever is asking for knowledge or support plays a quite critical role. This finding is contrary to previous studies, which neglect this aspect (e.g., Scherrer & Deflorin, 2017b). Furthermore, the plant-leader perspective provides a differentiated picture of the discussion about autonomy in the context of IMNs (see Chapter 2.6.5). It introduces decision-making dimensions that have not yet been considered in the context of autonomy distribution between plant and network level (e.g., Olhager & Feldmann, 2018).

3.3.6 Heterogeneity and Lack of Plant Overlap

"I can rule out language and culture. It [the lack of inter-plant exchange] is simply due to different lines of business and the focus directly on the local customer's premises."

(translated, F.1) (Wiech & Friedli, 2020)

A majority of the interviewed plant leaders, about three-quarters of the sample, indicated that lack of homogeneity among plants constitutes a fundamental barrier for inter-plant exchange (Wiech & Friedli, 2020). As shown in Table 14, the conducted interviews suggest that the lack of overlap between manufacturing facilities with regard to four broad themes can present an impediment for exchange between plants. The plant leaders pointed to positive effects of several similarities between plants. Several of the interviewees explicitly stated that lack of overlap is a reason for limited or non-existent exchange with other plants of the network (A.1, B.1, D.1, F.1 and G.1). A mutual view among the plant leaders was that only those plants that share specific characteristics could derive benefits, and thus have a reason for exchange. This finding concurs with previous IMN literature (Ferdows et al., 2016; Scherrer & Deflorin, 2017b).

Table 14: Statements about hetero- and homogeneity between plants[40] (adapted from Wiech & Friedli, 2020)

#	Similarity	Statement
A.1	• Location	"It [inter-plant exchange] does not necessarily depend on the geographical location."
B.1	• Products	"This is material-related, the product types that the other plants produce differ so much in the requirements and handling that there are obviously not so many synergies."
D.1	• Location • Markets • Products • Processes	"…I think, as I said, different markets, different cultures and different machine parks and production lines. In America, for example, now we have a similar product to the one here. I also have regular exchange with the American plant manager. Maybe it is also a little bit culturally related. Yes, I believe, especially for North- and South-America. They are closer to each other."
D.1	• Products • Location	"Although we produce similar products as the South-American plants, we seldom have any exchange. Typically, you have a lot more to do with the; I say, neighbours… but then you can have projects or topics with other plants."
F.1	• Location • Markets	"I can rule out language and culture. It [the lack of inter-plant exchange] is simply due to different lines of business and the focus directly on the local customer's premises."
F.2	• Products • Processes	"The products are different. The technologies and challenges are very similar."
G.1	• Markets	"…we focus on production of electronics… I do not interfere with the other networks. It is none of my business."
H.1	• Products • Processes	"Basically, we manufacture similar products. Therefore, the sequence in milling and drilling is very similar. Thus, it makes sense to occasionally exchange about what is happening or about what others have improved."

[40] Illustrative examples, translation based on interviews in German language.

First, the theme of market or business similarity recurred throughout the dataset. Different market or business focus implies differences in products and processes. This topic occurs mainly in larger firms with different business segments. The interviewees indicated that they perceive benefits of exchange only between "plants with same strategic orientation" (Scherrer & Deflorin, 2017b, p. 413). They outlined that in networks with plants each producing for different business segments, the similarity and overlaps are naturally limited, and thus, the exchange will be limited.
Second, even if plants produce for similar business segments, the plant leaders explained that commonality between the product portfolios of individual plants is an essential prerequisite for inter-plant exchange (see Table 14). The statements by D.1 and H.1 (see Table 14) highlight that similarity in products and processes between plants elicits a positive perception of exchange opportunities. A majority of the informants expressed product overlap as facilitators for exchange (A.1, B.1, D.1, E.1, E.2, F.2, H.1 and H.2). For example, E.1 and E.2 explained that product similarity with the parent plant is an important factor for explaining why there is such a close relationship. Also, the material flow-induced exchange in the examples of A.1 and B.1 underlined that similarity or overlap in products not only facilitates, but triggers inter-plant exchange. The findings on product similarity confirm the following propositions:

> "Knowledge-sending and knowledge-receiving plants that produce similar product portfolios are more willing to exchange knowledge than those that produce different product portfolios." (Scherrer & Deflorin, 2017b, p. 413)

Third, the interviewees agreed that exchange opportunities arise from different plants applying the same or similar processes or manufacturing technologies (see Table 14). In other words, the lack of overlap in processes between individual plants also limits the exchange between the network units. The shared view of the interviewees on processes heterogeneity as a barrier to inter-plant exchange confirms the following propositions:

> "Knowledge-sending and knowledge-receiving plants that follow similar processes are more willing to exchange knowledge than those that follow different processes." (Scherrer & Deflorin, 2017b, p. 413)

Fourth, two divergent discourses emerged about the effect of different locations (i.e., geographic and cultural distance). The statement of F.1 presented in Table 14 neglects the existence of cultural or language barriers for firm F itself. Other interviewees mentioned these factors explicitly as impediments for inter-plant exchange (C.1, D.1, F.2, H.1, H.2 and I.1). In order to cope with cultural effects on intra-network exchange, H.2 mentioned that it could be advantageous to have plant leaders with similar cultural background within the plants. According to him, it helps create personal ties across plants (see Chapter 3.3.6) and foster inter-plant exchange.

Furthermore, some interviewees (but not all) also took a position on the effect of distance on inter-plant exchange (see Table 14). Some stated that they have more interaction with closer plants, whereas other did not agree with the statement (see Table 14). Although the interviewees did not provide an unambiguous perception of geographic proximity or cultural factors, a minor effect was expressed by at least some plant leaders. As such, these findings differ from published evidence on the irrelevance of regional proximity on inter-plant knowledge transfer (Scherrer & Deflorin, 2017b), but correspond with earlier studies by Foss et al. (2010) and Tseng (2015). They focused on the knowledge transfer dimension, but find regional proximity to be relevant. However, the plant leader statements regarding the effects of heterogeneity in IMNs indicate that similarity of products and processes play a more dominant role than cultural topics or distance between facilities. While the interviewees do not share a unanimous view on culture or distance, they more or less agree that lack of similarity in product and processes is a barrier for inter-plant exchange. Overall, these findings confirm early IMN research that underpins the need to cluster similar plants in subnetworks (Ferdows et al., 2016; Scherrer & Deflorin, 2017b).

3.3.7 Lack of Individual-Level Ties and Missing Transparency

"I think this personal contact is priceless. Without, it is simply more difficult."

(translated, D.1) (Wiech & Friedli, 2020)

As stated in the publication by Wiech & Friedli, 2020, it was a sense amongst the plant leaders that individual-level ties with other plant leaders are essential for facilitating inter-plant exchange. Furthermore, the plant leader interviews pointed to a lack of transparency between plants. This section presents the findings on individual-level ties, and motivates the next section, which looks into the impeding character of missing transparency.

Table 15 provides several exemplary statements of the interviewed plant leaders on individual-level ties. A majority agreed that the individual-level ties are helpful. For one, the statements indicate that the motivational disposition to share and acquire knowledge (Gupta & Govindarajan, 2000a) or any form of support is much higher if the exchange between units is initiated by plant leaders who know each other. A majority of the informants saw the advantages namely for ad-hoc problem solving (C.1, D.1, E.2, F.1, F.2, H.1 and H.2.). E.2 and C.1 stated that having a direct line to another plant leader simplifies and accelerates support requests and problem-solving. One interviewee also alluded to the fact that he values personal exchange with other plant leaders to get feedback and coaching. He explained that this kind of exchange is particularly useful for younger plant leaders, who can benefit from the experience of their colleagues:

"Then, of course, there is always the question of whom I get along with and with those; I have calls from time to time. I think it is very dependent on people and from whom I want feedback. Meaning, whom I value and if I ask them 'How do you see that'? – Whose opinion am I interested in." (translated, A.1) (Wiech & Friedli, 2020)

Table 15: Statements on individual ties[41] (Wiech & Friedli, 2020)

#	Effect of individual-level ties	Statement
B.1	• Creates transparency • Facilitates plant-level exchange	"Then we had a bigger quality issue, for which I also travelled to the US and visited the factory. Since then, the exchange has simply been much stronger. Before, there was already a telephone exchange for the quality topic. However, at the end of the day, it was my visit to the US and the fact that we then knew each other - since then the exchange has become much easier and much more intense."
D.1	• Facilitates plant-level exchange	"I think this personal contact is priceless. Without, it is simply more difficult."
D.1	• Creates transparency • Facilitates plant-level exchange	"It also refers to the fact that you typically know those plants better and that you can classify them much better. If someone has a problem, then he usually searches mostly, not mostly, but in many cases, you first search your own front door and look for your own solutions and probably ask too little then the other plant managers."
D.1	• Facilitates plant-level exchange	"I do not think we are getting enough out of this. If someone has a problem then he usually searches mostly, not mostly, but in many cases you first search your own front door and look for your own solutions and probably ask too little then the other plant managers."
F.1	• Creates transparency	"The search barrier, yes, that's certainly an issue. That one quickly finds things that others may have already dealt with and you just do not find it.
H.1	• Facilitates plant-level exchange	"That is actually almost the ultimate basis for cooperation. In other words, if you do not know your colleagues, you always have a hard time. If you have ever experienced a crisis with your colleagues and you all got along well, it is very simple."
H.2	• Facilitates plant-level exchange	"It is the idea that you can also coordinate more closely and in case of escalation you can actually help each other."

Numerous studies that are mainly focused on the transfer of knowledge confirm the supportive characteristic of individual-level relations between the involved actors (e.g., Gooderham et al., 2010; Gupta & Govindarajan, 2000a). In the domain of IMN, two recent studies confirm the finding that lacking personal ties impedes inter-plant exchange (Scherrer & Deflorin, 2017b; Szász et al., 2019). For managerial practice, they highlight that "creating

[41] Illustrative examples, translation based on interviews in German language.

the possibilities for social interaction between employees between peer plants is of utmost importance" (Szász et al., 2019, p. 302).

Another recurring theme in the interviews was that personal ties create transparency (i.e., knowledge about the capabilities and help in understanding the situation of other facilities). According to D.1, personal contact with other plant leaders also eases the classification of other facilities, namely concerning their capabilities (see Table 15). Clarity about the capabilities of other plants is crucial for plant leaders in order to fulfil their role in building bridges between experts from their own facility and counterparts from other manufacturing units (e.g., Abdullah & Liang, 2013). Furthermore, transparency is particularly needed if problems occur and plant leaders are in search of solutions. The statements below highlight that plant management can find such solutions by approaching their colleges, who have potentially already dealt with similar topics in their plants:

> "I do not think we are getting enough out of this. If someone has a problem, then he usually searches mostly, not mostly, but in many cases, you first search your own front door and look for your own solutions and probably ask too little then the other plant managers." (translated, D.1)

> "That one quickly finds things that others may have already dealt with, and you just do not find it. That is in our size certainly a topic." (translated, F.1)

> "If we [the whole firm] knew what we know, then we would already be one big step ahead." (translated, A.1)

The last statement refers to the fundamentals of intra-organisational knowledge exchange, which a seminal study puts into a nutshell by asking "why organizations do not know what they now" (Szulanski, 1996, p. 38). The plant leaders' interviews provide no comprehensive answer, but the interviews indicate that the lack of transparency and individual-level ties also contribute to this intra-organisational challenge.

It is relevant to know who might have experience and expertise to help, especially for leaders of receiving plants that require ad-hoc support or general expert knowledge. Indeed, the individual plant leader's experience within the firm and how well the plant leader is connected across the network can help to reduce this issue. For example, at the time of the interview, E.1 had been working as a plant leader for less than a year. As such, he emphasised that he was still building up individual-level ties and knowledge about other plants. In contrast, F.2 and G.1 underlined that their long-term affiliations equip them to identify and approach the right people throughout the firm:

> "… the managers who have been with the company for a long time know which specialists are located in which divisions." (translated, F.2)

> "… through 26 years of affiliation, I know exactly how the firm works and whom to approach." (translated, G.1)

In addition to information about the capabilities of other plants, the interviewees also pointed out that inter-plant transparency is a prerequisite for supporting other plants proactively. Eight plant leaders expressed a desire for more transparency in their regular information exchange (B.1, C.1, F.1, F.2, G.1, H.1, H.2 and I.1). According to I.1, information about the current situation of other plants would foster proactive support, especially in situations where the plant in need does not request help:

> "If somebody does not ask, I cannot taste it. It is not like we are extremely active in approaching them [other plants]…. especially during ramp-up of course, if key figures are exchanged on a regular basis. If there are fluctuations, then, of course, we can ask: where do you have a problem?" (translated, I.1)

Both I.1 and F.2 underlined that nobody likes to admit problems, especially if the executive management attends the information exchange. Therefore, many refrain from openly reporting their problems. They also pointed out that this transparency can trigger help from other plants and thus contribute to efficacious problem-solving. The plant leader interviews suggest enhancing transparency through the regular exchange of figures that depict the current situation in the facility among all plants.
Taken together, the plant leader interviews indicate two transparency dimensions that refer to the question of who is in need or to the question of whom to approach if a plant is in need. The following two dimensions were outlined by the plant leaders:

1. Current plant challenges and situation (Who is in need?)
2. General plant competences and capabilities (Whom to approach?)

In summary, this section has discussed the plant leaders' perception of individual-level ties and inter-plant transparency. The latter is of utmost importance for plant leaders in order to know whom to approach when in need and to know who is in need. The individual-level ties between plant leaders contribute to inter-plant transparency. Furthermore, the section has shown that personal contact between plant leaders is a prerequisite to facilitating plant-level exchange.

3.3.8 False Incentives

"Neither data nor information will be exchanged. Everyone tries to look as good as possible, and that is a situation, from my point of view, that exchange will be limited to almost zero." (translated, H.1) (Wiech & Friedli, 2020)

The statement above reflects the view amongst several interviewees that competition between plants in the network impedes exchange and cooperation. In particular, plant-level incentives for individuals were identified as a central reason for walling up behaviour, and concerns were expressed about plant leader colleagues pursuing local objectives at the expense of other network units. Research on MNC has identified incentives as one important mechanism for managing the degree of competition and cooperation between subsidiaries (Luo, 2005).

Before a discussion of the perceived effects in the context of IMNs, the following paragraph briefly introduces the incentive-levels applied by the interviewees' employers. Target agreements of the identified plant leaders were linked to four different levels at the time of the interviews:[42]

1. *Individual-level:* Remuneration linked to the individual performance of the plant. For example, the bonus relevant objectives of G.1 include a soft target about the cooperation with the peer plant, which is, according to the informant, challenging to measure. Mentioned by B.1, G.1 and I.1.
2. *Plant-level:* Plant leader bonus is a function of operative plant performance. As the statement below underlines, these targets are typically linked to operative KPIs: "normally the classic performance of my plant. Failure cost, safety at work, which means local topics" (translated, B.1).
   Mentioned by A.1, B.1, E.1, E.2, (F.1), (F.2), G.1, (H.1), (H.2) and I.1.[43]
3. *Network-level*: Plant leader bonus is a function of network performance KPIs. For example, aggregated stock of multiple plants. Mentioned by (A.1), B.1, E.1 and E.2.[44]
4. *Firm-level*: Plant leader bonus is linked to corporate level success. Typically based on aggregated business performance KPIs (e.g., EBIT): "It means: today a plant manager has a bonus which essentially depends on the goal achievement of the entire company, of the division and the business unit" (translated, F.1). Mentioned by C.1, D.1, F.1, F.2, H.1, H.2 and I.1.

Overall, several of the interviewed plant leaders had multiple targets linked to different levels. Nevertheless, most plant leaders were incentivised by local plant objectives. Only a few firms from the sample set network-level objectives. This is surprising since the idea for shared objectives is not new (Gupta & Govindarajan, 1991). Furthermore, Liebetrau (2015) suggested aggregating operational KPIs of plants to measure network performance.

[42] The remuneration system was redesigned soon after the interviews, at least in two firms of the sample.
[43] In parentheses: not relevant for financial remuneration.
[44] In parentheses: not relevant for financial remuneration.

Table 16: Statements on the effect of incentives[45] (adapted from Wiech & Friedli, 2020)

#	Basis for incentive & effects	Statement
A.1	• Plant-level • No effect	"Overall, I am only evaluated by KPIs on plant level....[46] I can only speak for myself. I do not really care what the target agreement says. I do what makes sense and where I am convinced that the company will benefit!"
B.1	• Plant-level	"… the classic performance of my plant. Failure cost, safety at work, which means local topics."[47]
B.1	• Network-level • Facilitates cooperation	"We shared common failure costs… so yes, it is meaningful and motivates, and we need that."
F.2	• Plant-level • Hinders cooperation	"I've already seen people chasing after just one bonus target instead of focusing on the target, which is critical to the company… I came from a company with a bonus system, and that was not supportive, but rather obstructive."
F.2	• No effect	"And I have to tell you quite honestly that I do not even know in detail what the targets are. That is not relevant to me. I have to do my job; I have to make sure that my plant is running."[48]
G.1	• No effect	"I do that because I am convinced that it is right…. Incentives are important, but for me, it is nothing driving."
H.1	• Network-level or business-segment • Facilitates cooperation	"… we have common goals, and we try to achieve them together."
H.1	• Individual-level • Hinders cooperation	"Before, when it was not like this, some plant managers tried everything to reach their individual goals. Also, at the expense of others."

As shown in Table 16, plant leaders perceived some of the incentives as obstructive to inter-plant exchange. Wiech & Friedli, 2020 find that although incentives are "particularly imperative to promoting and fostering internal competition among foreign subunits" (Luo, 2005, p. 86), several plant leaders ignored the intention of these incentives. As it can be seen in Table 16, obout one-third does not pay particular attention to these incentives. In other words, decisions of their day-to-day business are not affected by any target agreements (Wiech & Friedli, 2020). Furthermore, concerns about the effectiveness of incentives, in general, were expressed by several plant leaders (A.1, G.1, F.2 and H.2). One interviewee pointed out the fundamental issue of incentives that only reward actions with short-term

[45] Illustrative examples, translation based on interviews in German language.
[46] At the moment of the interview. Soon after the interviews, the incentive system has changed in the firm.
[47] At the moment of the interview. Soon after the interviews, the incentive system has changed in the firm.
[48] The interviewee emphasised in a second call, that his statement should not be misunderstood. Every year he discusses his targets with his boss, however, these objectives do not alter his decisions in daily business.

effects: "… you do not see the effect of your actions in the immediate period thereafter, i.e. in the incentive relevant period, but sometimes it takes two or three years" (translated, H.2) (Wiech & Friedli, 2020). This concern is particularly relevant in the context of manufacturing. Massive wins and shortcuts are rare for operations in which incremental optimisation has been the daily business for decades. Therefore, the statement above raises the valid question for network management of whether the short-term nature of incentives can even create the desired behaviour or whether it constitutes a barrier to the intended outcome.

Another recurring view amongst interviewees was that high-level corporate performance indicators, like EBIT, are a rather weak incentive. One concern expressed was the disbelief that their actions have a significant influence on these high-level indicators. F.2 explains that any market-related performance indicator is hardly affected by his actions and therefore should not be considered as an incentive for plant leaders. Furthermore, the statement below underlines how one plant leader scrutinises the effects:

> "… I do not know whether it really changes the way of thinking, everyone can judge themselves to provide support or not…. The question is always how much influence do I have on this figure? Yes, it might help to create a 'We-Feeling'. However, I would say, the further down [hierarchically] you are, the less influence you have." (translated, D.1) (Wiech & Friedli, 2020)

Since the plant of D.1 generates a relatively high share of the Business Unit (BU) revenue, he states that incentives based on the success of the BU are much more motivating:

> "… we make up a very large portion of whether things are going well or badly. Therefore, we have much more impact [on the BU success compared to overall corporate] and I can identify myself with these objectives." (translated, D.1)

The statement above underlines that identification with objectives increases if plant leaders perceive that they can make a difference. Eventually, it appears that incentives linked to the corporate level do not provide a strong motivation for all plant leaders to engage in inter-plant exchange, and especially not for smaller plants with a low output. However, it also appears that these incentives do not pose a barrier to inter-plant exchange.

Shared goals among a limited number of peer plants seem to have more impact on the plant leaders' actions. The experiences of A.1, B.1 and E.2 indicate that such incentives can actually create personal ties between plant leaders and also enhance the cooperation between affected plants (see Table 16). The plant leader statements confirm that "the unit managers' motivation to engage in interunit cooperation is likely to be greater when their incentives are tied to the performance of the cluster of units as a whole" (Gupta & Govindarajan, 1991, p. 781). However, one interviewee also highlights the downside of shared objectives:

> "… a massive recall tore down the quality KPI and thus the bonus for the whole business line…. the other 50 people were all pretty upset because the special trip to wherever it is going was cancelled due to the failed KPI. People turn up their noses according and say: just because of you." (translated, H.2)

The experience of H.2 indicates that instead of fostering cooperation and inter-plant exchange, shared incentives between multiple plants can easily cause finger-pointing and a rather destructive climate. As such, the interviews draw an unambiguous picture. Network-level objectives can facilitate inter-plant exchange, but such incentives also hold the risk to hinder inter-plant exchange.

The topic of plant-level objectives received broader consent among the interviewees. As shown in Table 16, many plant leaders perceive that plant-level based remuneration impedes inter-plant exchange. Incentives based on operational plant performance seem to limit the willingness to cooperate across plant boundaries. Plant leaders that provide knowledge and problem-solving capabilities to the network particularly face a dilemma. If the bonus is only linked to operative plant performance, their cooperative behaviour poses a risk to the target achievement, as shown in the following statement:

> "If the plant manager has to deploy his permanent staff for two weeks, he can hope to get money for it. However, people do nothing for the plant during that time. They do not work on their projects. That means he as a disadvantage for the time being. And that is a question of how much altruism someone brings along and accepts that." (translated, H.1)

Though the majority of plant leaders reflected critically on incentives based on local plant performance, more than half of them still received their bonuses that way. The apparently common practice in many IMNs of applying plant-level incentives impedes inter-plant exchange and thus limits the potential benefits that could be obtained through a cooperative manufacturing network (Wiech & Friedli, 2020).

Overall, the plant leaders' perspective on incentives underlines how IMN coordination mechanisms that target the micro level have implications for inter-plant exchange. As such, this section confirms the finding of a recent study on knowledge flows in IMNs, which concluded that well-designed incentive systems could support cross-plant knowledge sharing (Szász et al., 2019). To put it another way: a bad-designed incentive system can impede inter-plant exchange.

The plant leaders' perspective points to the downside of plant-focused incentives, which are at odds with providing support to other facilities. Selected examples of shared objectives between plants seem to foster cooperation among them, but the motivational effect of these shared objectives decreases as they become more abstract. Taken together, the plant leader perspective reveals that there is more to lose than to win when designing an incentive system to facilitate inter-plant exchange. While network management can easily impede inter-plant exchange, it is less clear how to design the incentive system in order to foster inter-plant exchange.

3.3.9 Mind-Set and Career Path

"It [engagement in inter-plant exchange] works well because my attitude is different - my personal attitude." (translated, G.1)

A recurrent theme in the interviews was a sense amongst interviewees that the plant leader job asks for a specific type of individuals. The majority of the informants agreed that their conduct strongly influences the attitude of their subordinates towards inter-plant exchange. Many interviewees reported that common collaboration barriers like not-invented-here or hoarding (see Chapter 2.5) occur among their employees (B.1, C.1, D.1, E.1, G.1, F.2, H.1, H.2 and I.2). The interviewed plant leaders see themselves in an influential position or overcoming these barriers and shaping the general perception of inter-plant exchange among their employees.

> "If I were to be extremely negative towards it [supporting other plants] and talk badly about the other plants in front of my department manager or other employees. It would clearly have a negative impact... it would be fatal." (translated, I.1)

> "… I would say: First and foremost, it is the plant leader who guides the direction [of employees in the plant]. They are on top; they guide the way. If they request and live openness and teamwork, it is something different if they start bunkering or silo thinking." (translated, F.2) (Wiech & Friedli, 2020)

Another informant exemplified the importance of filling the plant leader's position with suitable people. He reported on his previous assignment; there, the exchange began to evolve only after a replacement of his counterpart in the peer plant. Before, he was not able to create a cooperative relationship with the peer plant. Any inter-plant exchange was blighted by the other plant leader's attitude. This example highlights that network management needs to carefully select individuals for the plant leader job, or they might create a significant barrier to inter-plant exchange and cooperation among network units. Accordingly, one interviewee describes the mindset that he regards as suitable for a plant leader: "We need people with a certain mindset who share information without expecting money or any kind of incentive" (translated, H.1).

In addition to general statements about the necessary mindset, some interviewees referred to the career paths of plant leaders as a vital theme in the context of openness towards inter-plant exchange (G.1, H.1, H.2 and I.1). They recognise the risk that career-focused people see the plant leader position as a short-term assignment to prove him or herself and qualify for a higher corporate position. This career-driven attitude of a plant leader is also described by Walder (1989):

> "One manager spoke to me about his career and his factory. He had been in his current job for a short time, but he was already thinking ahead to the time when he would leave the factory and move up in the bureau hierarchy. He wanted his period in office to be remembered fondly by his colleagues, especially by his subordinates." (Walder, 1989, p. 249)

Several interviewees alluded to the problem of short-term plant optimisations, which support the individual career at the expense of other network entities (G.1, H.1, H.2 and I.1). This kind of behaviour is enforced by the promotion of standardised career paths, in which the plant leader position is seen as an intermediate step. Although an overwhelming majority of all interviewees disagreed that there is a typical plant leader career encompassing foreseeable steps in their firm, they observe mainly two potential subsequent assignments. Either plant leaders move up in the hierarchy and take over a function within corporate operations (e.g., H.1) or they are assigned to other plants, presumably more complex ones. The sample entails one interesting exception of a plant leader who was responsible for the same plant for 20 years.

Overall, the plant leader perception is that this job should not be seen as an intermediate career step. The statements indicate that if it is, then less sustainable short-term optimisation would be a common concern. The interviews indicate that central network management should carefully consider how to fill a plant leader vacancy. In order to foster inter-plant exchange, network management should select candidates with the right mindset.

3.4 Summary and Conclusion

This chapter has described the plant leaders' role as key decision-makers in IMNs and presented their perspective on inter-plant exchange. As such, the interviews with 12 plant leaders complement previous research findings with several topics that impede inter-plant exchange from a micro-level point of view.

Perhaps most compelling are two findings of this chapter. First, the results show that key decision-makers on the plant-level determine the engagement of their unit in inter-plant exchange. The interviewed plant leaders indicated that their doing so has a significant effect on the willingness and openness of their plant. This confirms the findings of Gupta and Govindarajan (1991), who referred to an MNC context in general. Second, the plant leaders also signalled that several IMN coordination mechanisms (see Chapter 2.6.5) could have a significant effect on their conduct, and thus, eventually determine the plants' bearing towards inter-plant exchange.

With regard to the underlying research theory (see Chapter 1.4), the previous sections provide significant implications for the understanding of how plant leaders assign their attentional focus. Figure 11 shows that plant leaders need to balance between the operation of their facility and the engagement in inter-plant exchange (see Chapter 3.3.2 and Chapter 3.3.3). The first task enjoys priority, and thus, only limited attentional capacity is devoted to inter-plant exchange. As other scholars pointed out, this work confirms that network management has to actively guide the attention of their plant leaders towards inter-plant exchange. Otherwise, plant management will most likely regard inter-plant exchange as "unnecessary or secondary to their jobs" (Luo, 2005, p. 86). Another problem regarding attentional capacity is the lack of resources on the plant level, which further induces the internal focus of plant leaders (see Chapter 3.3.3).

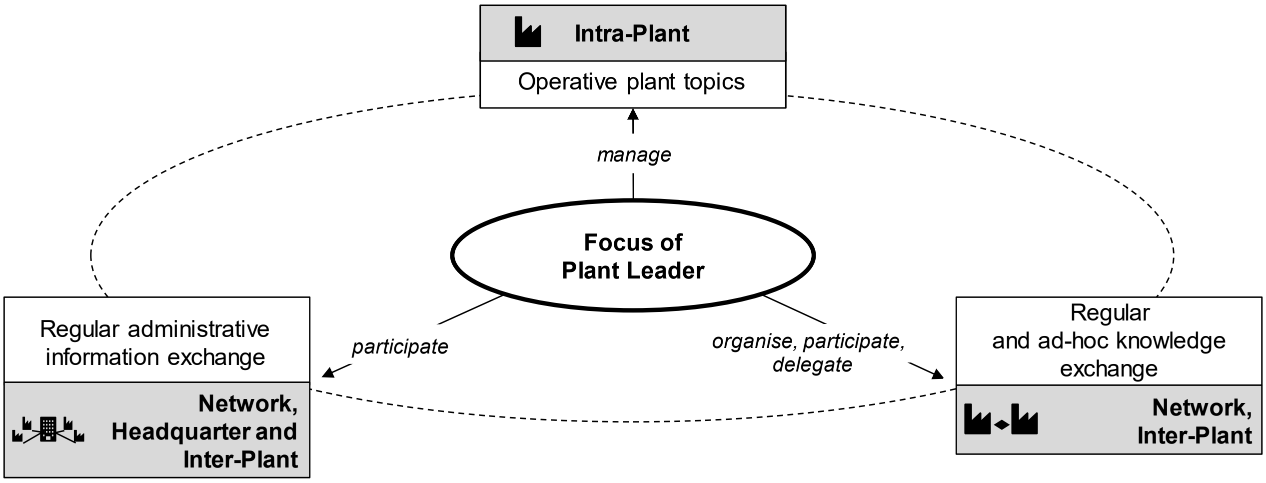


Figure 11: Trade of in plant leader focus

On the question of impediments to inter-plant exchange, this chapter found that IMNs without a network mission promoting internal learning across plant boundaries suffer from limited exchange. It is encouraging to compare this finding with another OM scholar who also outlined the importance of an openly communicated strategic mission "to focus the employees of a company and support the achievement of strategic goals." (Voss, 1995, p. 7). The analysis of the plant leader interviews revealed that network management has to pay attention to the effects of centralism (see Chapter 3.3.5). Plant leaders indicated a reluctance to support other plants if a central unit pushes them to do so rather than a pull from the other plant. Conversely, the informants also outlined that inter-plant exchange can benefit from centralism if network management organises platforms for regular exchange (e.g., best-practices).

Another striking finding from the plant leader interviews is consistent with recent IMN studies. The similarity between manufacturing plants is a fundamental prerequisite for inter-plant exchange (Scherrer & Deflorin, 2017b). Therefore, the results suggest delayering an IMN into congruent subnetworks (Ferdows et al., 2016) (i.e., in clusters of peer plants) with similarity in products, processes or strategic orientation (Scherrer & Deflorin, 2017b).

The lack of individual-level ties between plant leaders is another critical barrier for inter-plant exchange. These relationships decrease the initial barrier to approaching another plant, and it appears that plant leaders are more willing to provide support to plants that are managed by colleagues they know personally. Since IMN literature mainly applies a plant- and network-level perspective (see Chapter 2.6.6) contrary to knowledge management research (Michailova & Mustaffa, 2012), it tends to neglect inter-personal relations as a central determinant for knowledge flows. The analysis presented in Chapter 3.3.7 also found that individual-level ties enhance inter-plant transparency, which is seen as another critical impediment to inter-plant exchange by the plant leaders. The plant leaders highlighted that transparency about other plants' current situations (i.e., current performance and challenges) and capabilities facilitates inter-plant exchange.

The plant leader perspective on IMN coordination mechanisms, which mainly addresses the micro-level, outlines that falsely designed incentives can impede or even bring inter-plant exchange to a standstill. Many plant leaders reported the downsides of incentives that can create inter-plant competition. The findings are in accord with recent IMN studies indicating that incentives are an essential lever for fostering inter-plant exchange (Szász et al., 2019).

Another impediment to inter-plant exchange emerged from the discussion on what kind of people are suitable for the plant leader job. Several interviewees explained that the plant leader position should not be promoted as an intermediate career step. Otherwise, this draws in people with the wrong mindset, that is, people pursuing a short-term agenda to qualify for the next career level.

Taken together, the identification of eight impediments to inter-plant exchange calls for a careful examination of the individual-level perspective in the domain of IMNs. Furthermore, references to the plant context were particularly prominent in the interview data. Several informants mentioned that plant context concerning the current situation and long-term capabilities have substantial implications for the individual level. Similarly to the interrelated nature of plant and network level (e.g., Colotla et al., 2003; Friedli et al., 2014; Thomas et al., 2015), the relationship between individual and plant level also seems to be characterised by a strong interdependency.

In conclusion, the plant leader interviews provide an answer to the second research question as follows:

What barriers exist that hinder plant leaders from engaging in inter-plant exchange?

---

1. The plant leaders' attentional focus on internal topics, amplified by a lack of designated resources for inter-plant exchange, impedes their network-related involvement.
2. Without a network strategy that promotes inter-plant exchange, plant leaders lack guidance about the strategic priorities, and thus, abstain from focussing on inter-plant exchange.

3. Both an excessive degree of centralism and the lack of centrally organised exchange platforms limit the willingness of plant leaders to participate or focus attention towards inter-plant exchange.
4. Plant leaders are questioning the benefits of exchange with factories that lack a certain degree of overlap concerning strategic orientation, products or applied production processes.
5. The lack of individual-level ties between plant leaders hampers inter-plant exchange.
6. Lacking transparency about current plant performance and challenges and plant capabilities hinders the initiation of exchange across plant boundaries.
7. False incentives promote inter-plant competition, guide the attention of plant leaders to internal topics and thus impede inter-plant exchange.
8. The promotion of the plant leader position as an intermediate career step draws in unsuitable candidates characterised by an improper mindset, who hamper inter-plant exchange.

Several limitations need to be considered. First, the findings are limited by the relatively small sample of 12 plant leaders. However, this study is based on a more extensive sample compared to other scholars who interviewed only 11 plant leaders (Smith et al., 2009). Similarly to their study, this chapter applied an inductive approach, mainly relying on statements from the plant leaders. The results are therefore potentially biased "by the perceptual lenses of these managers" (Smith et al., 2009, p. 441). It was the intention of this chapter to capture the individual-level perspective of key decision-makers in IMNs. As such, the results certainly reflect the perceptual lens of plant leaders. The case-study phase of this thesis seeks to minimise bias by supplementing the plant leader perspective with a central management view. Furthermore, the sample of interviewed plant leaders suffers from a geographic bias. All interviewees, though located across the globe in places such as Serbia or India, were from the German-speaking area and worked for a firm headquartered in the same area.

4 Conceptual Design

The conceptual approach builds on the findings from the plant leader interviews (see Chapter 3) and incorporates the underlying research theory (see Chapter 1.3). This work builds on a general research framework (see Chapter 1.3) to guide the overall research process. However, specific research focus and questions guide the subsequent case study phase (Voss et al., 2002, p. 199). Therefore, this chapter discusses selected constructs that are to be studied (Miles & Huberman, 1994). The emerging categories and constructs form the basis for the subsequent case research (see Chapter 5).

4.1 Linking the ABV with the Plant Leader Perspective

A central element of the model of situated attentions are attention structures, which "govern the allocation of time, effort and attentional focus of organizational decision-makers in their decision-making activities" (Ocasio, 1997, p. 195). In the context of this study, attention structures can be interpreted as important levers used to guide the attention of plant leaders on the topic of inter-plant exchange. Network management can foster network conduct of their plant leaders by setting up respective attention structures.

Three mechanisms characterise the attention structures (see Figure 12), which "regulate the valuation and legitimization of issues and answers, the creation and distribution of communications channels, and the interest and identities that guide decision-makers' actions and interpretations" Ocasio (1997, p. 195).

Valuation of issues and answers	Communication and procedural channels	Structuring of interests and identities
"The firm's attention structures govern the valuation and legitimization of the repertoire of issues and answers available to decision-makers. These values are not uniform throughout the firm but are differentiated according to the division of labor inherent to the firm's rules, positions, players, and resources." (Ocasio, 1997, p. 199)	"The firm's attention structures channel and distribute the decision-making activities of the firm into a set of procedural and communication channels." (Ocasio, 1997, p. 199)	"The firm's attention structures provide decision-makers with a structural system of interests and identities to motivate their action and to structure their decision premises." (Ocasio, 1997, p. 200)

Figure 12: Mechanisms of attention structures

Ocasio underlines that firms can structure the attention of their decision-makers through rules, resources and social relations: "The firm's rules, resources, and social relations structure attention in organizations by generating a set of values that order the legitimacy, importance, and relevance of issues and answers." (Ocasio, 1997, p. 196)

This leads to the question how IMN management can design the network-related attention structures to guide the attention of their key decision-makers and eventually overcome the impediments mentioned by the plant leaders as outlined in the previous chapter. Some of the identified reasons that plant leaders focus on their own operations and do not engage in inter-plant exchange are directly associated with a lack of adequately designed attention structures. For example, the problem of heterogeneity and lack of overlap between plants of the same network can be linked to an insufficient structure of interests and identities. IMN management has to provide a structure that brings together individuals with similar interests and identities.

Several plant leaders mention various aspects of communication and procedural channels that are either not well-designed for facilitating exchange between plants of the network or lack exchange between plants entirely. Also, the plant leaders' criticism of incentives that foster inter-plant competition or the lack of an openly communicated network mission can be linked to the insufficient valuation of issues and answers. These examples show that several impediments to inter-plant exchange, which emerged from the plant leader interviews in the previous chapter, can be linked to the three attention structures by Ocasio. Figure 13 presents how the remainder of this chapter integrates the attention structures, the plant leader perspective and the selected decision areas of IMN management. The last is basically a translation of the plant leader perspective into decision areas for IMN management. The overall conceptual approach aims to integrate the decision areas and attention structures to guide the focus of plant leaders concerning their plant's context.

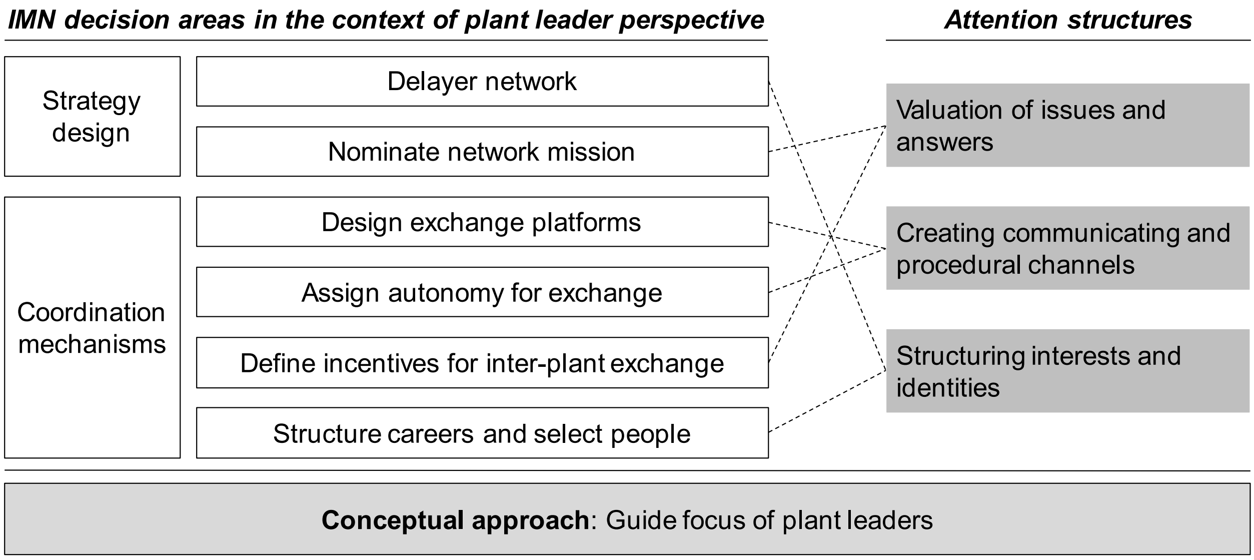


Figure 13: Decision areas of IMN management and attention structures

Several decision areas refer to the process of IMN strategy definition. For example, the perceived lack of homogeneity within a network of plants requires IMN management to

delayer the overall network into smaller clusters. Furthermore, plant leaders express that lack of a network strategy, which integrates the mission of engaging in inter-plant exchange, or not knowing the strategy, are explanations as to why they are restricted in exchange with other plants. Plant leaders are important decision-makers in executing the strategy and transferring it into the plant (see Chapter 3.1). Hence, IMN management has to decide on the content of the network strategy, but also has to consider how to integrate plant leaders and communicate the strategy.
Alternatively, IMN management also needs to consider coordination mechanisms and tactics (see Chapter 2.6.5) that address several of the identified impediments. The design of incentives, autonomy, careers and platforms for exchange appear to be relevant levers.
The remainder of this chapter discusses briefly how each decision area is linked to the respective attention structures and the plant leader perspective. Furthermore, it provides prior instrumentation (Miles & Huberman, 1994) for the subsequent case study research phase.

4.1.1 Strategy Network Design

Formulation of network strategy and mission constitutes a fundamental step for the management of IMNs (Friedli et al., 2014). Hence, network strategy is the starting point from which to address the perceived barriers from the plant leader interviews. Ferdows suggests defining congruent subnetworks and assigning each with "an appropriate manufacturing mission" (Ferdows et al., 2016, p. 63). Therefore, delayering a firm's manufacturing network into several subnetworks of peer plants provides the basis for formulating an adequate network mission and to address the plant leader's issue of too much heterogeneity (see Chapter 3.3.6).

Delayering Networks:

To cluster peer plants into subnetworks is a strategic decision of IMN management (Ferdows, 2018; Norouzilame, 2018, pp. 66–67), and thereby, IMN management structures the interests and identities of key decision-makers (see Figure 13). Lack of overlap between plants emerged as a perceived barrier from the interviews. Despite being part of the same firm, plant leaders question the benefit of intense exchange with plants that lack a certain degree of similarity. The interests and identities between leaders of plants that lack overlap and similarity are indeed different. Therefore, they also focus their attention differently. Heterogeneity was mentioned, for example, in terms of different customer demands, different products or varying processes. Scholars also found evidence of heterogeneity affecting the willingness of plants to engage in inter-plant knowledge exchange (Scherrer & Deflorin, 2017b). The conducted interviews, and other studies, show that manufacturing firms should pay specific attention to forming subnetworks of plants with similar characteristics and a minimum degree of overlap. Applying a more strategic perspective, Ferdows et al. (2016, pp. 63–74) propose to define subnetworks based on both product and process characteristics. The case study phase of this work addresses how IMN practice creates subnetworks, namely, which factors are relevant in order to differentiate plant clusters.

Nominate Network Mission:

The complete lack of a network strategy, the lack of a network strategy that addresses inter-plant exchange and insufficient communication of the network objectives were named as root causes for turning a blind eye to inter-plant exchange (see Chapter 3.3.4). This raises the question of how IMN management can address the topic of inter-plant exchange within their network strategy, which is linked to the valuation of issues in terms of objectives the network should achieve (e.g., learning), and answers (see Figure 13). Answers understood as cooperation and exchange among plants to achieve overall network goals, respective to solve challenges of individual plants through the help of others.

Thomas et al. (2015, p. 1713) and Friedli et al. (2014) put the concept of network capabilities or network output forward as a potential operationalisation of the IMN strategy (see Chapter 2.3). Concerning the contribution of the individual level, both learning and mobility are of particular interest. First, several studies demonstrated that the willingness of a subsidiary or a plant to send knowledge to other plants (i.e., to contribute to network learning), depends on the willingness of the responsible staff (e.g., Gupta & Govindarajan, 1991, p. 777). Second, the plant leader interviews indicated that network mobility is also partially a function of the critical decision-makers' willingness. For example, one interviewee explained that he deployed production employees to accommodate another plant of the network that was struggling due to a shortage of workers. This cooperative behaviour contributed to the network's mobility, that is, "its ability to react flexibly to environmental changes" (Thomas et al., 2015, p. 1716).

Taken together, the prioritisation of both network capabilities, learning and mobility indicate whether network management promotes inter-plant exchange as the network mission. In other words, analysing the desired state of network learning and mobility indicates whether IMN management strives for inter-plant exchange or prefers encapsulated factories. As such, a discussion of the strategic network dimensions is part of the case study phase.

Furthermore, as the high-level character of the network capability concept leaves room for interpretation, the case study phase also intends to analyse how IMN management breaks down the targeted network capabilities and communicates this to the key decision-makers within the network plants in order to foster inter-plant exchange.

Guiding questions for case study analysis

1. *How do firms delayer their global IMNs into smaller subnetworks of peer plants?*

2. *What is the network strategy for the respective subnetworks, and how does it address inter-plant exchange?*

4.1.2 Coordination Mechanisms

Several of the identified impediments (see Chapter 3.3) relate to either the complete lack of IMN coordination mechanisms or the implementation of mechanisms that do not support inter-plant exchange. Ideally, both network configuration and coordination are designed to support strategic network capabilities (Friedli et al., 2014). Therefore, the case study phase sets out to identify how firms implement coordination mechanisms to support inter-plant exchange, particularly those stemming from the plant leader interviews: exchange platforms, autonomy for exchange, incentives and careers (see Figure 13).

Exchange platforms:

Attention structures create procedures and communication channels that help decision-makers in attending to problems or changes (Ocasio, 1997, p. 195). Thus, in the context of inter-plant exchange, how these procedural and communication channels are designed is of particular interest. Design of adequate exchange platforms to specifically facilitate the transfer of knowledge and information within the network has been a recurring theme in the plant leader interviews (see Chapter 3.3). They outline the benefits of regular and face-to-face exchange with their counterparts. Yet, the interviewed plant leaders revealed that many networks do not have adequate or sometimes any exchange platforms. IMN literature provides some practical ideas for the exchange of knowledge in a global manufacturing network (e.g., Ferdows, 2006; Wæhrens et al., 2012). One recent study highlights the importance of cross-plant social interactions like “mutual plant visits, joint projects, informal meetings, internal social networks, joint training programs and team buildings” (Szász et al., 2019, p. 302). Other studies present evidence that personal relations and trust between individuals from different subsidiaries positively affect the exchange of knowledge or information (Abrams et al., 2003; Foss and Pedersen, 2002; Gupta & Govindarajan, 2000a; Tsai, 2002). This leads to the question of how IMN management creates these beneficial individual-level ties between leaders of different plants.

Autonomy or centralism:

Norouzilame (2018, pp. 57–59) identified autonomy assignment within an IMN as a major challenge related to IMN coordination. Autonomy for exchange has emerged from the interviews as another potential impediment to inter-plant exchange (see Chapter 3.3.5). In problem-solving situations, plant leaders particularly favour a decentralised approach. Initiation and organisation rest with both leaders, first with the one in need and then with the one providing support. The preferred self-organisation of exchange by plant leaders represents an informal network to “find information, solve complex problems, and learn how to do their work” (Abrams et al., 2003, p. 64). However, from a headquarters’ perspective, it might be beneficial to centrally coordinate and control this kind of exchange. The assignment of responsibility for different forms of inter-plant exchange represents a specific chapter of the general debate on decision autonomy in IMNs (Olhager & Feldmann, 2018). Therefore, the question arises of how and to what degree autonomy is assigned to the plant leader in the context of inter-plant exchange.

Incentives:

Determinants for bonus remuneration were another recurring theme in the plant leader interviews (see Chapter 3.3.8). Ocasio describes incentives as a key lever in order to valuate relevant issues and answers: “this set of incentives regulates the attention of organizational decision-makers so as to recognize and resolve those issues and activities most highly valued by the firm” (Ocasio, 1997, p. 199).

Scholars in the domain of IMN and MNC have outlined that central management can create competition between plants by incentivising, for example, operative performance on the plant level (Friedli et al., 2014, pp. 147–157). Alternatively, cooperative behaviour can be triggered through shared targets on the plant level and suitable remunerations (Friedli et al., 2014, pp. 147–157; Luo, 2005, p. 74). Incentives play a vital role for fostering exchange between firm subunits like plants (Szász et al., 2019), and some studies have even found that the lack of incentives is a primary reason for uncooperative behaviours (Burgess, 2005, p. 337). Conversely, Kohn (1993) advises against rewards for several reasons, including the fact that rewards can have adverse effects on employee relations. This argument is supported by other scholars who find extrinsic rewards not to be the most effective lever in creating a cooperative climate (Cabrera et al., 2006, p. 259). Some even suggest that extrinsic rewards hinder the knowledge sharing behaviour of individuals (Bock, Zmud, Kim and Lee, 2005).

As such, the two divergent and often conflicting discourses on incentives provide no conclusive recommendation for IMN practice. Therefore, the case study phase of this research aims to understand how network management defines incentives for promoting inter-plant exchange.

Careers and mindset:

Selection of individuals for the plant leader job and career opportunities were much-debated topics during the plant leader interviews (see Chapter 3.3.9). This topic has not yet been considered in IMN related literature (see Chapter 2.6), nor is it directly associated with Ocasio’s attention structures. Nevertheless, this topic provides interests and identities that motivate the decision-makers’ actions (Ocasio, 1997, pp. 199–200). It can be reasonably anticipated that career path and subsequent job opportunities intrigue individuals like plant leaders. In spite of this, the majority of the interviewed plant leaders do not see a pattern of plant leader career paths within their firms. Scholars find that typically “production managers have been drawn in from other functional areas, it is most often from R&D or quality” (Lee et al., 2004, p. 420). However, the question of what comes after a plant leader assignment remains unanswered. The plant leader interviews indicated that standardised career plans create strong interest among ambitious individuals, namely if the plant leader position is promoted as a short-term assignment to qualify for the next level. Such predefined career paths increase the problem of plant leaders being caught between wanting to impress their "superiors and at the same time enhance a manager's legacy to the enterprise" (Walder, 1989, p. 250). Overall, this raises the question of how IMN management handles the career ambitions of individuals.

A shared view amongst plant leaders was that this job requires the right mindset and suitable characteristics. A study by Hautaluoma et al. (1992) addressed a similar topic by comparing personalities of industrial managers. Their cluster analysis identified six personality types of industrial middle managers. They emphasise cooperativeness as a critical characteristic of middle managers (i.e., plant leaders)[49]: "effective middle managers must be cooperative, because of the need to coordinate with others in their work relationships (Thornton & Byham, 1982, Tornow & Pinto, 1976)" (Hautaluoma et al., 1992, p. 2012).

It remains unclear whether IMN practice agrees with this characterisation of suitable plant leader characteristics. Therefore, it is the objective of the case study phase to investigate how IMN managers fill the vacant plant leader assignments.

Guiding questions for case study analysis

1. *How can IMN management create exchange platforms and individual-level ties between plant leaders?*
2. *How is autonomy for inter-plant exchange distributed between plant leaders and central management?*
3. *How are plant leaders incentivised to engage in inter-plant exchange?*
4. *How can IMN management handle the career ambitions of plant leaders?*
5. *How does IMN management select the plant leaders?*

4.1.3 Guide Plant Leader Focus

The previous section has discussed selected IMN coordination measures, which present the focal research interest for the case study analysis. Based on the findings from the plant leader interviews, the following argues that a differentiation in the application of these measures appears to be necessary.

One impression that emerged from the plant leader interviews is that the situational context of plant leaders respectively the situational context of their facilities has a significant impact on the plant leaders' attentional capacity. Some plant leaders appeared to be much less constrained with running their operation or fixing production issues, and instead they spent

[49] Despite the fact that Smith et al. (2009) outlines that plant managers are regarded as middle managers in the strategic management literature, Chapter 3.1 discusses that plant managers might also be considered as top management depending on factors like plant size. Nevertheless, the analysis of Hautaluoma et al. (1992) seems applicable.

time and effort supporting other plants of the network or even organised exchange meetings within the network. Whereas one interviewee stated that he spent about 50% of his time on network-related topics, others elucidated that they were fully engaged with running their plant. Similar to the findings from the plant leader interviews, scholars also experienced that IMN coordination suffers from local focus: "there was occasionally some friction when obtaining resources from subsidiary plants while they tried to maintain their focus on the tasks at the local plants" (Norouzilame, 2018, p. 44).

Situation influences, attentional focus and urgent problems occupy the cognitive capabilities of individuals (i.e., key decision-makers) (Ocasio, 1997). As such, it is reasonably expected that plant leaders of smooth-running operations have more attentional capacity available to focus on knowledge or information related exchange with other plants (see Figure 13). This raises the question of which factors determine the attentional capacity that plant leaders have available for network-related decision. Two dimensions appear particularly relevant in the context of plant- and network operations.

First, the interviews show that current challenges associated with the plant operations allow a sound estimate of the plant leader's internal focus. For example, multiple interviewees explained that the ongoing overload of their operations keeps them busy with local matters. Operational plant performance, for example output quantities or quality level, could provide an appropriate operationalisation for depicting whether or not a plant leader is facing internal challenges. In order to measure plant performance, a seminal study applied multiple measures like "work-in-progress, production cycle time, business impact measures include market share and customer satisfaction" (Voss, Blackmon, Hanson and Oak, 1995, p. 3). However, business impact seems to be less relevant for the discussion on plant leader focus, as their responsibility is limited to the operation in most cases. The operationalisation of this first dimension is the subject of the case study phase.

Second, IMN literature indicates that long-term characteristics of plants (i.e., plant capabilities) have significant implications. One interviewed plant leader explained that due to the capabilities located at his facility, he has to consider network-topics and support other plants more than a plant leader of a recently opened facility. Plants usually take a long-term position within IMNs, which can change gradually over the years (Cheng et al., 2011). As such, plants take distinct roles that pertain to particular tasks and duties (see Chapter 2.4). Besides characteristics of the plant location (Ferdows, 1989, 1997), literature discusses competence on plant level in order to describe the role and position within the network (Demeter & Szász, 2016, p. 188). Among these are plant age (Scherrer & Deflorin, 2017b), contribution to knowledge flows (Scherrer & Deflorin, 2017b; Vereecke et al., 2006), plant autonomy (Maritan et al., 2004) and experience and ability to perform certain activities (Feldmann & Olhager, 2013). It is subject of the case-study phase to identify which capabilities mainly guide the plant leader focus.

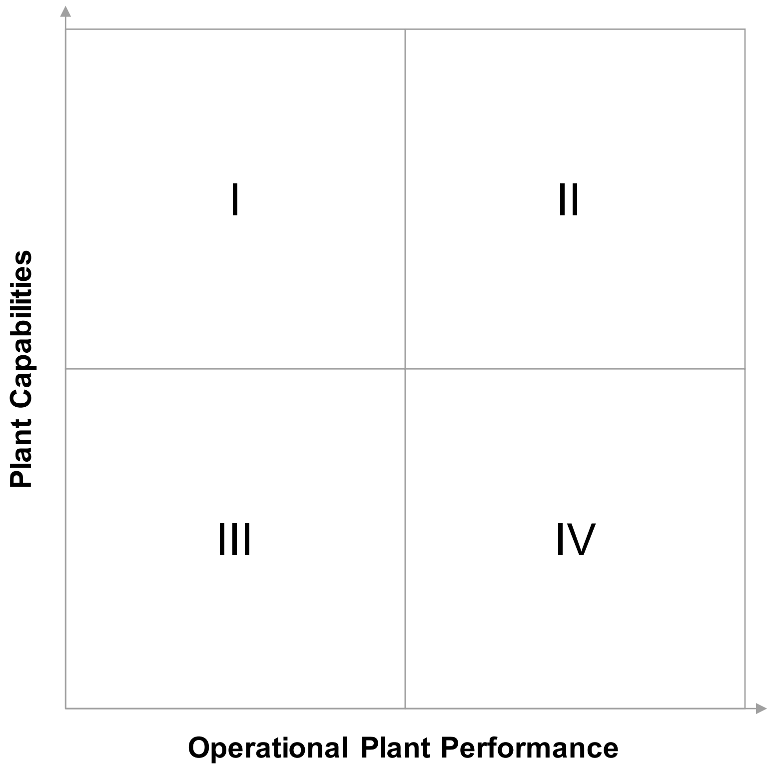


Figure 14: Plant context to guide plant leader focus

Eventually, both dimensions form a matrix that follows the idea of Voss et al. (1995), who group similar plants based on performance and competences, (i.e., practices). Their matrix provides a sound basis for discussing implications for each category: "within each group sites may share similar problems and opportunities" (Voss et al., 1995, p. 18).

As shown in Figure 14, four distinct clusters emerge from building the matrix based on two dimensions that define plant context. Each cluster is linked to a specific attentional focus of the plant leaders. Network management can cater to the situational differences of each cluster by designing adequate IMN coordination measures. Norouzilame (2018, p. 44) underlined that different plant characteristics pose a challenge for assigning resources for network activities to the plants (i.e., the plant leaders). By considering the plant context, the conceptual framework aims to support the resource allocation for IMN coordination related activities

The matrix depicted in Figure 14 elicits strategic questions concerning inter-plant exchange and the focus of plant leaders. What are the implications for the leader of a plant if (I) capabilities are high, but the current status is strained, (II) capabilities are high moreover, and everything is running smoothly, (III) capabilities are low, and current status is problematic, and (IV) capabilities are low, but the current status of the plant is unproblematic? This also begs the question of whether IMN management should customise incentives, individual autonomy, exchange platforms and the selection of individuals concerning each category.

A secondary effect of the matrix presented in Figure 14 is that it provides visualisation, (i.e., open communication) about the capabilities and performance of peer plants. Therefore, it presents a potential approach for overcoming the barrier of missing inter-plant transparency (see Chapter 3.3.7). The matrix presented in Figure 14 provides all the information that the interviewed plant leaders suggested to be useful: knowing whom to approach (i.e., which plant could provide a high level of competences and is currently not too busy with its own problems). It also reveals which plant is currently struggling with problems and might require support to all decision-makers.

To conclude this section, the conceptual framework stemming from the plant leader interviews and IMN literature provides more than a sound basis for the data collection in the following case-study analysis. Although subject to verification during the case studies, it potentially supports network management in the design of IMN coordination measures that cater to the individual situation of plant leaders.

Guiding questions for case study analysis

1. *How can one operationalise (operational) plant performance and plant capabilities?*
2. *What are the implications for plant leaders in the respective categories?*

5 Case Studies

This chapter is dedicated to outlining the applied case study method and presenting the case findings within. It builds on the conceptual design as discussed in Chapter 4 and aims to find strategies for overcoming selected barriers to inter-plant exchange, which have been identified in Chapter 3.3. Both the present chapter and the subsequent Chapter 6 aim to provide answers to the third research question (see Chapter 1.2).

5.1 Methodology

"A case study is an empirical method that investigates a contemporary phenomenon (the "case") in depth and within real-world context, especially when the boundaries between the phenomenon and context may not be clearly evident."

(Yin, 2018, p. 15)

Like Yin (2018), other scholars also emphasise that the case study approach is particularly applicable for new or unknown topics (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). In such a sense, the conducted literature review (see Chapter 2.6) certainly underlines that the research interest of this work is new to the domain of IMN. It shows that the phenomenon of inter-plant exchange and engagement of plant leaders has not received much scholarly attention. The potential interaction by central IMN management to integrate the plant leader into the network coordination remains vague and thus justifies the application of the case study methodology.

Furthermore, according to Yin (2018, p. 13), the case study method is particularly suitable in order to answer exploratory *how* and *why* questions. For this work, it can be confirmed that the conceptual design (see Chapter 4) and the underlying research questions (see Chapter 1.2) fall into this category.

This research builds on prior conceptualisation. According to Yin (2018), the case study approach "benefits from the prior development of theoretical propositions to guide the design, data collection, and analysis" (Yin, 2018, p. 15). The previous chapter has set out to develop several guiding questions, based on both theory and empirical evidence from the plant leader interviews.

In the context of operations management research, case studies are applied to explore, build theory, test theory, and extend or refine theory (Voss et al., 2002, pp. 198–199). This case-based approach aims to identify practical applications of the IMN coordination mechanisms that consider the individual-level. Thus, the case study approach provides "an excellent means of studying emergent practices" (Voss et al., 2002, p. 199).

The organisation of the case results (Barratt, Choi and Li, 2011, p. 331) typically applies a twofold approach (Eisenhardt, 1989; Yin, 2018). The first step is part of this chapter and provides "a within-case analysis, where a single case description is offered and the emerging constructs and their relationships are delineated" (Barratt et al., 2011, p. 331). The subsequent Chapter 6 provides the cross-case analysis, which aims to find patterns among all cases and is essential for the generalisability of the results (Voss et al., 2002, p. 214).

5.2 Selection and Sample

Researchers conducting case studies face the fundamental questions of how to select cases and how many are required to serve the research purpose (Barratt et al., 2011; Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Voss et al., 2002; Yin, 2018).

"A primary distinction in designing case studies is between single- and multiple-case study designs" (Yin, 2018, p. 49). Voss et al. (2002, p. 203) provide a brief summary of the advantages and issues of both single and multiple case studies. For single case studies, they see greater depth per case. However, generalisability is low due to potential bias. Barratt et al. (2011, p. 337) find that every fifth study in operations research applies a single case study method. Multiple cases help to overcome bias and provide more external validity as well as generalisability (Eisenhardt, 1989; Voss et al., 2002, p. 202; Yin, 2018). On the downside, multiple cases require more resources and potentially engage less in the details of each case (Voss et al., 2002, p. 202). If conducting multiple cases, Yin (2018, p. 55) states that two or three cases should be selected for cases in which similar results are predicted. Eisenhardt (1989, p. 545) states that "a number between 4 and 10 cases usually works well." Although a majority of studies in operations management apply fewer than four cases (Barratt et al., 2011, p. 337), the work at hand complies with Eisenhardt's proposal by using four cases. Therefore, generalisability, though limited by the nature of the case study approach, is higher than in most operations research studies. Intense and long-term cooperation with each case firm[50] helped to obviate the danger of superficial cases (e.g., those not containing enough depth).

Case selection followed a purposive sampling approach (Bernard, 2013, pp. 164–167). The following three parameters were applied in order to control the sample and select suitable case companies:

Number of Plants and Global Dispersion:

A manufacturing network is defined as an aggregation of at least two manufacturing plants (Colotla et al., 2003, p. 1194; Mengel, 2017, p. 23). Therefore, scholars in the IMN domain consider the number of plants for case selection (Scherrer & Deflorin, 2017b; Szász et al., 2019; Thomas et al., 2015). For example, Thomas et al. (2015) and Szász et al. (2019) demanded that a potential case firm operates at least three or four plants. Geographic dispersion of plants is another applied criterion to control the sample of firms (Feldmann & Olhager, 2019, p. 166; Szász et al., 2019). As such, both the number of plants and global dispersion are relevant selection criteria in the context for this work. Both a higher number of plants and an international manufacturing footprint indicate that a firm has already been

[50] The author was involved in a project cooperation with all Case Firms except Case Firm D. However, archival data from a previous project cooperation between case firm D and the ITEM-HSG informs the case as well.

dealing with network coordination and inter-plant exchange. The minimum number of plants that a firm operates has been set to ten for this work. It appears that several aspects of inter-plant exchange will be of less importance in a small network (e.g., one containing three plants).

The case firm has to operate an internationally dispersed manufacturing network of at least ten plants.

Network Management:

Another important selection criterion is that the firm has a "dedicated network manager in place" (Scherrer & Deflorin, 2017b, p. 398). First, it reflects that the firm actively engages with network management, and thus, network coordination. Second, the network manager provides a clear point of contact, also known as the "principle informant" (Voss et al., 2002, p. 206). It can be expected that a person who is involved in the management of the firm's network is also well informed for providing the required information. However, it needs to be noted that job titles usually do not reveal whether a firm has such functions in place. In most instances, high-level representatives of operations also hold responsibility for some aspects of the IMN, although their job title does entail any network-related term.

The case firm has at least one person in place who is responsible for network management.

Multiple Subnetworks:

The last selection criterion refers to delayering the overall manufacturing network into subnetworks of peer plants (Ferdows et al., 2016). Such measures are expected to have strong implications for inter-plant coordination and exchange, at least from the plant leader perspective (see Chapter 3.3.6). Previous research has applied similar criteria to select cases, such as Feldmann and Olhager (2019) who also ask for firms with multiple networks: "a variety in product types, which can create variation between manufacturing networks" (Feldmann & Olhager, 2019, p. 166).

To investigate how firms define their subnetworks and what implications it has for the network coordination (and respectively inter-plant exchange), the selected case companies for this work should be able to provide some experience in delayering their IMN.

The case firm operates at least two distinct subnetworks within their overall IMN.

At this point, it must also be mentioned that the willingness of participating firms and access to respective firms and individuals affect the case selection and the final sample. The case selection for the work at hand was also confronted with some reservations by firms to participate. Reasons for these reservations include concerns about the sensitivity of data and time constraints of the informants.

Finally, four leading manufacturing firms from different industries form the sample for this work (see Table 17). The industry classification is based on the second revision of the *Nomenclature statistique des activités économiques dans la Communauté européenne* (European Commission, 2008) according to the ORBIS database entry for each firm. The vague character of this classification guarantees anonymity and confidentiality, which most interviewees demanded.

Furthermore, Table 17 provides some basic information about the firms and outlines that all meet the selection criteria mentioned earlier. All case firms operate a relatively large number of manufacturing plants located on nearly all continents with headquarters in the German-speaking area. The firms' sizes vary quite substantially in terms of employee numbers and revenue.

Table 17: Sample firms overview

Case firm	*A*	*B*	*C*	*D*
NACE 2	Manufacture of other electrical equipment (27.90)	Manufacture of other parts and accessories for motor vehicles (29.32)	Manufacture of machinery for metallurgy (28.91)	Manufacture of electronic components (26.11)[51]
# of manufacturing plants	>25	>40	>10	>50
Global dispersion (plants in respective regions)	Asia, Europe, North America	Asia, Europe, North, and South America	Africa, Asia, Europe, North, and South America	Africa, Asia, Australia, Europe, North, and South America
Multiple subnetworks	Yes	Yes	Yes	Yes
# of employees	> 5.000	> 20.000	>2.000	>100.000
2018 revenue (k€)	≈ 1.000	≈ 4.000	≈ 400	>50.000.000

5.3 Validity and Reliability

Case study research is often seen as a less rigorous and therefore less desired scientific method compared to other modes of inquiry like experiments or surveys (Yin, 2018, p. 18). However, if qualitative case research meets scientific requirements of validity and reliability (Yin, 2018, p. 42), it can be "one of the most powerful research methods in operations

[51] Integrated technology company, NACE 2 classification of the segment considered in the following analysis.

management, particularly in the development of new theory" (Voss et al., 2002, p. 195). The following paragraph describes how this research addressed validity and reliability.

This work applies comprehensive documentation including a case study database (Yin, 2018) to assure reliability regarding concerns as to whether another researcher conducting the data collection procedure could obtain the same or at least similar results (Yin, 2018, p. 46).

Case research concerns the three distinct dimensions of external, internal and construct validity. The third dimension pertains to the operationalisation of the concept being studied. For this work, the constructs being studied were derived from the plant leader interviews combined with evidence from IMN literature. However, due to the openly structured approach, specific measures were not defined before the research phase. Instead, the objective was to identify IMN coordination practices and refine the conceptual framework (see Figure 14). Chapter 5.4 outlines how construct validity has been met and tested through triangulation and the use of multiple sources (Voss et al., 2002, p. 211).

External validity concerns whether the case study's findings are generalisable (Yin, 2018, p. 45). The guiding questions as outlined in Chapter 4.1 were incorporated into an interview guideline (see Appendix C.2) to structure the data collection process and help to generate findings that can be applied to a variety of firms operating an IMN (Yin, 2018, pp. 45–46). Furthermore, this work engages with four case-firms and applies a replicational logic (Yin, 2018, p. 55), which provides higher external validity than a single case study design.

Overall, the case study process as applied for this work can be considered as reliable and valid. The following chapter moves on to describe data collection comprising approaches such as triangulation, which also have to do with reliability and validity.

5.4 Data collection

Prior instrumentation, which "comprises specific methods for collecting data" (Miles & Huberman, 1994, p. 36), was twofold for the work at hand. First, all case firms were involved in close cooperation with the ITEM-HSG. Little instrumentation was applied during this project cooperation engaging in the field IMN management and optimisation. However, this early stage of less structured data collection also provided valuable and in-depth input for later analysis. As such, this early stage provided mainly observational evidence, which "is often useful in providing additional information about the topic being studied" (Yin, 2018, pp. 121–122). The second phase of data collection applied prior instrumentation based on the constructs discussed in Chapter 4. Finally, a case study database was established to structure and store the extensive amount of data and to facilitate the subsequent data analysis (Yin, 2018).

The project phase used multiple methods to collect data depending on the content of the cooperation between the case firm and the ITEM-HSG. This first phase of data collection bore a certain resemblance to action research, which, according to Coughlan and Coghlan (2002, p. 224), "requires co-operation between the researchers and the client personnel, and continuous adjustment to new information and new events." Cooperation between the firm's network management teams and the researcher of the ITEM-HSG was close through all projects. The latter also participated in the problem-solving process (Coughlan & Coghlan, 2002). However, the project objectives and resulting actions diverged from the content and research goals of this work. Therefore, specific data was collected in an action research setting, but post-project usage and analysis of data for the intention of this work is based on the case-study methodology according. Workshops and interviews with managers from various functions (mainly operations) were conducted during the project phase.

Furthermore, plant data was collected through questionnaire-based surveys, an extract from the enterprise resource system and interviews with informants. Other sources supplemented the data collection, such as public firm presentations or internal documents. Documentation of several workshops, interviews and the overall project outcomes ensured data access even after project completion. Each of the following sub-chapters gives a short overview of the data collection methods applied in the particular project.

The second phase of data collection was based on shorter case study interviews (Yin, 2018, p. 119). Each interview was scheduled for two hours and conducted with one or two informants from the case firms (see Appendix C.1). At the time of the interviews, all informants were involved in a network management function. A total of six interviews was conducted. An interviewer guided the individual interviews, which typically lasted from two to three hours. The guideline was sent out to all interviewees before the meeting. In order to maintain a chain of evidence (Yin, 2018), the interview protocol was structured into five sections: (1) introduction about the interviewee's professional background and details about the current assignment as dedicated network managers, (2) understanding the manufacturing network in terms of products, size, global dispersion and more, (3) discussion of issues and answers to guide the plant leaders attention, (4) discussion of procedure and communication channels to foster inter-plant exchange, and (5) discussion of interests and identities that guide plant leaders. Meeting minutes of each interview were created within 24 hours based on field notes and if approved by the interviewee based on an audio recording. Whereas data collection during the project phase varied between the case firms, the interviews followed more or less the same structure.

The description above shows that triangulation in terms of multiple data sources and multiple informants has been met (Yin, 2018, p. 128). Encouraged by Yin (2018, p. 128) and to strengthen construct validity, multiple sources were used even though some did not provide alternate findings. Furthermore, the interpretation of data was facilitated by multiple researchers involved during the project cooperation with each case firm. Overall, versatile sources and methods characterise the data collection applied for this work, which ensures an adequate degree of triangulation, reliability, and validity (see Chapter 5.3).

5.5 Case I

The first case provides rich input and the perspective from two distinct manufacturing networks. First, the following chapter provides an overview of the applied data collection. Second, a brief introduction describes the firm and the network characteristics. Finally, this chapter presents the within-case analysis.

5.5.1 Data Collection

The intense project cooperation from June to November 2018 between the ITEM-HSG and the case firm allowed the gain of detailed insights about the network operation of one business unit. Two researchers from the ITEM-HSG were involved in the data collection and analysis.[52] In close cooperation with the BU's operations management team, several workshops were conducted. Table 18 provides an overview of the primary data collection steps.

After the project cooperation, two interviews with network managers responsible for distinct subnetworks were conducted in July 2019 (see Table 18). These interviews provided the opportunity to discuss the implications derived from the previously collected data in the context of IMN coordination and plant leader involvement.

To gain a comprehensive understanding of the case firm's markets, products and operations, the researchers were involved in several workshops with experts from the market and product function (e.g., product groups, see Table 18). Furthermore, both researchers visited three production facilities. A shop floor tour was conducted during each visit to get a feeling for the complexity and challenges of the firm's operation. A comprehensive understanding of all network plants and the plant leader's perspective was developed through two steps:

1. The researchers participated in one plant leader meeting
2. A survey was sent out to all plants covering the following themes: (1) general plant data and selected KPIs, (2) product competences, (3) process competences, and (4) network perspective. In total, all seventeen plants of the BU participated in the survey

In addition to data collection on the plant and individual levels, several workshops with the BU operations management provided in-depth insights.

[52] The author of this work was involved.

Table 18: Data collection - case I

Method	Scope	Purpose
Semi-structured interviews	• Two interviews with a network manager from each subnetwork • Interview duration: between 120-150 minutes	• Gather detailed information on plant leaders (e.g., implications of matrix for plant leaders) and discuss outcomes from plant leader interviews • Data and informant triangulation
Network capability workshops	• Two managers from network management • Workshop duration: 150 minutes • European plant leader meeting • Workshop duration: 240 minutes	• Derive current and needed network capabilities for each subnetwork • Derive plant leader's perspective on network capabilities • Sensitise plant leader's for network topic and facilitate potential contribution
Market drivers workshops	• Six workshops – each with several participants from the corresponding product group and operations	• Derive customer perspective and implications for operations • Discuss how the manufacturing network could support business success
Plant competence survey	• Seventeen questionnaires filled out by operations leaders of 17 plants • One workshop with a group of plant leaders	• Derive plant leader perspective on selected network improvements • Evaluate plan status, contribution, and capabilities
Network configuration workshops	• Four workshops, each with three network managers	• Discussion of future footprint and implications for plant roles • Definition of subnetwork structure
Network coordination workshops	• Three workshops, each with three network managers	• Discussion on how to improve inter-plant exchange in sub-networks (e.g., as-is and to-be for plant leader incentives, competence teams) • Definition of a network steering approach
Archival Data	• Internal data about plants (e.g., from controlling) • Publicly available information	• Data triangulation • Additional understanding of case firm and business context

5.5.2 Firm and Network Characteristics

Case firm I is a German stock listed company that offers a broad portfolio of carbon products. The firm is involved in both development and production, and describes itself as a solution provider for the following markets: mobility, energy, digital, industrial applications and chemistry. It operates a highly integrated value chain that covers nearly all production steps from the conversion of raw materials to intermediate processing and assembly of finished products. To control the entire value chain, the firm operates an international manufacturing network of about 30 plants (see Table 17).

Fundamental changes characterise the recent company's history. After a strategic realignment in 2015, the company sold the core of its previous business in 2017. The reorganisation resulted in two remaining business units with distinct operations functions (see Figure 15). Only selected functions like innovation and other services were assigned to a corporate level. In 2018, the operations structure of the BU I was subject to a comprehensive analysis. Two researchers from the ITEM-HSG were involved in the network analysis and strategy definition, so rich, in-depth data was collected that informs this case study. The following discussion integrates some simplifications to ensure confidentiality.

The BU I of the case firm has an extensive product and customer portfolio. It provides semi-finished material to customers and also offers a wide range of finished products based on the very same material from mainly own production. As such, the operations function of BU I is clustered into two distinct subnetworks of plants, (1) producing material or plants, and (2) processing the material. The following case provides a partially separate discussion for both subnetworks of the BU I:

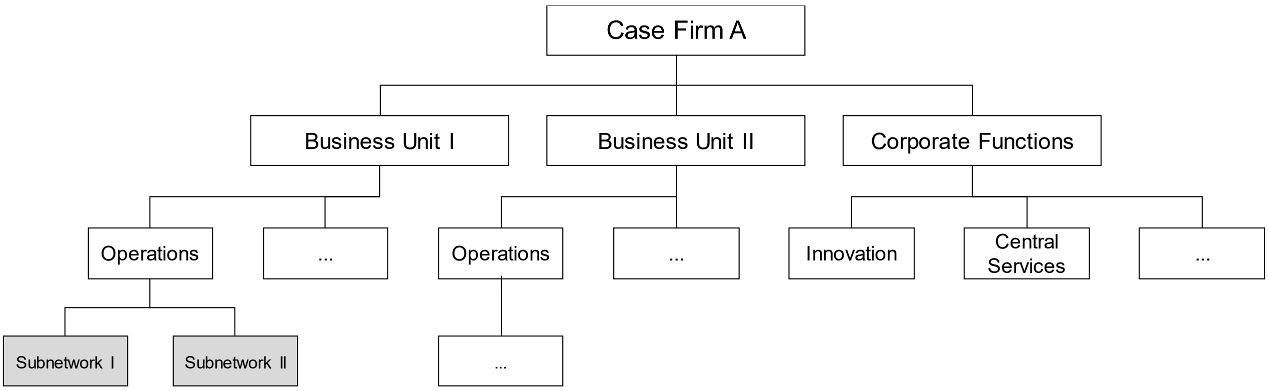


Figure 15: Organisational structure of case firm I[53]

Subnetwork I: Plants of this subnetwork convert raw materials into semi-finished goods. Eight production facilities in China, France, Germany, Poland and the US belong to the first subnetwork. Three basic production steps are conducted in these plants: [54] (1) grinding and mixing of raw materials, (2) forming or shaping, and (3) thermal treatments. The thermal processes particularly take a lot of time and result in overall high lead times (several months). Therefore, the output of plants from the subnetwork I does not follow a strict pull-principle. Instead, it continually feeds into the stock. Either external customers or subnetwork II plants are supplied from this stock.

The needed production technologies in subnetwork I require high investments. Therefore, the production is driven by economies of scale. Plants are therefore, on average, larger (e.g.,

[53] Highlighted boxes show the focus of this case.
[54] Subject to simplification.

in terms of headcount) than subnetwork II facilities. Most plants do not have a regional market focus but are embedded in a global value stream with other plants of the same network. The regional presence of plants within regions that present main markets at the same time have been the result of past acquisitions rather than a systematic network development process. However, recently this regional presence has turned out to be an advantage. The imposition of duties or threat of imposing by some countries has increased the importance of local proximity for subnetwork I.

Subnetwork II: This network comprises thirteen plants which process the intermediate material and provide finished components and products. The subnetwork II serves four business segments with different products and distinct priorities. As such, the network is characterised by a much higher product variance and complexity than subnetwork I. The following broad categories of production processes are applied: (1) machining, (2) impregnation, (3) purification, and (4) assembly. Several plants also function as service hubs for selected products of the portfolio, but most plants are focused on selected products and therefore cover only associated processes. For example, one of the smallest network plants (about ten blue-collar workers) only performs machining.

The footprint of the second subnetwork is driven by customers who ask for short delivery times (several days) and local service. As such, the higher number of plants meets the demand for proximity to the customer. Plants have a regional focus and are located in China, France, Germany, India, Italy, Japan, Poland, the US and Spain.

The organisational structure of plants differs depending on whether the location functions as a shared site for both subnetworks. Small sites in both subnetworks have a plant leader who is deeply embedded in production topics. Larger sites are headed by a site manager primarily responsible for representative tasks. Each operation is then managed by an operations leader who is also the relevant counterpart for inter-plant exchange in the respective subnetwork. As such, at sites with multiple operations, each is regarded as a distinct plant and assigned to the respective subnetwork. Thus, for the shared factories of case firm I, operations leaders are relevant decision-makers for inter-plant exchange (see Chapter 3.1).

Initial Situation – Sparse Network Thinking

Before the transformation of the BU I's operation had been started, the level of cooperation and exchange between plants was rather low. A questionnaire was sent out to all plant leaders of both subnetworks to obtain information on the initial situation. The feedback indicated that the network had not been used optimally during recent years. One plant leader reported: "There has been limited exchange to date due to our site being somewhat unique in our portfolio and processes" (translated, plant leader from Case firm I). Another answered the question of how often they exchange across plant boundaries: "Not as often as a few

years ago. There is no real forum for communication amongst [peer] production sites anymore” (translated, plant leader from Case firm I).
Inter-plant exchange only occurred when material flows triggered it or when central operations management assigned a project. To share expertise or to support other plants was seen as a threat, especially from factories equipped with high competences located in a high-cost environment. Past relocation to low-cost facilities has created a lasting sense of caution, namely in the plants that send people.
The willingness to engage in inter-plant exchange has changed quite significantly within one year. A network manager of the case firm I emphasises that success stories can be seen, but these are still fragile: ”I must say quite clearly that was not possible a year ago, it is like a little flower that you have to nurture” (translated, I.2).

5.5.3 Network Strategy

“We bring together a network – we bring together a team… they [operations/plant leaders] start to act more and more as colleagues.”
(translated, I.2)

The quote above demonstrates a fundamental characteristic of the first case - the network management has set a clear objective to create more cohesion among plants of the same cluster. The case provides evidence that this not yet completed journey is already bearing first fruits in both subnetworks.

Delayering homogeneous networks:
After the reorganisation of the case firm I in 2017 with a new composed structure of business units, the definition of subnetworks constituted the first step in structuring the operations of BU I. From an overall perspective, assigning distinct operations functions to each business unit (see Figure 15) is the first level of delayering. Thus, seventeen of thirty plants are under the responsibility of BU I operations. As such, the first level of delayering follows a business perspective.
The second level of delayering applies a process perspective. Plants that produce material belong to subnetwork I and plants that process material to subnetwork II. However, due to the complexity of both subnetworks, further delayering was necessary to create more homogenous clusters of peer plants. The logic for defining clusters below the subnetwork level differs for both subnetworks.

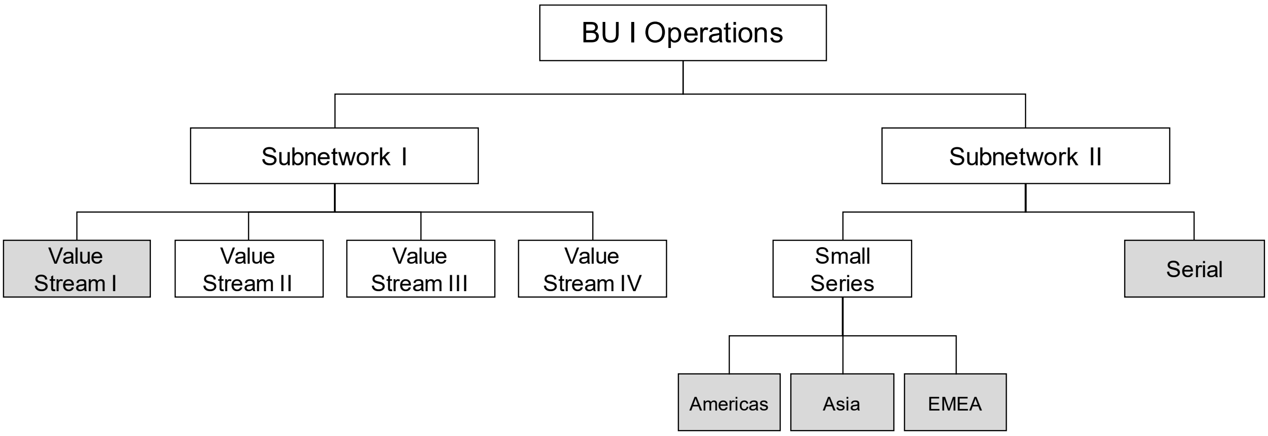


Figure 16: Subnetworks of BU I[55]

Subnetwork I is clustered into four distinct value streams. This logic follows the idea that value streams create an overlap and a natural connection between plants. Subnetwork II applies a different logic. Flows of material, like in subnetwork I, are not common in subnetwork II. However, some plants share parts of the product portfolio and apply similar processes. This similarity is a function of production volumes. Quantities in the serial network can be up to five million per annum, and therefore, stable and reliable production is critical for delivering the small-sized products to the mainly automotive customers. Variance in the serial product portfolio is relatively low. On the contrary, small series production is characterized by low volumes and even customised orders. The product portfolio is very diverse ranging from simple to high complexity parts. The small series production is also driven by proximity to the customer with multiple small facilities in each regional market. Small series production has to cope with customers who demand short lead times (a few days). Therefore, balancing over- and underutilisation is a challenge for production planning in the small series network. By delayering regional clusters, operations management targets much closer cooperation among plants (i.e., the respective leaders) within the same region in terms of knowledge exchange, but also in terms of balancing.

Overall, case I exemplifies how a firm applies up to four levels in order to delayer their IMN of 30 plants into much smaller subnetworks. This approach results in small clusters of three to six plants with a high level of overlap and homogeneity. The following statement by a plant leader from subnetwork I summarises the perceived effect on exchange between plants by delayering the BU I operations network: "It is much better now; we talk about the same processes and products" (translated, plant leader from Case firm I).

Nominate network mission:

The BU I operations strategy includes targets, development steps and actions for both subnetworks. Operations management defined the objective of manifesting mutually supportive cooperation between the network entities. One network manager emphasises

[55] Highlighted boxes show the focus of this case.

how important it is to have a common goal for all involved plant leaders: “It is very important for me that we have for the network, which in the end is a network of plant- and production leaders, that we formulate a mutual target for these colleges” (translated, I.2).

Figure 17 presents the target network capabilities for both subnetworks. Whereas both internal learning and mobility are nearly on the same level for both networks, the configurational aspects differ widely. Subnetwork II faces the challenge of offering short lead times and services, which requires proximity to the customer, but subnetwork I mainly sends output into stock first. Therefore, subnetwork I focuses on thriftiness, or economies of scale. Relatively high volumes are bundled in each facility to utilise the elaborate production technologies (e.g. investment intensive furnaces). On the other hand, machines needed for production in subnetwork II are less costly, as such economies of scale and thriftiness play a subordinate role. Both networks rely on different means of access to resources. Energy-intensive thermal processes in subnetwork I ask for an IMN that provides access to low energy cost. For subnetwork II wages, not energy cost, are the main drivers.

Mobility and learning are essential for both subnetworks. Creating the ability to balance production peaks to better utilize furnaces is vital for subnetwork I. As the similarity of production output is generally higher in subnetwork II, the exchange of entire orders is highly relevant. However, in the past, exchange of production volumes between plants was scarce. Figure 17 conveys this message and underlines the intention of network management to foster internal learning (i.e., exchange about process improvements or best-practices). Since more plants in subnetwork II apply similar processes and produce similar products than in subnetwork I, the target of internal learning is slightly higher in subnetwork II. Nevertheless, operations management also assigns high importance to internal learning in subnetwork I.

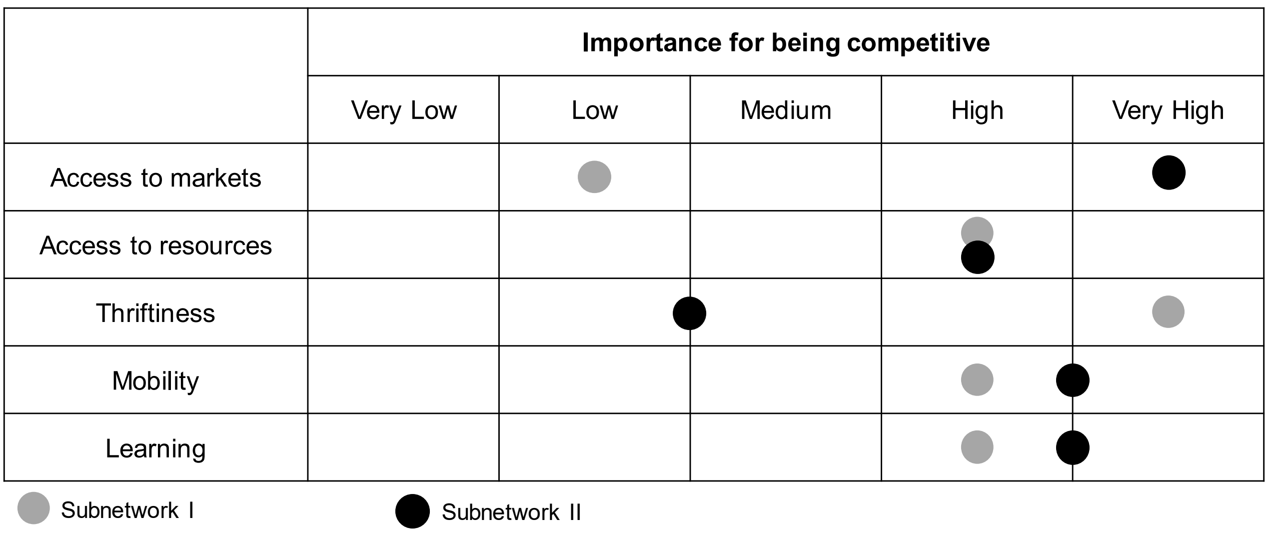


Figure 17: Network targets – case firm I

Overall, Figure 17 outlines that the operations strategy of BU I addresses inter-plant exchange. The roll-out of the network mission was started about a year ago at the time of completing this work. Before, the need to increase cooperation among plants and exchange knowledge was communicated openly to various members of the organisation. Production and network strategy were explained to all plant leaders during meetings. One subnetwork manager underlines why he was so keen to involve the plant leaders:

> "My goal is that the plant leaders take the network strategy and translate it into their factory. Because I cannot implement these things myself, therefore I need support from the plant-level." (translated, I.2)

The network mission has become integral to the BU's operations strategy. However, the case firm did not only point to the importance of inter-plant exchange, but also introduced specific measures for how to do it. The following chapter elaborates on these measures.

5.5.4 Coordination Mechanisms

Operations management implemented several coordination mechanisms for facilitating knowledge flows between plants and promoting the network as a new source of a competitive advantage. Some mechanisms are equal in both networks, and others are network-specific incorporating the contextual situation.

Means of exchange:

The information flows between headquarters and plants have changed significantly in both networks. Instead of individual calls between each plant leader and network management, the latter introduced a mandatory cluster call each month. These calls serve the purpose of reporting operations performance of each entity, and they support inter-plant transparency, as all plant leaders catch the report of their colleagues. Depending on the plant cluster, these calls take up to two and a half hours. In addition to the plant leaders, each plant participates with a controller and a production system representative. Each plant leader has a designated time slot of ten minutes to present a KPI scorecard and ten minutes to talk about the low- and highlights of the last month. Questions and suggestions are welcome during the call. The network managers report that the plant leaders commonly contact each other after the calls to discuss, for example, how one of them solved a specific issue. While the one network manager underlined that these shared calls indeed facilitate inter-plant exchange, he also highlighted that maintaining discipline during a call with more than twenty participants is a significant challenge. Nevertheless, he observed that these calls become better as everyone gets used to the procedure.

Two different approaches for knowledge exchange are applied for subnetwork I and subnetwork II. The similarity between plants in the latter network is higher than in the subnetwork I. Therefore, plant leader or respective operations leader meetings in the EMEA network are the centrally organised exchange platform in subnetwork II. Twice a year, all EMEA plant leaders meet for two days in one plant, and the location differs each time. The purpose of these meetings is manifold. First, they create a platform where plant leaders can exchange about process, products and running a plant in general. It also includes a shop floor tour each time to collect ideas and see how others deal with similar production challenges. Second, there is a meeting where network management can discuss strategic network topics. Third, a meeting is held to create inter-personal ties between the plant leaders.

More Time for Personal Interaction

In subnetwork II, plant leaders were invited to meet twice a year for two days. On account of long distances, meetings were conducted on Wednesdays and Thursdays. However, after a few meetings the group of plant leaders asked for a different schedule. Despite having to travel back on a Saturday, they proposed holding the meeting on Thursdays and Fridays to spend more time outside of the workplace together, which shows that the plant leader meetings resulted in close inter-personal relations.

In subnetwork I, the value-stream structure results in plants with partly no overlap in products. Therefore, operations management decided not to conduct plant leader meetings in this network for knowledge exchange purposes. Instead, they initiated meetings of process experts from respective plants across all value-stream clusters (see Figure 16). It means that once a year all experts for a particular thermal process come together to discuss process improvements and best practices. The integration of some expert input from externals (e.g., universities) is also planned for these meetings. As such, this exchange is of a more technical nature, but also fosters the creation of individual-level ties between process experts. One informant emphasised that the plant leader's role for this particular exchange is limited to delegating respective experts from the individual plant.

Autonomy of exchange:

Operations management of BU I pursues a decentralised approach. Despite central organisation of both plant leader meetings and competence teams, it is the intention of operations management to encouraged autonomous exchange between plants. Namely, as subnetwork II applies no standardised best-practice exchange, it is up to the plant leaders to identify learning opportunities in other factories (i.e., during the plant leader meetings). Similarly, if shop floor problems occur and help from another plant is needed, the network manager of subnetwork II encourages the plant leaders to find solutions among each other. The following success story proves the potentials of this autonomous exchange between plants:

Without Central Coordination

The biggest plant of subnetwork II was facing a staff shortage in assembly. The responsible operations manager immediately called the leader of the French plant and asked for support (i.e., workforce). Both leaders knew each other from the plant leader meetings. The French plant leader deployed one employee without waiting for a formal commission. Thanks to the quick support, the German plant deliveries were on time.

The second example happened between the other German and the Polish plants. The German facility was facing a long-term downtime of their only grinding machine. The German plant leader approached his Polish colleague and asked him to take over the grinding process until his own machine was running again. Therefore, staff from the German facility had to qualify the machine in Poland. In the end, cooperation between plants led to a limited impact on customer deliveries. Furthermore, the network benefited by now having this process as a backup in case another machine faced downtime.

In subnetwork I, autonomy for exchange is partially delegated to a designated plant leader. Within the value-stream clusters, one plant leader is awarded responsibility to organise inter-plant exchange and support other facilities. As such, in some sense, coordination of the network is not conducted centrally but by a plant (i.e., the respective plant leader). Chapter 5.5.5 presents this concept in more detail.

Overall, both subnetworks of case firm I encourage their plant leaders to take the initiative for inter-plant exchange themselves. Though platform-based information and knowledge exchange are organised centrally, the profound cooperation between plants builds on the initiative of individuals. In doing so, plant leaders are assigned with considerable autonomy in pursuing such exchange.

***Incentives*:**

The case firm has undergone some significant changes to its incentive system in the recent past. During the project cooperation between the case firm and the ITEM-HSG, the flexible remuneration of all plant leaders has been based on an overall firm success, plant operational KPI's and individual goals. In regards to creating a network of cooperating plants, one network manager expressed scepticism about the success of these former incentives. According to his observation, the high importance of local KPIs created a focus on the individual plant: "Actually, you [as a plant leader] were forced to work independent and local" (translated, I.2).

By now, the whole firm has undergone a drastic change in its incentive policy. For any employee, the bonus is tied to the overall firm and the respective business unit success. Plant leaders do not have operational KPIs on the plant level as bonus relevant targets anymore, and the full effects of this incentive change have yet to be determined. One interviewee points out that from a manufacturing network management perspective, neither the old nor the new approach are ideal. He believes that incentives tied to a level between plant and the overall firm would be more suitable: “A personal network goal would certainly improve cooperation within the network” (translated, I.2). However, due to the current economic situation, members of the BU I’s operations management do not see that incentives are affecting the behaviour of the plant leaders:

> “In the current phase, incentives are not important. We are in a period of very high utilisation… but I am not sure what’s going to happen when this situation changes and whether then everyone is going to look out for their plants first.” (translated, I.2)

One interviewee mentioned that as long as plant leaders see the benefit of exchange for themselves (e.g., in their plant), it is not necessary to incentivise this behaviour. Since the new network structure and the new exchange platforms have been implemented, operations management perceived much positive feedback from the plant leaders. Regarding knowledge exchange, the plant leaders saw the benefit for themselves and therefore were willing to contribute without much hesitation. As of yet, experience in subnetwork II is that individual efforts were kept within reasonable limits.

Overall, case firm I provided evidence that incentives can impede inter-plant exchange but are less important for facilitating cooperative behaviour. Other factors, like mutual benefits from inter-plant cooperation, are more important than the financial remuneration.

Structure of careers and candidate selection:

There is no standardised pattern for becoming a plant leader in case firm I, but the plant leader job is a long-term assignment and not seen as an intermediate short-term career step. One plant leader of the BU I has been doing the job for 25 years, which supports the idea that there is no designated next step for plant leaders.

Both internal and external candidates are considered for this position. One informant from case firm I outlined that recruiting suitable candidates has become a major challenge in the recent past: “In some regions, it is definitely a challenge to find somebody who has the right technological skills, management competencies and is fluent in English” (translated, I.1).

In general, plant leaders are assigned according to a local for local management philosophy. Especially in smaller plants, the plant leaders have to work directly with the shop floor staff. Therefore, cultural background and language skills are seen as important job requirements. Technical expertise also plays a significant role and is seen as the most critical requirement in case firm I:

> “The organisation expects thoroughly technical competence. Plant leaders need to know what they talk about. They do not only need to know how business processes work – they need to know how to produce products… The machine operators assume that their manager [the plant leader] has high technical competence and that they can ask technical questions.” (translated, I.2)

The first case underlines the technical nature of the plant leader job. Furthermore, it provides evidence that standardised and designated career paths are rather uncommon in medium-sized firms.

5.5.5 Guide Plant Leader Focus

The conceptual matrix has been applied in both subnetworks of the BU I. The remainder of this chapter introduces the operationalisation of both axes first, then presents the matrix rendering value streams I and II, and the two EMEA clusters of subnetwork II.

***Operationalisation*:**

The question of how to measure long and short-term plant status was the content of both interviews with network managers from subnetwork I and subnetwork II. The questionnaire that was sent out to all plant leaders (see Table 18) also entailed a section asking for plant capabilities. The vertical axis represents how competent a plant is in producing the products or performing the required processes. It also considers the complexity of the respective operation by integrating the range of products or processes. Due to the different characteristics of both subnetworks (see Chapter 5.5.2), competences and range of processes were applied for subnetwork I, and competences and range of products for subnetwork II. Initially, the plant competence rating was built on the self-evaluation of the plant leaders (i.e., rating their plant's competences from one to five for each process or product). However, the self-evaluation was lacking the comparative perspective of other plants in the network. Therefore, competence rating was adjusted by operations management if necessary.

The abscissa (i.e., the short-term status), considers the plant's operational performance. According to the interviewees, the same KPIs that are discussed during the monthly calls with all plant leaders are suitable measures for assessing this short-term perspective. However, the informants mentioned that plant position on the abscissa should not reflect the one-time performance as discussed during the last call, but rather present a qualitative average of the last months in order to filter outliers. Each interviewee gave a qualitative assessment of their respective subnetwork.

Subnetwork I:

Figure 18 presents two plant clusters of subnetwork I. Value stream I consists of three quite different plants. Two highly capable plants located in Western Europe and one plant with low capabilities and low operative performance in Asia. Both plants A and C show a correlation between capabilities and performance. However, plant B, with a very high capability level, fails to deliver expected operative performance. Old production machines, a heterogenic portfolio and the role as a toll manufacturer for other plants of the network might explain that this position is linked to structural problems. Plant A has always been the implicit lead plant of the network. Their competences are needed for support, especially in plant C.

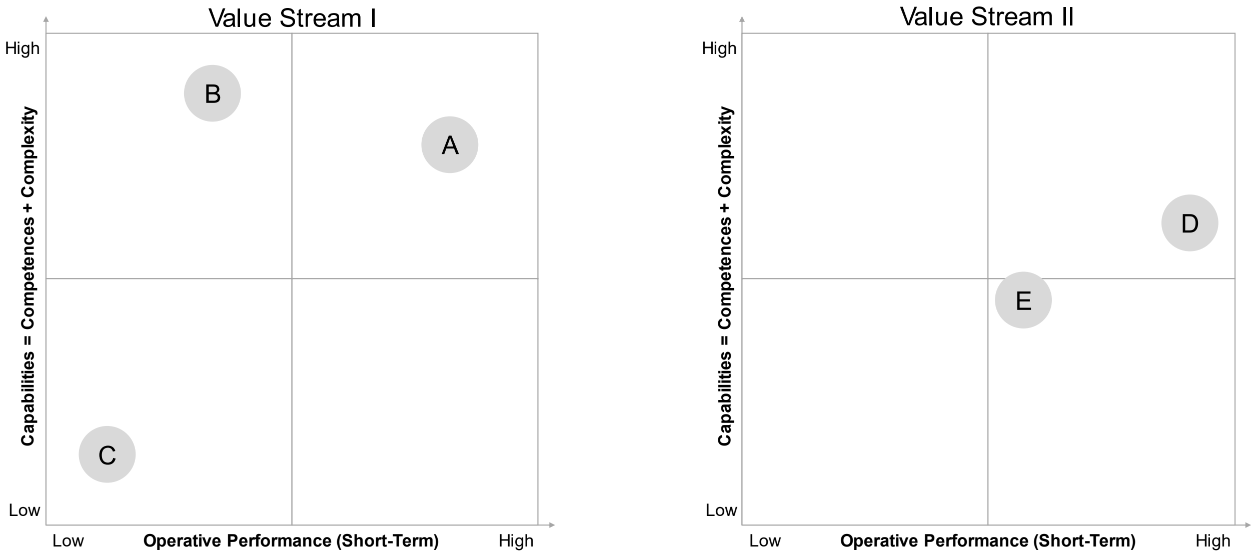


Figure 18: Application of conceptual matrix in subnetwork I

Value stream II is a small cluster of only two plants. The Eastern European facility has the highest competences and performance. Despite the peer plant being located in a high-cost environment and older, their competences for the value stream II production are lower, and their performance also suffers from structural problems.

Subnetwork II:

Figure 19 presents two regional clusters of subnetwork II. First, the small series network is characterised by two groups of plants with either high or low capability levels. Plants A and B are, according to the interviewee, regarded as competence centres within the network.
The much smaller serial cluster presents a different situation. The most capable plant G was struggling with a production ramp-up, a high number of new employees and the introduction of new processes at the time of the interviews. The designated position for G would be the top-right corner. As such, the interviewee underlined that the new leader of plant G faces high expectations for getting operations under control.

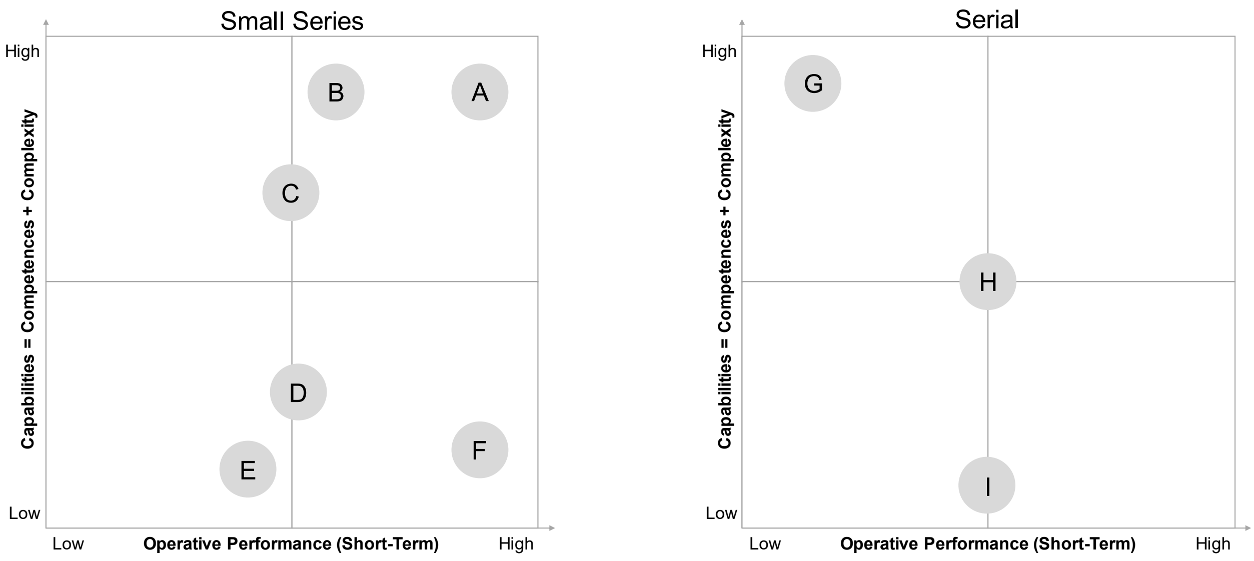


Figure 19: Application of conceptual matrix in EMEA subnetwork II

Implications:

The interviewed informants confirmed that the proposed matrix is a suitable tool for depicting the actual network status. The interviewees confirmed the informative value and validity of the plant positions. Furthermore, they agreed that this matrix could serve as a tool for guiding the focus of plant leaders. They agreed on a network-related focus, especially for plant leaders in the top-right corner.

The development of a concept for value stream I during the project cooperation incorporated the underlying idea of the matrix. The concept intends to assign additional resources and network-related duties to plant A, which is located in the top right corner. As such, the focus of the respective plant leader is supposed to shift from the own plant to the whole network. The concept also proposes making plants located in the right top quadrant, the preferred location for the industrialisation of new products and the pilot-implementation of new processes. Therefore, the concept foresees the allocation of additional resources to these plants for process engineering and supporting other network entities. The concept also assigns additional autonomy to these plant leaders. It expects them to organise the regular exchange between all sites of the cluster. For product and customer-related topics, these plant leaders are also expected to act as the direct point of contact for the product group (i.e., the market organisation). The plan also considered incentives. The idea was to link the bonus of these plant leaders to network performance in order to bring the network success forward as the focus.

In subnetwork II, plant leaders in the upper right quadrant were typically expected to organise the support of other facilities: “He [plant leader in Germany] should also cope with the growth in Poland … he is somebody who is well-connected across the network” (translated, I.2). As subnetwork II did not apply a formalised lead-satellite plant structure, the interviewee emphasised that plant leaders in the lower-left also have to approach other plant leaders of more capable plants to absorb knowledge:

> "It is about introducing production processes that are already established in Europe. These colleagues need to find contacts… and obtain knowledge. He is in an absorbing position… They are proactive in feeding questions to the network." (translated, I.2)

In subnetwork I, plant leaders in the upper right quadrant were assigned with the task of co-developing a roadmap (e.g., a development plan for other network sites). The interviewee emphasised that plant leaders in the remaining quadrants should focus internally first. The network manager explained that plant leader C, who received help from plant A, "has definitely to move to the right" (translated, I.1). Concerning plant leaders in the lower-right quadrant, the interviewee highlighted their internal focus:

> "First of all, that one is a change manager… that is someone who motivates people as his main duty. He has to ensure that the site remains good with regard to the KPIs down there. He has to motivate the people permanently, ensure they have the right mindset, ensure they work on the right things. He is the driver for efficiency…
> first and foremost he looks internally." (translated, I.1)

Case I provided an interesting example of how long- and short-term plant status could be applied to define and steer the attentional focus of plant leaders. The first case also exemplified that the application of the conceptual matrix is based on some prerequisites. Network management refrained from implementing precise coordination mechanisms to guide focus according to plant status in the small series cluster of subnetwork II. Despite having a relatively high number of plants, these were quite different concerning product and process portfolios. Therefore, leaders of plants in the top right corner were not assigned with a different autonomy or responsibility than plant leaders of a plant in other corners (e.g., the bottom-left). The implicit status of plants A and B as competence centres was not reinforced. In the serial cluster, however, the situation was different. Network management assigned plant leader G with the task of supporting plant I. Plant leader G was expected to get the internal issues under control beforehand, and as such, this example supports the matrix concept. Leaders of plants in the top left quadrant should focus their attention on their own problems first before broadening their perspective on the overall network.
Taken together, the application of the proposed matrix in case I confirmed that autonomy, objectives and resources could be assigned to plant leaders according to their plant's long- and short-term status. Namely, the value stream A in subnetwork I provided an example that showed how the plant leaders could be assigned with network coordination tasks (e.g., organise exchanges). However, the presented examples also underlined that not all networks are suited for this approach. The approach reaches its limits if plants are too different (e.g.,

heterogeneous product portfolio), like in the small series network of subnetwork II. In addition, this case confirmed that the proposed matrix could provide the basis for a job description of plant leaders and support the work of IMN managers.

5.6 Case II

The second case (like the first one) provided rich input and the perspective from two distinct manufacturing networks. First, the following chapter introduces the applied data collection methods. Second, a brief outline of the firm's characteristics is followed by the within-case analysis.

5.6.1 Data Collection

An intense project cooperation from November 2016 to October 2017 between the ITEM-HSG and the case firm allowed the gain of detailed insights about their network operation. Two researchers from the ITEM-HSG were involved in the data collection and analysis.[56] Several workshops were conducted in close cooperation with the global operations management team. Table 19 provides an overview of the primary data collection steps.

After the project cooperation, two interviews with managers from the global production strategy team were conducted in July 2019 (see Table 19). These interviews provided an opportunity to discuss the implications derived from the previously collected data in the context of IMN coordination and plant leader involvement.

In order to gain a comprehensive understanding of the case firm's markets, products and operations, the researchers were involved in several workshops with experts from the market and product function (see Table 19). Furthermore, both researchers visited three production facilities, including the largest plant by far of the case firm in south-east Germany. To get a feeling for the complexity and to understand the challenges of the firm's operation, a shop floor tour was conducted during each visit.

Multiple workshops and virtual conferences with two managers from the global operations team were conducted to refine the operations structure (i.e., to define congruent subnetworks, to set the needed network capabilities and to develop a concept for comparing all production facilities) of case firm II. During a global operations meeting with high-level participants (e.g., regional operations leaders), these results were evaluated and refined. Furthermore, the European core team meeting with participants from operations, logistics, controlling and human resources constituted another step of the iteration.

Eventually, detailed data from the firm's enterprise resource planning system about each plant was collected to compare plants based on various dimensions. Also, each regional operations leader provided qualitative input on the competences and capabilities of their plants. Finally, discussions with the firm's COO provided a basis for this case.

[56] The author of this work was involved.

Table 19: Data collection - case II

Method	Scope	Purpose
Semi-structured interviews	• Two interviews with a network manager from each subnetwork • Interview duration: between 120-150 minutes	• Gather detailed information on plant leaders (e.g., implications of matrix for plant leaders) and discuss outcomes from plant leader interviews • Data and informant triangulation
Network capability workshops	• Two managers from global operations	• Derive current and needed network capabilities for each subnetwork
Market drivers workshops	• Three market segments • Either by phone or during workshop sessions • Each with one participant from the corresponding market segment	• Derive customer perspective and implications for operations
European core team meeting	• Group of managers responsible for European manufacturing network • Participants from operations, human resource, logistics and controlling • Workshop duration: 120 minutes	• Derive feedback on network capability definition • Evaluate subnetwork definition • Discuss the operationalisation of plant competence and performance dimensions • Validate the evaluation of European sites
Global operations meeting	• Regional operations managers • Managers from global production strategy • Workshop duration: 180 minutes	• Derive feedback on network capability definition • Evaluate subnetwork definition • Discuss the operationalisation of plant competence and performance dimensions
Archival Data	• Internal data about plants (e.g., from controlling) • Public available information	• Data triangulation • Additional understanding of case firm and business context

5.6.2 Firm and Network Characteristics

Case firm II is a German family-owned company with more than 20,000 employees worldwide. The firm offers a wide range of products in the area of filtration. Overall, the case firm spends a considerable amount of sales on research and development. Furthermore, it operates a manufacturing network of more than 40 plants located in nearly all regions. However, the firm still generates half of its revenue in the European home market. The Americas and Asia each comprise a quarter of total revenue.

The main product segments are air and liquid filters for the automotive sector. Additionally, case firm II provides filter systems for industrial applications, buildings and water treatment. To serve these markets, the firm is structured into two business units. As shown in Figure 20, the operation is a function detached from business organisations. The business units function as a direct interface to the market, whereas operation concentrates on the internal processes to meet business needs.

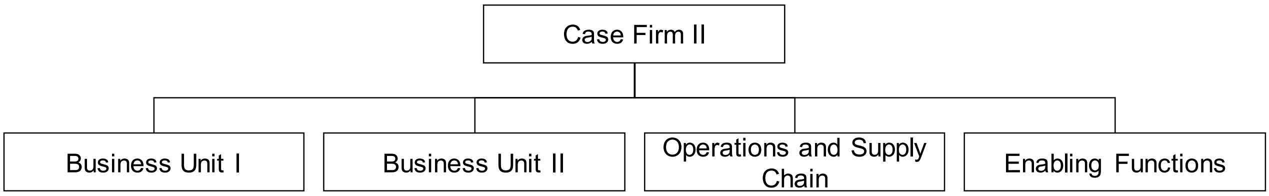


Figure 20: Organisational structure of case firm II

Although Figure 20 depicts a clear separation between business and operations, the interviews revealed that this separation only applies for the BU I. The second BU integrates recently acquired businesses and is neither as clearly structured nor as clearly separated from the operations function as the first BU. The following case discussion focuses on well-structured operations, which mainly provide manufacturing for BU I. The relevant network for this case comprises nearly forty plants.

From a process perspective, plants produce filter elements, injection moulding of plastic components and perform assembly of filter systems (i.e., combination of filter elements with plastic components). Being a supplier for the automotive market, volumes are generally high. For example, one plant of case firm II produces more than 150 million units per year, but some products of the extensive portfolio are sold and produced in low quantities. Nevertheless, compared to other cases presented in this work, case firm II can be described as a mass producer. As such, standardisation and process automation are much higher compared to others (e.g., case firm I).

The relatively large network of case firm II is managed by a chief operating officer and four regional operations managers. Namely, two managers lead the European manufacturing network, and each is responsible for one distinct subnetwork. Furthermore, the firm employs a staff department for global operations strategy development and coordination.

Figure 21 shows the organisational structure, which is the same in each plant. Three distinct functions for logistics, production and services report directly to the plant leader. Case firm II fosters inter-plant exchange through this functional structure. One interviewee underlined that the plant leaders in case firm II have a limited effect for inter-plant exchange: "The plant leaders are rather involved with administrative topics than with technology-related topics" (translated, II.2).

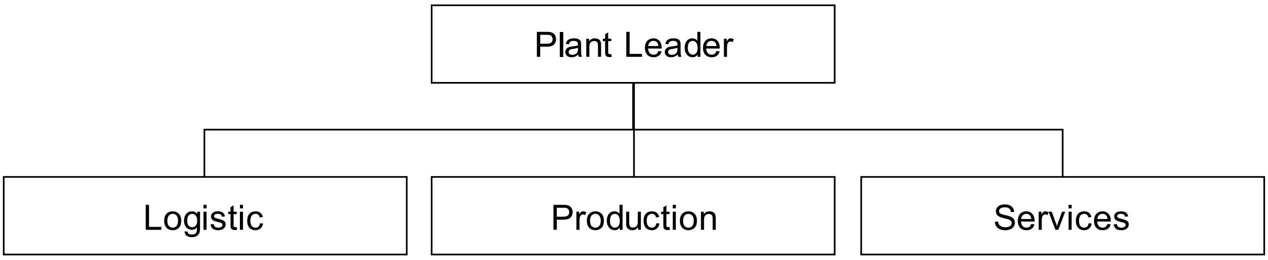


Figure 21: Organisational plant structure case firm II (simplified)

5.6.3 Network Strategy

"Performance of the plant stands or falls on the plant leader."
(translated, II.1)

The statement above underlines the fact that the plant leader is seen as a key decision-maker in case firm II. However, the interviewees also expressed a tendency of their plant leaders to promote internal plant focus. As such, the second case provides an example for plant leaders playing a less prominent role in inter-plant exchange.

Delayering homogenous networks:

The case firm has implemented some significant changes to the structure of their manufacturing network during recent years. Initially, the firm had divided its operations into three distinct clusters, each based on a different perspective (e.g., market, product and volume). This mix of perspectives has led to several conflicts and unclear responsibilities. For a few years, the operations had been divided into two congruent subnetworks based on a clear production technology perspective. One interviewee explains this approach as follows:

> "It means you do not organise your plants according to markets. Instead we organise them according to products they produce, according to their production technology. Because that is what the plants have to exchange. For us this is about process technologies, respective about production technologies. It is not about markets and customers…" (translated, II.1)

The statement outlines that for the case firm product, perspective is similar or even equal to a production technology perspective. Furthermore, the interviewee underlined that creating subnetworks based on the production technology perspective supports inter-plant exchange. As such, the firm delayered its network of nearly forty dispersed plants based on similar production technologies into two distinct networks. Subnetwork I uses production processes to produce filter elements. Subnetwork II applies injection moulding and assembly. The latter merges plastic parts from injection moulding with filter elements delivered from subnetwork I plants. As such, a one-way value stream between subnetworks exists (see

Figure 22). Indirectly, subnetwork I also provides elements for market segments that are provided by subnetwork II. As shown in Figure 22, differentiation of operations and business-unit level allows creating subnetworks by only considering operations related topics. Therefore, the organisational structure of case firm II with its independent operations unit has advantages in creating subnetworks that support inter-plant exchange.

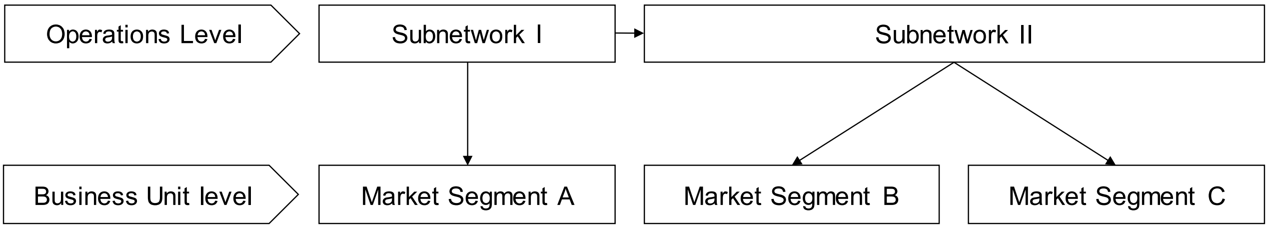


Figure 22: Subnetworks and value streams in case firm II

However, one interview emphasised that firm size is a prerequisite in assigning each plant to one particular network. He explained that with fewer plants, the firm would have to operate more shared factories without a clear assignment to one subnetwork.

> "We decided to have technology leading plants. That is why we do not want all technologies in all plants… I mean, considering the number of plants we have, this is a size you can actually do it. You need a specific size to do that, and you need to have enough plants on every continent." (translated, II.1)

This clear production technology focus appears to be a possible approach to facilitate inter-plant exchange and create networks of homogenous plants. However, it relies on a separation of business and operations perspective, which appears primary suitable for larger corporations.

Nominate network mission:
Figure 23 presents the intended focus of both subnetworks. The most apparent differences between both subnetworks are about network configuration. Whereas subnetwork II has to provide production close to their automotive customers all over the world, market access can be neglected as a driver for the first subnetwork. Overall, operations management of case firm II has set a clear region for region footprint target.
The high degree of automation in subnetwork I comes with high investment needs. Hence, economies of scale are important and relocation is much more complex than in subnetwork II. On the contrary, in subnetwork II production machines can be relocated with fewer efforts. As such, the trade-off between proximity to customer and economies of scale is handled differently for both subnetworks. Although subnetwork I has plants in each region as well, it optimises for economies of scale with larger but fewer facilities. Subnetwork II opts for shorter delivery distances with a much higher number of plants.

Due to the different configurational strategies for both subnetworks, one interviewee explained that operations management has set the goal of creating focused factories, which can be assigned to only one subnetwork. Before, the firm operated mixed plants belonging to both subnetworks with different production technologies. The new objective, however, has not only obtained approval, but also protest. As a result of the focus strategy, some plant leaders have had to hand over parts of their production, thus decreasing their area of responsibility and authority. As the informant outlined, this created a natural defensive attitude: "There are always winners and looser in a network. I mean, it is the intuitive aim of a plant leader to make the own plant grow, to keep the employees… to increase the area of authority" (translated, II.1).

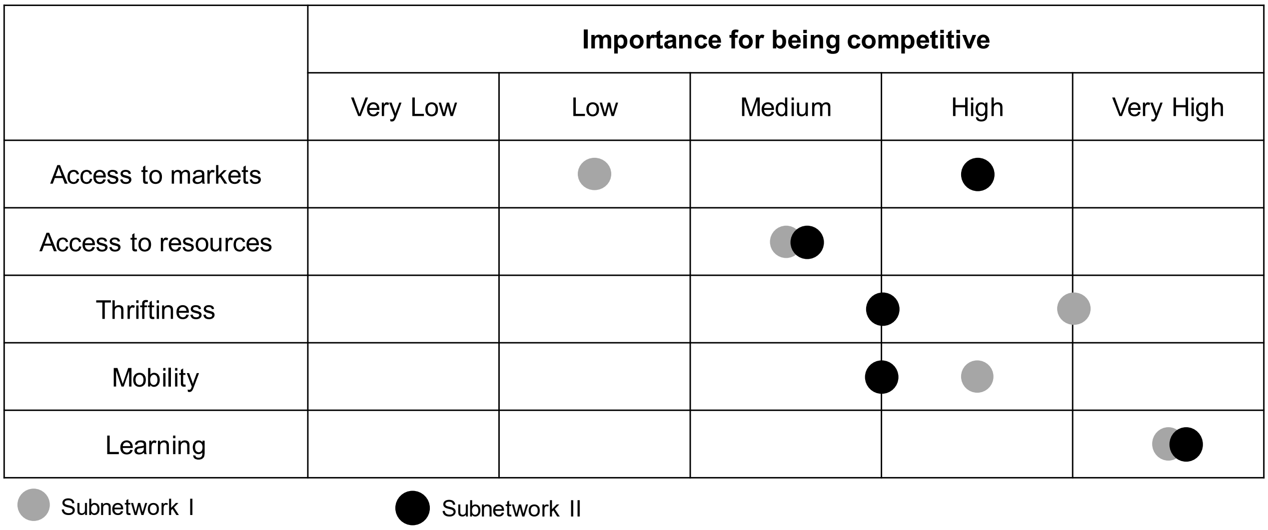


Figure 23: Network targets – case firm II

From a coordination point of view, Figure 23 hints at the fact that the inter-plant-related capabilities of mobility and learning are of major importance (see Figure 23). The project cooperation revealed that a medium to high level of product and production volume mobility is needed in both subnetworks. Learning about internal factors (i.e., exchange of process knowledge between plants) is rated as the highest priority, but one interviewee put this high rating into perspective: "If your plants have a certain similarity in products or production technology, I would say there are few firms saying: I do not care about learning from each other. I would say it is important for everyone" (translated, II.1).

Nevertheless, as presented in the following section, case firm II uses several mechanisms to foster inter-plant exchange. As such, the network capabilities send a clear mission. Subnetwork I is driven by economies of scale and internal learning. Subnetwork II is driven by proximity to the customer and internal learning as well. A network manager from case firm II expressed that these topics are centrally supported: "In general, cooperation across plants is supported… a plant leader is allowed to talk to another plant leader and exchange about anything" (translated, II.2).

5.6.4 Coordination Mechanisms

In order to meet the network mission of high internal learning, case firm II applies several mechanisms to facilitate exchange between network plants. However, the plant leaders play only a subordinate role in the case firm's inter-plant exchange approach.

Means of exchange:

One interviewee of case firm II explained that for more than five years, the regular and primary approach for exchanging knowledge between plants in case firm II had taken place without the direct participation of plant leaders. Through several functional and process technology-oriented lead teams, regular knowledge exchange was conducted on an expert level. These lead teams would discuss process improvements and innovations and define standards for machines, tools and processes. Each plant that performed, for example, a particular injection moulding process typically participated with one or two process engineers in the respective lead team on injection moulding. The central staff function organised the lead team meetings, and the plant leaders only had an indirect saying in this exchange. Eventually, they had to accept that their process engineers participated in these meetings. According to the interviews, on rare occasions they would not let their experts leave due to recent problems in their own plant. However, this rarely happened.
Eventually, this lead-team approach with regular physical meetings between experts from various plants from all over the world created substantial travel costs. Nevertheless, both interviewees from case firm II underlined that they trust the effectiveness of this approach for exchanging knowledge across the network: "We believe that it [cost for inter-plant exchange] is worth it" (translated, II.1).
Concerning plant leaders, the interviewees explained that the yearly leadership forums posed an exchange platform. However, the informants noted that these events were not specifically for plant leaders, but all high-level managers of the case firm. Nevertheless, according to the interviewee, these meetings fostered inter-personal ties between plant leaders.
Within the regions, it was up to the regional operations manager to set up plant leader meetings. Both interviewees reported that within Europe, the plant leaders met between one and three times a year to report the performance of their plants and discuss current topics. Furthermore, plant leaders participated in monthly one-to-one calls with the regional operations managers, mainly for reporting purpose.

Autonomy of exchange:

In general, both interviewees elucidated that plant leaders have limited autonomy regarding inter-plant exchange in case firm II. Knowledge exchange between plants is organised centrally by a staff unit. Plant leaders are expected to go through central functions for problem-solving or support demands. For example, a German plant was recently struggling.

Support was provided by other plants only after the regional operations manager directly approached the experts located in these plants. An autonomous exchange between the plant leaders did not take place.
The informants also explained that the degree of autonomy differs between plant leaders in subnetwork I. First, the leader of the largest plant in subnetwork I is also regional operations leader. As such, he holds decision autonomy for many network related questions in subnetwork I. Second, a special relationship between some plants in subnetwork I also comes with high autonomy for the leader of the more competent plant in the respective exchange between both plants. It mainly rests with the leader of the mother plant who decides on the exchange of experts, knowledge and even business: "It is possible to exchange business between the satellite and the mother plant" (translated, II.2).
This unique relationship between plants is discussed in more depth in Chapter 5.6.5. Aside from the particular case of satellite and mother plant in subnetwork I, the plant leader's autonomy for inter-plant exchange in case firm II is somewhat limited.

***Incentives*:**
Both informants reported that just like in case firm I, the incentive system structure has been modified in the recent past. Before, the variable part of the plant leaders remuneration was mainly a function of individual objectives linked to the plant's performance, but this has changed to overall firm success. One interviewee evaluates the incentive system change as follows:

> "Immediately, it has no noticeable effect. However, in the intermediate run, I expect a positive effect… like any change, it takes some time until it works… In principle, the motivation for changing the incentive system is to foster the network idea." (translated, II.2)

Although one informant expected positive effects regarding inter-plant exchange. Both interviewees outlined that the leaders of smaller facilities will not see how they can contribute to the overall firm goals. As such, these high-level goals will not create a strong incentive for inter-plant exchange.
Nevertheless, both interviewees underlined that in addition to financial incentives, the plant leaders have individual goals that can have implications for their career advancement. Inter-plant exchange related topics can still, therefore, be significant for the incentive discussion.

Structure of careers and candidate selection:
Plant leaders in case firm II are relatively high on the corporate hierarchy. Both interviewees expressed that as vice-presidents, the plant leaders are part of the top leadership level. Within the firm, the plant leader position is acknowledged, and it is therefore seen as an attractive career opportunity. One interviewee remarks that it is a challenge to find an

adequate assignment after the plant leader job. Only four direct reports are in the direct line above more than forty plant leaders.

Both interviewees highlighted that the plant leader position is also a long-term assignment and several plant leaders in case firm II have been doing this job for more than ten years:

> "…we try to fill the position for the long-term. The disadvantage of a rolling system, when every two or three years the next one comes, it means a complete readjustment of the local organisation with regard to [leadership] style. This is not always helpful… we favour consistency." (translated, II.2)

In general, candidates for the plant leader position in case firm II are selected without any standardised approach. Though one interviewee mentioned that there had been a quite recent discussion about creating a more guided career path for plant leaders, case firm II did not yet apply any standardised approach at the time of the interviews. However, the second interview revealed that, in general, local people are favoured for the plant leader job.

Overall, some examples in subnetwork I underlined that plant leaders can be assigned with responsibility beyond their facility. Expanding the area of responsibility is, therefore, one potential career step in case firm II.

5.6.5 Guide Plant Leader Focus

Due to the size of the case firm networks, the conceptual framework has only been applied to one of the European subnetworks. The classification of seven plants according to both dimensions of the conceptual matrix (see Chapter 4.1.3) provided interesting insights and implications.

Operationalisation:

During the project cooperation between the case firm II and the ITEM-HSG, several attempts were made to find useful measures for comparing plants on capability and performance scales. Eventually, the following four measures were applied to assess plant capabilities: (1) experience of the plant in production for the product group, (2) number of process innovations by the plant during the last years, (3) knowledge outflow and network support, and (4) digitalisation maturity. The plant's short-term performance was measured by its margin achievement (i.e., a comparison of the plant's actual performance to a threshold value defined for each product segment).

For the specific context of plant leader focus, however, the interviewees suggested a slightly different operationalisation of the performance dimension. Since both interviewees outlined that the market impact on the previous horizontal axis is beyond the plant leader's control, they confirmed that operational performance would be more suitable. Though their assessment has been qualitative, the interviewees agreed that the monthly reporting of safety, quality, delivery and cost (SQDC) performance indicators could be a suitable data basis. For application of the conceptual matrix, plant positions were evaluated based on a qualitative assessment of the interviewees. For this qualitative rating, the plant capability assessment also takes plant complexity in terms of product range into account.

Subnetwork I:

Figure 24 presents the European network of plants producing filter elements. Two distinct groups of plants emerged from the illustration in the matrix. Three plants (A, B and D) with high competences and stable operation are located in the top-right quadrant. Three plants (E, G and F) are located in the low capability and low operational stability area of the framework. Each of the second group of three is linked to one of the more capable and stable plants. For example, as indicated by the arrows, plant E functions as a satellite for plant A. Plants E, G and F function as an extended workbench and produce similar products as their parental counterparts. They are located in Eastern Europe; thus, they have labour cost advantages compared to their Western European counterparts.

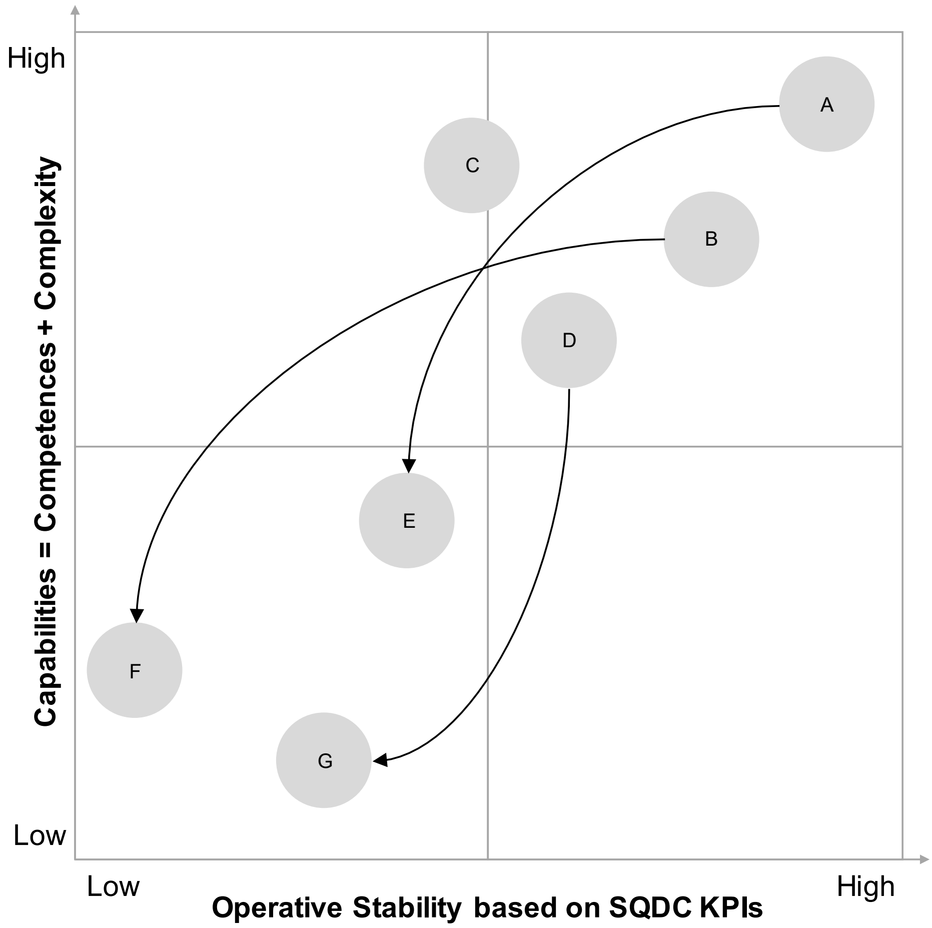


Figure 24: Application of conceptual matrix regional subnetwork I of the second case[57]

[57] Arrows indicates parent-satellite relation between plants.

Plant C is the only stand-alone facility in the subnetwork. It is characterised by a high capability level but failed to deliver stable performance due to an overload in recent years. By slowing down growth in plant C, the production has gained stability, and has thus continuously moved to the right. Thus far, the leader of plant C has been focused on stabilising operations. The interviewee summarises the focus of plant leader C as follows: "Continuous improvements and efficiency gains are on his agenda to move further to the right2 (translated, II.2).

Implications:

Similar to what was seen in the previous case, both informants from case firm II confirmed that the proposed matrix is a suitable tool to depict the network status of plants. The interviewees confirmed the informative value and validity of the plant positions. Furthermore, the conceptual framework proved meaningful by outlining the special relationships between plants in subnetwork I. Whereas managers of plant F, G and E are focused on their own facility, the leaders of A, B and D also have to integrate the linked satellite into their awareness. They even hold responsibility for volume and product allocation between their own and the satellite plant. One interviewee remarks that in the past, this autonomy has led to higher utilisation of the competence plant at the expense of the satellite plant. Nevertheless, this has not been a significant issue, according to the network manager: "At the end of the day, they do not just look after themselves, and they also consider the business case" (translated, II.2).

To inhibit this self-optimisation, the competence plant leader had individual objectives, which also considered the performance of their satellite plant. As such, their incentives were bound to the performance of two plants (i.e., their own and the satellite plant). However, since the incentive system has changed recently (see Chapter 5.6.4), remuneration based on individual goals is not applied anymore. However, the interviewee emphasised that the autonomy of plant leaders A, B and D also functions as an incentive. As such, he confirms the status of specific plant roles for other plant leaders of the network (Cheng & Farooq, 2018; Vereecke et al., 2006). For example, leaders of A, B and D are authorised to instruct the managers of their satellites. Even more authority is assigned to the leader of plant A. In addition to managing the case firm's largest facility in terms of headcount and revenue, he is also regional operations leader for subnetwork I. As such, this position clearly comes with a network-wide focus.

Overall, application of the conceptual matrix in case firm II mainly showcased the prominent role of plant leaders in the top-right quadrant. The case confirmed that this category of plant leaders exists in the real world and that network management guides their attentional focus towards the network through distinct measures.

5.7 Case III

Although the third case presents the smallest firm in the sample, it provides the opportunity to discuss three distinct subnetworks. The presentation of data collection, firm and network characteristics and the within-case analysis follows the same structure as the previous two chapters.

5.7.1 Data Collection

As shown in Table 20, data collection for this case was limited to three main sources. Data was collected between December 2017 and July 2019. However, archival data from previous project cooperation with the case firm in 2014 and 2015 also informs this work. During this previous project, a detailed network strategy was developed, and measures to configure and coordinate the network were defined.[58] This work and its analysis take into account the archival data from previous cooperation between the case firm and the ITEM-HSG (namely, in understanding the network focus and structure), an in-depth interview transcript with a network manager of the case firm conducted for the bachelor thesis of undergraduate student, and archival data from public sources, firm presentations and internal sources on plant performance.

Table 20: Data collection - case III

Method	Scope	Purpose
Semi-structured interview	• One interview with a global operations manager • Interview duration: 150 minutes	• Gather detailed information on plant leaders (e.g., implications of matrix for plant leaders) and discuss outcomes from plant leader interviews
Workshop	• One manager from network management • Workshop duration: 150 minutes	• Operationalisation of plant comparison • Data collection of qualitative and quantitative data for each site
Archival Data	• Several documents from previous project cooperation with the case firm • Interview transcript on incentives in case firm • Public available information	• Data triangulation • Additional understanding of case firm and business context • Utilise previous findings on network focus and subnetwork structure in the case firm

Both the workshop and the interviews were conducted with the same informant from the case firm. Therefore, triangulation is based namely on archival data input from previous cooperation with multiple informants from the case firm.

[58] The author of this work was not involved in the previous project.

5.7.2 Firm and Network Characteristics

Case firm III is a Swiss-based and stock listed manufacturer of serial and customer-specific machines in the field of wire processing. The portfolio ranges from test modules to machines that handle, cut, crimp or harness wires. According to the firm's reports, it is global market leader and serves the five segments of automotive, aerospace, data, industrial, and service.

Despite being the smallest firm within the sample (see Table 17), case firm III operates a growing international manufacturing network of about twenty plants and provides a local presence in most world regions. During the last seven years, the firm has pursued an active growth strategy and has acquired several smaller competitors. Because of this, the global dispersion and the number of different production processes and products within the network increased; thus, IMN complexity increased. This inorganic growth also supported the surge in revenue and headcount. In the period from 2016 to 2018, the firm increased its headcount by more than 20%.

Case firm III is organised in three distinct centres of competence, which represents a typical business unit structure, according to the interviewee. These three business units differ in their product portfolio, and are focused on either serial machines, customised machines or standard applications. As shown in Figure 25, each BU has its own corporate functions like operations or sales. Although each BU operates a distinct subnetwork of plants, some operations functions (e.g., operational excellence, procurement) are not assigned to a particular BU but located centrally in form of a staff unit. Nevertheless, significant differences in products and customer demands create three largely independent operations for each BU.

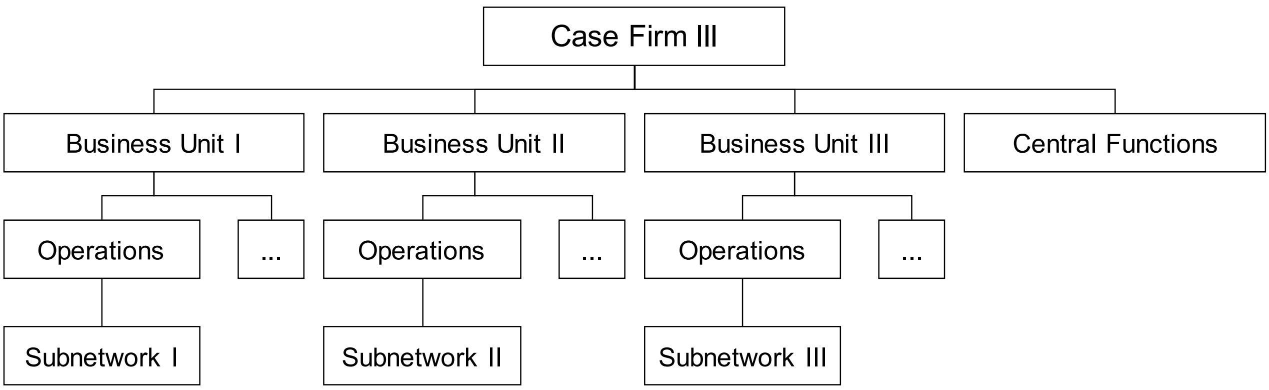


Figure 25: Organizational structure – case firm III (simplified)

Contrary to the previous case, there is no standardised organisational structure for all plants and networks. Most plants of case firm III have a general manager responsible for the end-to-end process, including sales and service. A level below, a local operations leader manages the production. Concerning the topic of inter-plant exchange, a discussion with the interviewee underlined that both positions need to be considered and cannot always be separated in the following chapters. As such, the term plant leader is used ambiguously in the following.

5.7.3 Network Strategy

"There are no synergies across the networks, in fact. I allowed exchange to a certain extent, but not too much, because we cannot benefit from each other." (translated, III.1)

The statement above underlines that the three subnetworks of case firm III share only limited synergies. However, the informant explained that within at least one subnetwork, inter-plant exchange plays a prominent role.

Delayering homogenous networks:

Figure 25 shows that case firm III operates three distinct manufacturing networks. Each subnetwork produces an independent product portfolio and has to cope with individual customer demands. Therefore, the overlap between plants of different subnetworks is very low. According to the interviewee, there are more or less no synergies between the plants of different BU. Additionally, he underlined that the formation of subnetworks is not only the result of limited synergies. He further explained that complexity to manage an aggregated network of twenty plants is too high. Instead, the firm assigned an operations leader for each network, and these managers are located on-site in a plant of each network.

The first subnetwork operates five plants with a headcount of between 6 and 150. High quantities allow for a sophisticated level of automation, which is also driven by extensive cost pressure. Each plant of the network is focused on a few products and produces high quantities. There is essentially no overlap in products or processes between the plants. As such, the interviewee explained that potentials of exchange between plants are seen as very limited.

The cluster leader of the so-called Serial network is located in a Swiss facility. Only four plants belong to subnetwork II, which is steered by a cluster leader who is located in a German plant. The smallest plant employs only five people, whereas the largest facility has a headcount of about 100. Project business characterises subnetwork II. Customers of special machines place high demands on delivery performance and adherence to specifications.

Finally, the subnetwork III operates eleven globally dispersed plants in proximity to customers, who expect short lead times. Headcount of plants in the Std. Application network is between 15 and 120. Plants of this subnetwork possess a high degree of similarity regarding products and manufacturing processes, and knowledge exchange and volume shifting play an essential role. The cluster leader of this subnetwork is located in Turkey.

Again, case III provides the example of a firm that offers a diverse product portfolio. The case firm delayered its IMN of about twenty plants into three congruent subnetworks based on the strategic orientation in terms of a customer demand perspective. Similarities between plants in case firm III are not necessarily high even within the subnetworks. Only one subnetwork exhibits significant overlap in process technologies and products.

Nominate network mission:

The interviewee explained that in general, case firm III pursues a local for local strategy. Proximity to the original equipment manufacturers is important, especially in the Std. Application subnetwork. Concerning inter-plant exchange, the interviewee rated both network capabilities of mobility and learning for all three subnetworks (see Figure 26). This outlines that the importance of inter-plant exchange varies significantly between the subnetworks. According to the interviewee, exchange of volumes and internal learning are of highest strategic importance in subnetwork III (i.e., Std. Application). Plants of this subnetwork are very similar in product portfolio and mostly perform the same processes. Subnetwork II plants also perform similar processes but differ in products. As such, the learning potential is high, but the strategic goal of production volume mobility between plants is only on a medium level. The serial subnetwork is optimised for economies of scale and bundles each product in a distinct plant. Thus, mobility of volumes is not relevant, and learning potentials are low. As such, Figure 26 underlines that inter-plant exchange is of secondary importance in subnetwork I. Thus, the following discussion on coordination measures primarily refers to subnetwork III and, to some extent, subnetwork III.

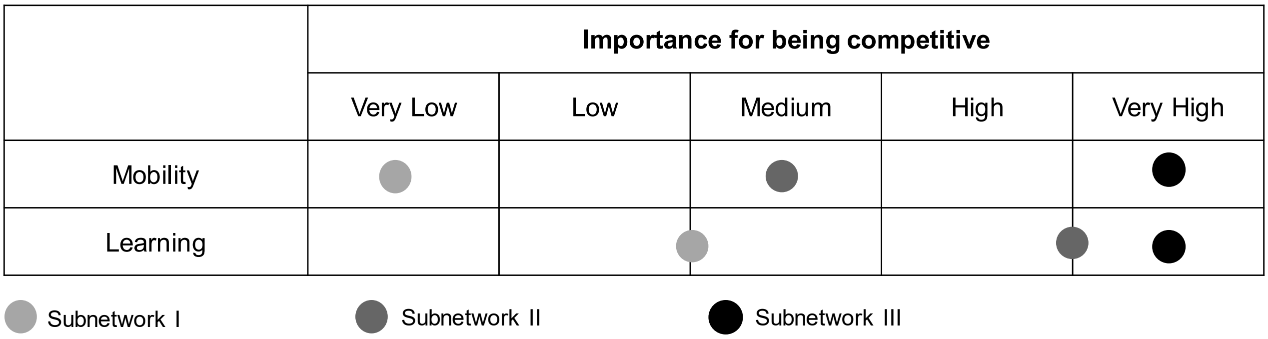


Figure 26: Coordination related network targets – case firm III

The interviewee expressed that, in particular, the network mission as presented in Figure 26 has been translated into specific measures for subnetwork III. He initiated and promoted the idea of inter-plant exchange in this subnetwork, so he outlined that persuasive efforts were needed in the first place: "It is important that we have a community, which also receives necessary resources, also from the plant leaders. They have to see the benefits. That is the most important thing" (translated, III.1).

Once more, the statement confirmed that plant leaders are key stakeholders for the coordination-related network capabilities, but the interviewee also reported that attempts to integrate plant leaders into strategy definition were only moderately successful. Within one subnetwork, all plant leaders were asked to provide their opinion on the future network strategy. Input from small plants with a low degree of maturity was particularly not useful. Although he had experienced mixed results, the interviewee expressed a firm belief that

integration of plant leaders into network strategy definition is key for coordination related questions: "How do we want to cooperate within the network" (translated, III.1)?
The interviewee reported that during his assignment as network manager, he involved selected plant leaders (i.e., the business unit's operations leaders) in strategy definition. Similar to the statement of one network manager in case firm I, he also recognised that plant leaders are crucial for strategy implementation: "I need to make him responsible because he has to implement it" (translated, III.1).

5.7.4 Coordination Mechanisms

Case firm III applies several mechanisms to coordinate its subnetwork. Some mechanisms directly or indirectly address plant leaders about creating inter-plant exchange. The following primary refers to subnetwork III (i.e., the subnetwork with the highest strategic importance of inter-plant exchange).

Means of exchange:

Similar to case firm II, the main mechanisms to exchange knowledge between plants takes place without the direct interaction of plant leaders. A so-called *community of operations experts* from all plants in subnetwork III meets once a year. The interviewee explained why this exchange community is only implemented in one subnetwork but not across all plants of case firm III:

> "Otherwise, we would have topics where half of the people have no interest. This exchange is based on the premise that it must be of interest, it must create added value, and things are getting implemented operationally." (translated, III.1)

The idea that all participants of this exchange should take at least an idea home was, according to the interviewee who initiated this exchange, also a key in convincing the plant leaders of this idea. After all, the plant leaders are expected to deploy and finance the travel expenses of their participating employees. The interviewee explained that this buy required extensive lobbying, but finally garnered commitment.
Furthermore, functional exchange is facilitated through a quality- and lean-audit process. Employees from all network entities conduct audits of peer plants regularly. According to the informant, in the past this process worked well to enable mutual learning and create transparency about other entities.
The regular information exchange between plants and headquarters differs for each network. In the first subnetwork, a monthly call between each plant leader and the network management is conducted. In subnetwork II, each month central network management only talks to the subnetwork operations leader. In subnetwork III, however, all plant or production leaders participate in the call similar to what was seen in the first case (see Chapter 5.5.4). These calls are, therefore, less focused on KPI reporting:

> "I rather do not see it as a typical reporting function… he [plant/operations leader] should rather see what his peers have been doing, and he should ask them why they performed better." (translated, III.1)

This statement underlines that the joint conference calls also serve a knowledge exchange purpose. These calls create transparency in the sense that they inform other network units about the current performance and the measures taken to get there. As such, these calls constitute a possible answer to the interviewed plant leaders' perceived impediment of lacking transparency in many IMNs (see Chapter 3.3.7).

Autonomy for exchange:

In general, the autonomy of plants in case firm III is higher than in case firm II. The interviewee's comments indicated that inter-plant exchange is based on the willingness and buy-in of each plant's representatives. Autonomy differs to a large extent between "normal" plants and plants that are assigned with the cluster leading competence. For example, the operations leaders are assigned with the autonomy to organise operations meetings in their respective networks.

Furthermore, the interviewee explained that firefighting or problem solving do not follow any structured approach. Requests for problem-solving are usually directly addressed to the leader of the supporting plant. For example, the Turkish plant had directly requested help from the Germany facility in the past. Due to the unique role of the German plant as cluster leader, it had an obligation to support. However, each plant (or the respective person in charge) generally has the autonomy to decide whether or not to provide support. The interviewee mentioned the downsides of this approach: "We had topics where I could not do anything. They said: no I have too much work… We certainly had those problems" (translated, III.1).

The regular knowledge exchange in subnetwork III is also more or less based on the optional participation of each plant. The interviewee who initiated this exchange platform underlined the importance of winning the plant and operations leaders over for this idea. According to his view, the network should not apply a top-down philosophy. This somewhat decentralised approach might also depend on the firm's size. Despite operating an IMN of twenty plants, case firm III is, in terms of headcount, still comparably small (see Table 17). Thus, the firm does not afford a pronounced central network management unit as in the first two case firms. Instead, the case firm nominates a cluster leader, who is then assigned with both responsibility for IMN and the operations of his or her own plant.

Incentives:

Contrary to the first two cases, case firm III still links the variable remuneration of plant leaders to the performance of their plant. The interviewee explained that he tried to set goals for the plant leader, who in the end, had to translate these objectives into the different functions for the plant to create: “I tried to set the goals in a way that they could only be achieved as a team within the plant” (translated, III.1). However, although objectives on network-level exist, they are not linked to the plant leader’s remuneration. Only the operations leader of the cluster has this incentive. According to the interviewee, linking the plant leaders’ bonus with goals for the network was unenforceable: “There are many who say if I cannot influence these objectives to full extent, I do not want these objectives. But this is wrong. You are always the group” (translated, III.1).

The interviewee was well aware that his current incentive system impeded cooperation among plants to a certain extent. Since local plant KPIs are relevant for the plant leader’s bonus, he had no financial incentive to support others. Nevertheless, the interviewee believed that, at least for subnetwork III, this system would not impede inter-plant exchange too much: “It is okay. I can live with it. We do it by appreciation and saying ‘thank you’” (translated, III.1).

Furthermore, the interviewee expressed that especially outside of Europe, people identify themselves with the firm and highly value if their work is recognised. Therefore, he believes that network exchange is also successful because the firm recognises these efforts and does not apply a top-down approach: “The incentive is a ‘thank you’ and to have a platform for exchange where you can show how good you are” (translated, III.1).

Examples in the network underline that the willingness to engage in inter-plant exchange can also have positive effects on a personal career. The informant explained that an individual from the Turkish plant had been promoted in part because of his willingness to share the local knowledge with other plants of the network.

Overall, although the case firm operates a financial bonus system in subnetwork III that does not facilitate the cooperation among plants, it achieves inter-plant exchange through the recognition and appreciation of individuals.

***Structure of careers and candidate selection*:**

With regard to the incentive system, which does not motivate plant leaders to engage in inter-plant exchange, the interviewee underlined that selecting the right people is particularly relevant for the case firm: “In some clusters, it depends on the plant leader/ general manager – he or she has to be the right person. Otherwise, you have a problem” (translated, III.1). He is looking for people with a strong intrinsic motivation, who believe in cooperation and focus on the overall group success instead of their own facility’s EBIT.

In general, the firm does not apply standardised career paths for the plant leader job. The interviewee contemplated about the fact that it is a long-term position at the top of the firm hierarchy: “we do not take juniors for something like that” (translated, III.1). Furthermore, the interviewee mentioned that firm’s top management always interviews the candidates for a plan leader themselves.

In addition to a thorough understanding of the wire processing industry, the candidates have to be aligned with the firm’s culture and understand the local culture. Thus, in most countries a local candidate is selected for this position. It also sends the signal to the local employees that they can make progress in this firm. However, in China, for example, a German citizen is in charge. The interviewee mentioned that it is beneficial to have somebody who is responsible for China and speaks the same language as the central unit. Otherwise, it would be difficult to assure that central directives are understood and implemented in the right way.

The career opportunities for plant and operations managers in the firm are clearly visible. Examples from recent years show that plant leaders can expand their responsibility by being assigned to additional plants. For example, the US manager has become responsible for three manufacturing facilities and the Turkish plant leader has been assigned with the task of building another facility in Bulgaria. Local plant and operations leaders also have the opportunity to become members of the business unit's management team. For example, the operations leader of the Turkish facility was recently promoted to the operations leader of the whole subnetwork III.

5.7.5 Guide Plant Leader Focus

Application of the conceptual matrix sparked keen interest among the interviewee. The application of the conceptual matrix for all three subnetworks provided particular insights about the operationalisation of the x-axis. Furthermore, discussion about the implications of the matrix, namely for subnetwork I, revealed that linking coordination mechanisms to a plant's position within the matrix does not work for all network types.

Operationalisation:

The interviewee gave an *it-depends* answer to the question of how to operationalise plant capabilities and performance to receive a meaningful picture with implications for the respective plant leaders. He stated that plant performance is contingent on network characteristics. Directly comparing EBIT could be a potential operationalisation, as plant leaders are responsible for profit and loss. However, comparability is limited because some plants face external contingencies like high factor costs, which the plant leader cannot do anything about: "He can be as good as he wants to be; he will never execute that much" (translated, III.1)

Therefore, the interviewee suggested considering those competitive priorities that drive each network and then find KPIs or a qualitative operationalisation. As each subnetwork of case firm III has different characteristics, different factors need to be mapped on the x-axis.

For subnetwork I, cost is the main competitive factor. Due to high degree of automation, factor costs do not distort the comparison too much. For subnetwork II, delivery performance and quality are distinctive factors. Thus, KPIs to measure reliability of specification and on-time delivery share are suitable. In subnetwork III, delivery speed and cost are the main competitive drivers, so a lead-time KPI for similar products is suitable for comparing the speed performance of plants. For cost, both EBIT and the equivalent output

per employee would provide a suitable comparison of plants. Currently, all of these KPIs are already measured but not necessary evaluated in the same way. The interviewee therefore hopes that the ongoing digitalisation will enhance data quality to allow a fair comparison of plants: "By digitalisation, we want to measure with higher accuracy so that we compare apples with apples" (translated, III.1).
For the y-axis, plant capabilities are linked to the respective experience. As such, the interviewee confirmed the view of Demeter and Szász (2016) who bring up plant age as a key indicator for plant competences. However, the level is also related to the experience of responsible people. For example, the relatively new plant in Bulgaria is led by an experienced manager from Turkey. Hence, the plant competence level needs to incorporate this factor. Despite a customised approach for assessing plant performance in each network, according to the interviewee, the competence level evaluation does not vary significantly between the networks.

Subnetworks I and II:

Application of the conceptual matrix for subnetwork I and subnetwork II underline that both dimensions are suitable to identify the location of the cluster operations leader (see Figure 27). In both networks, plants with highest performance and capability level host a subnetwork related function. The local operations leaders of A and E assume the cluster related operations lead. As indicated by the arrow in Figure 27, plant E and the respective managers support the build-up of a new facility in Eastern Europe.

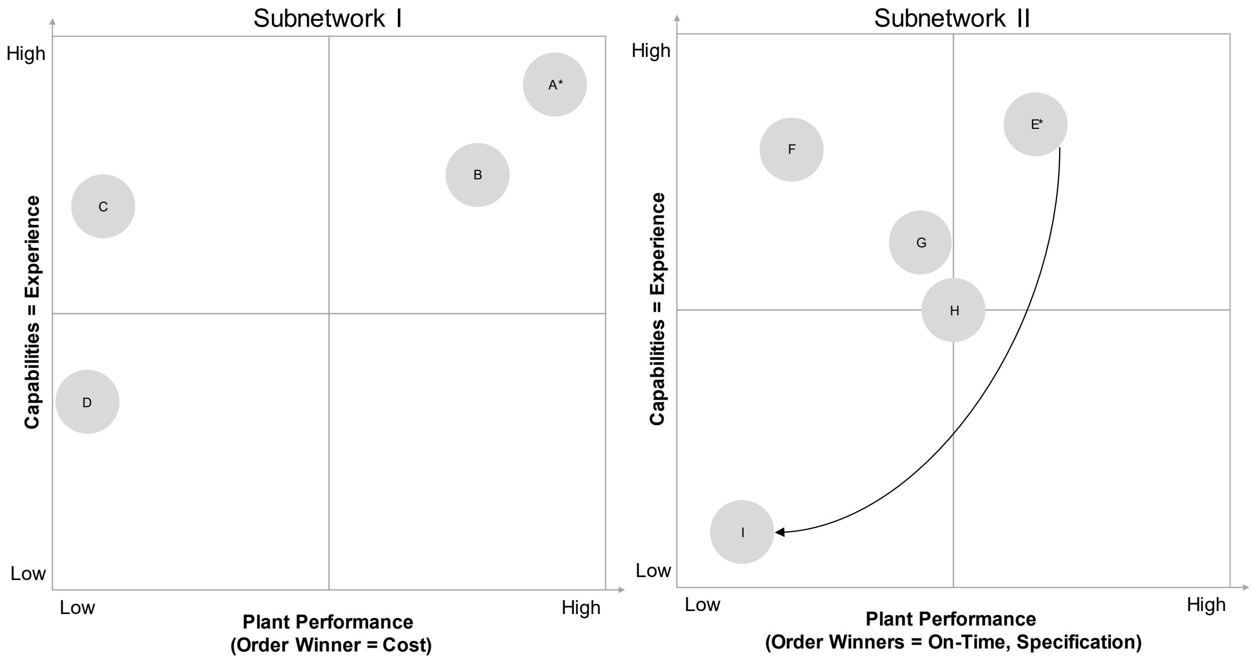


Figure 27: Application of conceptual matrix for subnetwork I and II in the third case[59]

[59] * location of cluster operations leader.

Nevertheless, both networks have only limited cooperation and exchange among plants. In subnetwork I, due to differences in products and processes, the implications for the head of plant A are low. The interviewee did not see any network-related tasks for the respective individuals. Furthermore, due to a major rebuilding in factory A, resources and focus are currently assigned to their own facility.

Subnetwork III:

Figure 28 presents the categorisation of nine Std. Application plants, according to a qualitative assessment of the interviewee. The Turkish plant takes the most mature and best-performing position. Sites in Tunisia and China also hold similar positions. Despite medium or even high capability levels, three sites face current performance issues. It was decided to close one of these three facilities after several attempts to move the facility further to the right.

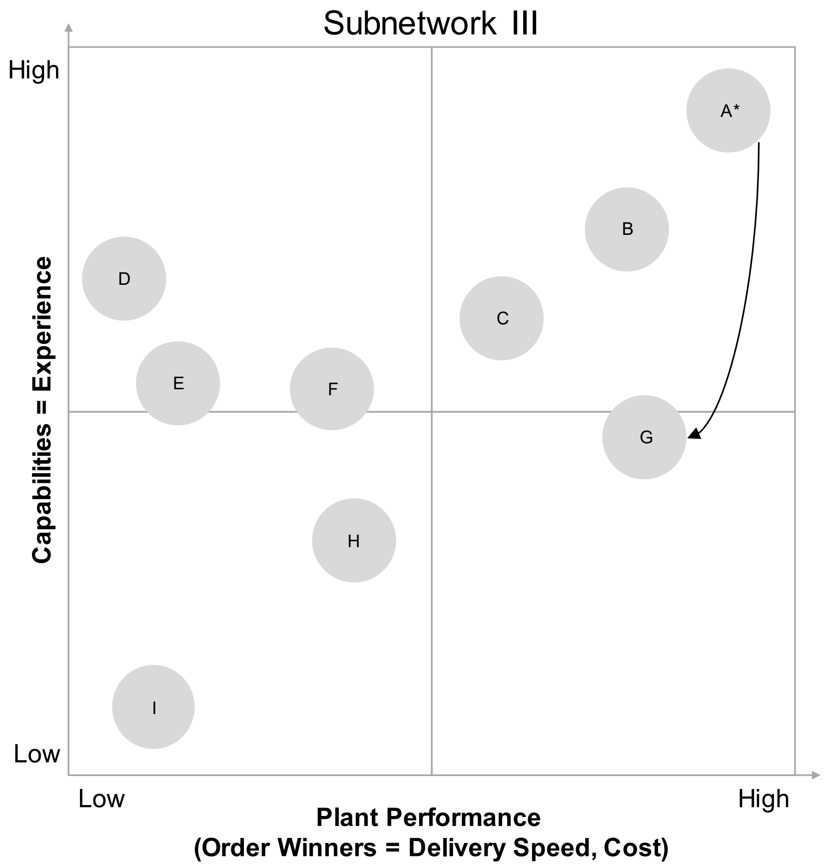


Figure 28: Application of conceptual matrix for subnetwork III in the third case[60]

Plant G is a relatively new facility benefiting from the support of the Turkish management team. The Turkish leader holds responsibility for both plants A and G. The interviewee explained that in an impressively short time, the Turkish operations leader and his team have

60 * location of cluster operations leader.

set up the new facility. As such, the high experience level of G results from the support and responsibility of the Turkish team. According to the interviewee, it is ideal to assign the responsibility for a new plant to the cluster leader, who has the best resources of the network at his facility. This helps to evade protectionism of individual resources.
The relatively new plant I is also still in the build-up process, and therefore neither holds a high level of experience nor performs well. The manager of facility I regularly seeks help with the central function to increase the local capability level. The interviewee remarks: “he approaches me, he wants support” (translated, III.1).
Figure 28 presents a gap in the lower-right quadrant. The interviewee underlined that the competitive priorities a plant faces in subnetwork III can only be met if a sufficient level of capabilities is achieved: “Lower right does probably not exist. They would not be successful. Without capabilities, it would be a coincidence. Capabilities need to be high to get speed… it is rather unrealistic for us” (translated, III.1).
Plant G is the only expectation in the lower-right quadrant. However, this position is only temporary and results from the support of the cluster leader.

Implications:
The application of the conceptual matrix for all three subnetworks provided evidence that the case firm already implicitly applies a logic that assigns different duties to selected plant or operation leaders. Each cluster leader is located in the plant with the highest capability level. Responsibility for the operations of the whole subnetwork implies less focus on their own facility. However, the coordination character of this role is less pronounced in both subnetworks I and II, which lack in-depth cooperation among plants.
The discussion of subnetwork III revealed that leaders of plants in the lower left quadrant should be focused on their operations. However, they have to actively search for support from someone, perhaps from the cluster leader, and should participate in all knowledge exchange platforms. Their autonomy is limited to their own operations or even less as the example of plant G shows. The interviewee confirmed that incentives, which guide the attention on his own plant, could be in the interest of the firm for this type of plant leaders. Subnetwork III also exemplifies that these start-up plants could be managed by a plant leader from the top-right quadrant.
Furthermore, the discussion with the informant revealed that leaders in the top-left quadrant should seek for best-practices and ideas from other plants. Their job is less about asking for support in terms workforce, but more about implementing something with his or her own resources. Therefore, internal plant barriers need to be overcome:

> “He has to help himself, but he also has to listen to what else there is. He has to learn from that and implement what others do better. It is more about open-mindedness and overcome the not-invented-here syndrome; this he has to overcome. He has to go on a study trip, and he has to ask for help.” (translated, III.1)

Nevertheless, as their responsibility and autonomy is limited to their own facility and therefore guides their focus internally, their advantage is a relatively high capability level that allows them to take their own measures to get things done. For example, the interviewee remarks that the plant leaders of upper-left plants are capable of defining and implementing a roadmap to move the plant from left to right within the framework: "They can really set up a plan, a program, a roadmap saying: I am here, I want to go there. I will go the following steps, and I need support here, which I will get from the best" (translated, III.1).

Finally, the cluster leader assignment in subnetwork III exemplifies the attentional implications for the top-right quadrant. These individuals are not only focused on their operations, but also have to consider the entire network. The interviewee emphasised that the attentional shift can be facilitated through incentives and that it requires additional resources.

> "…not only incentives, you also need to assign additional resources to the plant. Because, if you take him [the operations leader] from there, then he needs resources to transfer his knowledge. So that if somebody asks for his help, he can provide help. Therefore, it would be a neat idea if he gets group objectives. a) Incentivise what he is doing for the group and b) free resources for him." (translated, III.1)

The interviewee also explained that in subnetwork III, cluster leaders are assigned with the task of organising the regular knowledge exchange and the autonomy to support other facilities in the network. In order to overtake these duties, additional resources on plant level are required: "The general manager has to back up his operations leader. That is on him. He can distribute these costs through transfer pricing or accept that his plant will move to the left (translated, III.1)." The interviewee pointed to the fact that plants with network responsibility (i.e., plants where the cluster leader is located) need more resources and thus, might exhibit lower performance on the framework's x-axis. As such, the cluster leader is not necessarily located at the plant with the highest performance.

Eventually, the interviewee explained that structural factors also determine the position of a plant within the conceptual matrix: "Of course, it might be that somebody does not rise [within the conceptual matrix] due to other topics" (translated, III.1). For example, if cost is the only performance indicator, a plant leader in Western Europe would not be able to compete with one from a low-cost country in subnetwork III. Still, the plant leader in Western Europe could be better suited to adopt a network perspective, as his plant holds the necessary capabilities. As such, the informant remarked that the application of the conceptual matrix builds on a proper definition of the x-axis. The matrix will not serve its purpose if the plant performance comparison is based on measures that the plant leaders cannot change. However, he also stated that if designed correctly, the matrix provides a powerful management tool. This case exemplifies how the conceptual framework could be applied to design coordination mechanisms according to the plant leader's situational context.

5.8 Case IV

The last case considers one subnetwork of the most prominent firm within the sample. Due to the size of the firm, it was expected that the network management approach of this firm would vary significantly in terms of professionalism compared to the previously presented, much smaller case firms. This did not turn out to be a correct assumption, mainly because the firm network management is not as centralised as expected. The presentation of data collection, firm and network characteristics and the within-case analysis follows the same structure as the previous two chapters.

5.8.1 Data Collection

As shown in Table 21, a semi-structured interview and archival data from a previous project form the basis for the following analysis. Data was collected in July 2019 and during previous project cooperation in 2015. During this previous project, several workshops with the subnetwork's CEO, operations management and plant leaders were conducted. [61] A detailed network strategy was developed, and measures to configure and coordinate the network were defined. As such, the archival data from the previous project informs this work, namely to understand the network focus and structure. Furthermore, the analysis also considered archival data from public sources, from firm presentations and internal sources on plant performance.

Table 21: Data collection - case IV

Method	Scope	Purpose
Semi-structured interview	• One interview with a global operations manager • Interview duration: 150 minutes	• Gather detailed information on plant leaders (e.g., implications of matrix for plant leaders) and discuss outcomes from plant leader interviews
Archival Data	• Previous project cooperation on defining a subnetwork strategy in 2016 • Public available information	• Data triangulation • Additional understanding of case firm and business context • Utilise previous findings on network focus and subnetwork structure in the case firm

5.8.2 Firm and Network Characteristics

Case firm IV is a well-known integrated technology corporation headquartered and stock listed in Germany. It provides solutions and products for automation, electrification and

[61] The author of this work was not involved in the previous project

digitalisation. Due to its size of more than 300,000 employees globally, the firm is structured into several operating and strategic companies, each focused on different products and services. This case considers a subnetwork of one operating company with more than 70,000 employees. Due to recent organisational restructuring, the subnetwork has been assigned to a new division (i.e., an operating company). The portfolio of this operating company is clustered into six main technologies. The unit considered for this work provides products for transmission and distribution of electrical energy. It operates nearly forty manufacturing plants located in Americas, Asia and EMEA. These plants are clustered into six subnetworks.

The following analysis considers only one subnetwork. The primary informant for this case had been responsible for this subnetwork as a network manager until a few months before the interview. The considered subnetwork operates five plants in China, Germany, India, Russia and the US. The plants differ widely in terms of revenue. In 2015, the German facility generated the highest revenue by far, about twice as much as the second-largest plant of the network located in China. The main products are power transformers for trains, a business that faces fierce cost pressure and high-quality demands by the customers.

Furthermore, the rail industry has its own rules imposed by national regulators. Local content requirements are notably higher than in other industries. For example, the *Buy America Act* forces US-based rail operators to buy rail cars that were manufactured in the US. As such, the American plant of the subnetwork opens a door for the US market. Product focus of plants varies accordingly. Only one plant of the subnetwork is set to produce the whole product portfolio. This plant assumes the role as a hub, whereas the other plants serve as spokes. Flows of knowledge and material between the hub and each server plant exist.

Similar to in case III, the plant leaders are responsible for the end to end process. Each plant operates its own procurement, sales, quality, engineering and production functions. Selected lead functions are physically located at the German facility, but organisationally separated from the plant and provided by a central function.

5.8.3 Network Strategy

> *"Each plant has its own functions; everyone makes their own things; I do not care about my neighbours. I am just focused on my goals."* (translated, IV.1)

The situation described in the statement above was one of the main challenges for the interviewed sub-segment manager. During the interview, the informant explained various measures (which will be outlined in the following sections) to cope with this challenging situation in the subnetwork.

Delayering homogenous networks:

Since this case considers only one subnetwork of the case firm, it provides only limited findings on how to delayer a manufacturing network. In general, the interviewee underlined that the subnetwork for train transformers follows a product perspective. Though differences between the distinct product lines exist, from an operations perspective, similarities are high. Except for a small number of exceptions, production technologies and processes are similar across all plants.

The interviewee was assigned responsibility for five additional subnetworks shortly before the interview. Among these subnetworks, the interviewee expressed concerns about the definition of the network boundaries. Although assigned to distinct subnetworks, plants share many similarities: "While machines are relatively similar, also processes are similar, the vertical integration is very different" (translated, IV.1).

The interviewee emphasised that the definition of these subnetworks was the result of historical developments rather than deliberate decisions, so he considered reviewing the network definitions. He considered this particularly because many plants produce for different subnetworks, which is problematic in terms of competences and responsibilities but necessary for economic reasons: "You cannot have distinct functions for each business, at some point, you will not be competitive" (translated, IV.1).

With regard to the subnetwork considered in the following analysis, the interviewee concluded that the definition has resulted in a cluster of similar plants and high synergies.

Nominate network mission:

The interviewee explained that compared to other units of the firm, his former subnetwork stands out with a comprehensive and well-formulated network strategy. As presented in Figure 29, the subnetwork management defined the strategic network outputs a few years ago, and they reflect one of the railway industry's peculiarities mentioned above. The requirement of local content becomes evident in the high access to markets rating, but access to resources (i.e., suppliers and skilled labour) is the highest-ranked. From a coordination perspective, mobility of volumes between the production facilities also plays an important role. In particular, there can be a flexible exchange of components in case of high loadings in the German facility. The learning target is rated medium to high and refers to exchange of external knowledge about markets and latest technologies. Furthermore, the learning dimensions also consider the exchange of internal knowledge about successful practices in the case subnetwork.

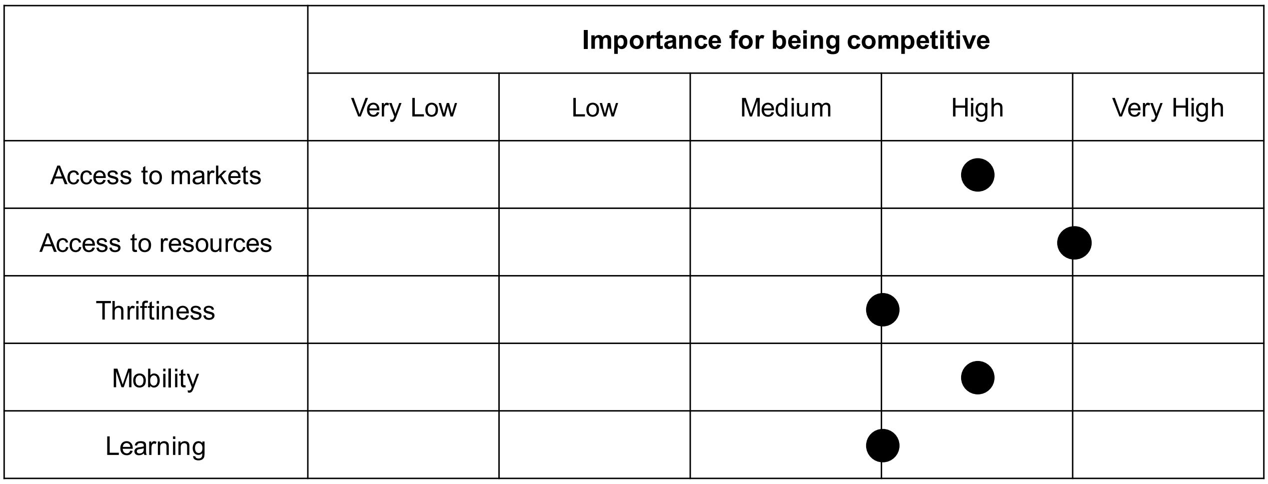


Figure 29: Network targets – subnetwork of case firm IV

The informant explained that the network mission is repeatedly revised and integrates the feedback from plant leaders: "Once a year, we look at: where are we? What has to change? Does it still fit, or do we have to re-position ourselves? Therefore, plant leaders were involved deliberately" (translated, IV.1).

He further outlined that particularly coordination topics are the content of this strategic review process. For example, several options for a best-practice sharing approach have been discussed with plant leaders in the past. These yearly meetings are the platform on which to define the strategic objectives for each site and the headquarter functions.

> "…what are the objectives for each site and the headquarter? Sounds easy, it was pretty tricky. At the end of the second day we had some excellent results. However, it took an eternity until we had something on paper for the headquarter functions."
> (translated, IV.1)

The statement underlines that it is a complicated and time-consuming approach to involve the plant leaders into a recurring strategy definition and revision approach, especially if the strategic discussions go beyond the standard focus of plant leaders (i.e., beyond their own plants).

Overall, the fourth case provides an example of plant leaders being highly involved in the process of defining and refining network strategy. Although the network capabilities put emphasises on the footprint, coordination and cooperation among network units are integral elements of the subnetwork's strategy, which defines responsibilities and assigns resources for related tasks.

5.8.4 Coordination Mechanisms

The subnetwork considered in this fourth case applies several mechanisms for coordinating the flows between plants and between plants and headquarters. The case exemplifies how the plant leaders play a central part in, for example, initiating best-practice exchange. The fourth case also shows that central network management deliberately decided to exclude plant leaders from other exchange topics.

Means of exchange:

The subnetwork considered in this case applies different means of exchange, which partially involve the plant leaders.

First, a functional exchange between plants takes place. For example, central procurement organises a call with all procurement functions of the plants once or twice a year. Furthermore, the production-related function of each plant regularly exchanges about layout topics.

Second, the network provides a platform for direct exchange between plant leaders. Once a year, network management organises a two-day in person meeting for all plant leaders. In addition to covering strategy topics, these meetings serve the purpose of being a place for the exchange of knowledge between plant leaders or for the initiation of an exchange that will happen at a later time. The interviewee explained that during those meetings, they nominate best-practice ideas to be shared by the respective knowledge holding plant. Usually, they define two best-practice topics for the following year. The meeting itself is about organising or initiating the exchange between the plant leader's employees.

Third, information exchange from plant to headquarters plays a vital role in case IV. During monthly calls, each plant leader reports KPIs to the business unit. Furthermore, network management conducts a factory tour with each plant leader every 14 days. Beyond that, network management also conducts a factory review every month via phone with each plant leader alone. The interviewee describes the content of these calls as follows: "It covers everything, from production utilisation, people, from how is profit, how is revenue, how are sales, what engineering did they need, what problems they had, what support" (translated, IV.1).

When asked about the plant leader's perception of the lack of transparency within the IMNs (see Chapter 3.3.7), the interviewee elaborated that he had thought about doing these monthly calls with a group of plant leaders so that they would be informed about the current status of each plant: "I have reflected at length whether it would be useful to have it regularly with all, but I could not think of the topics… one could have done it, that is probably a blank spot" (translated, IV.1).

In addition to this non-physical exchange within the case subnetwork, resources are also regularly exchanged between plants. Namely, the welding engineer is often a requested resource. Furthermore, the interviewee explained that resources from the German factory are designated for the ramp-up of the production process in other factories.

> "…then employees from Russia or India come to Germany. They join the prototype production… Later, the colleagues from the lead factor visit the local factory and accompany a transformer until it can be produced there in satisfactory quality." (translated, IV.1)

Furthermore, the exchange of production volumes between plants, mainly from the German plant to other plants, is common in the case subnetwork: "For example, if the German plant has too much volume, then Russia or India help and deliver components for it" (translated, IV.1).

Overall, the fourth case presents various forms of exchange between plants. The following section outlines that some aspects of inter-plant exchange take place without the significant involvement of plant leaders.

Autonomy for exchange:

Within the case subnetwork, plant leaders enjoy high autonomy on their sites but also lost responsibility for specific inter-plant exchange topics. First, plant leaders define which best-practice solutions should be transferred within the network. Central network management triggers this discussion once a year; implementation and transfer is then left to the plant leaders. According to the perception of the interviewee, this approach leads to an autonomous diffusion of best-practices through the network: "I guess because people liked it. That is how it should be" (translated, IV.1).

Despite high autonomy in best practice exchange, network management has decided to limit the decision autonomy of plant leaders for selected resources. Due to its high competence level, the German facility was due to its highest competence level, the designated provider for support-resources. However, the idea of an autonomous inter-plant exchange stumbled upon the willingness of the sending unit to provide requested resources to other network plants. The interviewee reported that support between plants was provided only after he had discussed it each time with the involved plant leaders: "It just works because I talked to my plant leaders: If we do it like this, is it possible? What is going to be postponed? It just works if you discuss it together" (translated, IV.1).

To avoid having this kind of discussion every time a plant asks for support (i.e., for design or certification), network management decided to assign these lead functions centrally. In other words, the autonomy of plant leaders on whether to provide resources to help other network units was decreased by taking these resources from the plant level to a central level. The interviewee explained that: "Lead functions are not assigned to a plant. Simply because the plant will always feel privileged to help themselves" *(translated, IV.1).* As such, the subnetwork management created designated network resources available to all plants.

> "I took them from them [the German plant] to avoid discussing with the plant anymore, to create equality and fairness… It triggered intense discussions. The plant leaders did not accept it". (translated, IV.1)

The interviewee remarked in retrospect, that autonomy for mutual support within a manufacturing network is a question of maturity. He concluded that the case subnetwork was characterised by rather low maturity.

> "This open-mindedness, in other words: I support them now, my peer… If he has a topic, I will send somebody over. I deploy somebody from my own plant. This is if you have network thinking if you have a mature network. If somebody says: I am autonomous, I have my own kingdom - why should I help you? - stay away! Then it is better to have a top-down, to decide it centrally." (translated, IV.1)

Overall, the fourth case is a unique example of detaching the plant leader from decisions regarding mutual support. Apart from a less structured best-practice approach, autonomy for inter-plant exchange was assigned to central functions uncoupled from any plant leader's responsibility.

Incentives:
Like in the previous case, the plant leaders have local objectives linked to the performance of their plant. The interviewee emphasised that the objectives are dictated by the business unit level: "These are specified by the business unit. It is revenue, cost, profit, cash and number of employees. I have not seen the network topic" (translated, IV.1).
The interviewee reported that this incentive structure constitutes a significant barrier, especially for discussion on volume exchange between plants:

> "They say: no I have to get my turnover, my profits. Then I say: typical for us; it is left pocket, right pocket. We transfer it from left to right. [They say:] Well, I would like to have it written down. Yes, and how is this going to look like in my yearly performance review? Thus, we certainly have these discussions." (translated, IV.1)

The interviewee also concluded that this incentive structure guides the focus of the plant leaders on plant internal topics instead of inter-plant exchange: "Plants are really focused on themselves to pursue their own objectives and not the network objectives" (translated, IV.1). Overall, the present case underlines the impeding character of individual financial remuneration linked to local incentives.

Structure of careers and candidate selection:
The last case firm provides a peculiarity compared to the previous cases. The interviewee remarked that the firm started a new trainee program for plant leaders three years ago. Young candidates accompany the leader of a large plant in Germany for particular period to overtake a similar position in a foreign plant. As such, the career path of plant leaders is becoming more standardised and well planned.

The interviewee doubted the sustainability of assignments that are too short in foreign plants:

> "In the first year, you are in the phase of self-discovery, how does everything work. In the second year, you are well seated, and in the third you already have to consider how to jump [to another assignment/position]." (translated, IV.1)

However, the interviewee also explained that he prefers to send delegates to foreign plants. As such, the fourth case provides a different view than the previous cases (see Chapter 5.5, 5.5.5 and 5.7).

> "If I have a local, he certainly acts according to local conditions. He has a local boss because he has a local contract.… The local senior has, of course, local interests. That is of course against a network… If you have a local, he will not act globally. Instead, he positions as the local superior likes him to do. If you have a delegate going there for three years, he knows that he will come back after three years, he has to act with headquarter focus. Therefore, I always tried to get delegates. That is really a topic. It also depends on whether the regional senior is German, respective if he has the global thought, then it works as well." (translated, IV.1)

The statement above outlines that although delegates have disadvantages due to their short-term focus, they bring an advantage for network management. The interviewee expressed the belief that delegated plant leaders have a strong focus on the headquarters. Thus, if network management asks them to support other plants, they act accordingly. In addition to his preference for delegates, the interviewee mentioned that technical competency is a critical prerequisite for the plant leader job. However, the interviewee emphasised that a can-do attitude is even more important.

5.8.5 Guide Plant Leader Focus

While discussing the conceptual framework with the interviewee, he got excited about the potential application, its simplicity and how well it depicts the subnetwork's situation. The discussion and application provided implications for the advancement of the conceptual matrix towards a useful management framework.

Operationalisation:

First, the interviewee commented on the y-axis. A comparison of plant competences had been the subject of discussions already in the previous project cooperation between the case firm and the ITEM-HSG. Therefore, based on a Likert-scale from one to six, each plant's functions (e.g., procurement and sales) had been rated. A similar approach was confirmed applicable for the conceptual matrix. According to the interviewee, bandwidth in terms of ability to produce products of the portfolio, competence in producing these products, technical product know-how and quality understanding are particularly relevant aspects to be incorporated into the vertical axis.

With regard to the performance dimension of the matrix, the informant declared that a wide range of operative performance measures could be applicable in comparing plant performance. Besides operational KPIs that reflect the smoothness of a plant's operation, profit and loss are also essential steering measures in the case firm's subnetwork (e.g., plant leaders hold profit and loss responsibility). Cost performance in terms of productivity improvement, delivery performance, quality performance and safety performance, were mentioned by the interviewee as useful measures. Moreover, plant performance is also subject to planning stability, flexibility and process coordination.

Eventually, the interviewee qualitatively evaluated the position of each plant based on in the conceptual matrix (see Figure 30).

***Subnetwork*:**

Figure 30 presents the plant positions based on a qualitative evaluation of the informant based on the measures discussed above. The distribution of plants in the conceptual matrix reveals an apparent concentration of competences in only one plant, the German facility. Whereas the German facility (A) is urged to play an active role in the network, other facilities mainly receive from this location. Nevertheless, the interviewee complained that the employees and management in the German facility lack the willingness to adapt in a flexible and open-minded manner, and therefore exhibit a medium performance level.

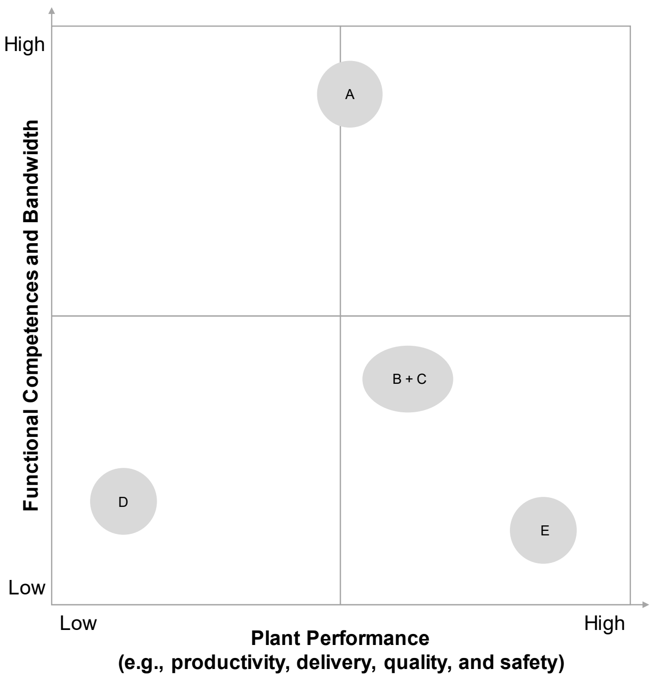


Figure 30: Application of conceptual matrix in the fourth case

Both facilities located in China (B) and Russia (C) are on a similar intermediate competency level and run smoothly. The Indian plant (D) is still in a development status, and therefore located in the lower-left quadrant. All three facilities in China, India and Russia are seen as server factories with limited autonomy (Ferdows, 1997).
Finally, the interviewee underlined the unique situation of the US facility (E), which is not embedded in the network and is seen as an isolated plant. Although the facility has rather low competences, it is running smoothly without needing much support from central lead functions.

Implications:
The fourth case confirms the applicability of the conceptual matrix. First, categorisation of plants according to the two dimensions creates an exact portfolio representation of the subnetwork confirmed by the interviewee. Second, the interviewee agreed that the categorisation of plants according to competences and performance provides a suitable framework with which to assign autonomy, incentives and duties correspondingly.
Confronted with the conceptual matrix, the interviewee began to ask himself several questions linked to each category of the conceptual matrix. The discussion underlined that each plant category comes with a distinct job description for the respective plant leader:

> "First, how could a career ladder look like? And second, why is someone moving and another one not? Why are the answers like they are from the people? Because it is linked to the categorisation of plants, I think… in the job description it has to be different, not the same." (translated, IV.1)

The interviewee explained that the matrix provides a suitable tool for defining incentives and a job description for the plant leader according to the categorisation. For plant leaders in the lower left quadrant, he underlined a focus on his own facility, but also the need to absorb ideas and inventions from other facilities. The interviewee states that the job description of "…the one in [D] should have in it: assume topics that you have, do not invent new things because we do not have that much money" (translated, IV.1).
On the contrary, the management of plants in the top right quadrant should be willing to support other network units and deploy their resources. Although the current subnetwork does not apply network incentives, the interviewee underlines that it should be modified respectively for plant leaders of these network focused facilities. Furthermore, the high-level competencies also imply that these plants do not ask for resources from others. The informant explained that: "they can help themselves; it is running and has the most competences" (translated, IV).
The interviewee described the intended focus of the plant leaders in the German facility: "…the one in [A] should have in it: you have to support, be open if somebody comes and gives them the information" (translated, IV.1).

Furthermore, the interviewee stated that managers of plants in the top left quadrant should be focused on improving their performance by accepting help even from plants with lower competence but higher performance:

> "…the one in the top left: concentrate on yourself, you will get offers from others how they can help, basically a peer-coaching. Like-minded plants which can help, one has to think about who is suitable" (translated, IV.1).

In respect to the career paths of plant leaders, the interviewee explained that newcomers usually start in the lower quadrants. Primarily due to the high number of employees and additional functions situated at the Germany facility, he believes that leading such a kind of plant requires more seniority.

Overall, the application of the conceptual matrix in the fourth case confirms the informative value generated by the portfolio framework. Furthermore, the interviewee is experienced with plant models and has even applied the site portfolio by Friedli et al. (2014) before. He explained that the conceptual matrix proposed in this work brings a different perspective and is easier to understand: "It is a different focus, a different perspective. It is also easier to understand than the site portfolio" (translated, IV.1). As such, the fourth case underlines the practical relevance of the conceptual framework.

6 Cross-Case Analysis and Reflection

This chapter aims to apply a structured approach and "look for within-group similarities coupled with intergroup differences" (Eisenhardt, 1989, p. 540). First, this chapter compares the results from the within-case analysis of network strategy and IMN coordination tactics. The structure of Chapter 6.1 and Chapter 6.2 follows the presentation of the within-case results. However, the presented findings within each category emerged through the use of different perspectives and lenses on the within-case data (Eisenhardt, 1989, p. 541). The third part of the following cross-case analysis advances the conceptual framework. The final section reflects the findings and links them with the existing knowledge base.

6.1 Network Strategy

The following section compares the network strategy-related content of the four case examples. Before analysing the network mission and strategy definition process, it discusses how the case firms delayered their manufacturing network.

Delayer Manufacturing Network:

The previous chapter presented the results from four case firms that delayered a total of ten subnetworks. As shown in Table 22, the cases provide different and partly multilevel approaches towards delayering an IMN into congruent clusters of peer plants (Ferdows et al., 2016). The previous chapter outlined that even within the case firms, the logic for defining subnetworks differs from subnetwork to subnetwork.

Table 22: Case comparison of subnetwork definition and size

Case	Criteria to delayer IMN into congruent subnetworks (sequence)					# of plants per subnetwork
	Business	*Process (Technology)*	*Product*	*Volume*	*Regional*	
I	• (1)	• (2)	• (3)	• (3)	• (4)	3-6
II		• (1)	• (1)		• (2)	3-9
III	• (1)					5-11
IV	• (1)	• (2)	• (2)			5

As shown in Table 22, corporate structure (i.e., divisional or business unit structure) constitutes the first level of network separation in three of four cases. For case firm III, this business-driven perspective is the only level to define three distinct subnetworks. Business-driven means that market demands are translated into the manufacturing dimensions of cost, quality, reliability and flexibility (Hill, 1993; Voss, 1995). It is a high-level approach to cluster plants that serve the same markets or customers. It implies that plants face similar demands or challenges (i.e., that plants follow a similar strategic orientation) (Scherrer & Deflorin, 2017b). However, it does not imply that they produce the same products or apply similar processes. For example, plants are clustered due to similar demands for manufacturing in subnetwork I of case firm III, but these plants do not produce the same products or apply the same processes. However, inter-plant exchange is limited, or even non-existent, in this subnetwork. This confirms the plant leader perception that lack of overlap between plants hinders inter-plant exchange (see Chapter 3.3.6). Evidence from the cases shows that delayering an IMN based only on similar manufacturing capabilities is not necessarily an adequate approach to animate exchange. However, case I and case IV demonstrate that the business-driven perspective is the first step for delayering an IMN, followed by subsequent levels applying diverse product, process, volume or regional perspectives (see Table 22).

Only one case example does not apply the business perspective at the first level to arrange plants. Due to the organisational setup of case firm II, operations are uncoupled from the business perspective. Therefore, the operations function of the third case applies a clear process technology perspective to delayer two subnetworks. This subnetwork structure has been implemented in the last few years and has gained approval from most plant leaders.

Table 22 highlights that most firms of the sample apply process technology as the second or first-level factor in delayering their manufacturing network. The interviews with informants from case II and case IV underline that products are closely linked to distinct process technologies. Therefore, plants producing similar product portfolios also apply similar production technologies. In case I, however, process technology does not imply similar products between plants. Products, or volumes, are a third level differentiation in case firm I. Furthermore, Table 22 shows that the first two case firms apply a regional layer to create smaller subnetworks. Particularly in cases I and II, subnetworks would be much larger without a regional focus. Eventually, the case firms decreased the number of plants through the subnetwork assignment to smaller clusters of three to eleven plants (see Table 22). The regional perspective helps to cope with network complexity particularly for larger networks and facilitates coordination.

Furthermore, shorter distances between plants implies fewer efforts to meet physically. Thus, the regional focus also facilitates inter-personal ties between the plant leaders. Apparently, a prerequisite for the regional level cut of subnetworks is an adequate number of similar plants within one region. For case IV, in which each of the five plants is located in a different region, such a delayering approach would not be suitable.

Overall, the cross-case analysis confirms Ferdows' approach to delayer production networks based on product and process characteristics (Ferdows et al., 2016). Additionally, the findings provide evidence that the propositions by Scherrer and Deflorin (2017b, p. 413) and Feldmann and Olhager (2019) are implicitly incorporated into the design of subnetworks in practice. The willingness of network entities is higher if they share (1) same strategic orientation, (2) similar products, or (3) similar processes (Scherrer & Deflorin, 2017b, p. 413). Thus, each case firm applies at least one of their propositions to create subnetworks of peer plants. The geographical lens turns out to be an additional aspect for defining plant clusters.

Nominate network mission:

As shown in Table 23, all case firms have developed a designated strategy for their manufacturing network operation. Only case three deviates somewhat. An initial network strategy was developed a few years ago centrally. Today, network strategy definition is incumbent upon each subnetwork leader. However, this topic does not enjoy the same priority among the three subnetwork leaders, and thus, has not been revised in all subnetworks yet.

The network strategy has been communicated to plant leaders in all case firms mainly through the subnetwork leaders or regional operations managers. As such, plant leaders were informed about the strategic direction of their network. Therein, the topic of inter-plant exchange plays a prominent role only in the first two cases. Both cases assign highest priority to the network learning capability. Case I especially applies the network strategy as a means to communicate and promote inter-plant exchange to the plant leaders.

Table 23: Case comparison of network strategy definition

Case	Designated network strategy	Relevance of inter-plant exchange as network mission	Integration of plant leaders into strategy definition/review
I	Yes	High	To some extent
II	Yes	High	Very limited
III	Partly outdated	Medium	Very limited
IV	Yes	Medium	Yes

Integration of plant leaders into network strategy development varies among all cases. In case IV, plant leaders participate in a two-day strategy workshop each year. In case I, each plant leader provided input (e.g., network improvement potentials) during strategy development, but content and strategic targets were set centrally without the participation of plant leaders. Both cases II and III are examples of the central development of network strategy. The attempt to integrate plant leaders into strategy definition in one subnetwork of case firm III has been quite sobering.

It is striking that case firm IV, which highly integrates plant leaders into strategy definition and revision has only an average rating of inter-plant exchange and struggles with network thinking among the plant leaders. Apparently, if the plant leaders are unconvinced about exchange and sharing with other network entities, they will refrain from setting it as a strategic network goal. As such, it appears more suitable to take the hybrid approach of case firm I and generate a sense of participation by querying input from each plant leader but deciding centrally on aspects that require a broader perspective.

Overall, the cases underline that having a network strategy that pursues inter-plant exchange through a high rating of the internal-learning target is a vital starting point for fostering inter-plant exchange (see Chapter 3.3.4). The cross-case analysis shows that different approaches exist regarding the integration of plant leaders into strategy development. In all cases, the network mission is openly communicated to the plant leaders, who need to convey the strategic message to their plants (Abdullah & Liang, 2013). However, having a network strategy and communicating it to the plant leaders is just the first step towards a more cooperative network. Implementation indeed rests on sufficient resources and appropriate measures initiated from central network management.

Implications

1. *The case firms delayer their IMNs into congruent subnetworks based on both multiple criteria and different levels. Strategic orientation, products, processes and regional location of plants are applied as lenses to define subnetworks of peers.*
2. *All case firms pursue a network strategy, which assigns at least a medium or high relevance to the topic of inter-plant exchange. Although the implementation of this mission statement remains vague in some cases, it signals some guidance to the plant leaders.*
3. *Network strategy development varies between no integration of plant leaders, some integration and close involvement.*

6.2 Coordination Mechanisms

The following section compares those coordination mechanisms that address the individual-level perspective and were applied by the four case firms. Therefore, this section is structured (as in the within-case analysis) into four paragraphs covering means of exchange, autonomy for exchange, incentives and careers.

Means of exchange:

The case firms apply various mechanisms to facilitate the exchange of knowledge, supportive resources and information between peer plants and between plants and central network management. While focusing on the involvement of plant leaders, Table 24 compares all four cases.

The intensity of exchange between peer plants differs significantly from nearly no exchange in subnetwork I of case firm III to a very intense and regular exchange of knowledge, information and resources in case firm I. Furthermore, plant leaders assume different roles within the intra-network exchange. Whereas plant leaders in case firm II are more or less obliged to deploy their functional experts to participate in the competence teams, in other cases the plant leaders themselves participate in the knowledge exchange. In case I and subnetwork III of case III, the plant leaders not only participate in a centrally coordinated exchange of peers, but also function as carriers to diffuse knowledge and best-practice ideas into their facilities. In case IV, plant leaders participate in centrally organised meetings to discuss, among other things, best-practice ideas to be exchanged between plants. Their role, however, is limited to initiating the exchange and delegating the actual knowledge transfer to the employees.

Table 24 shows that the role of plant leaders in intra-network knowledge exchange is linked to the exchange mechanisms applied in the network. Mainly functional experts participate in so-called competence teams (Case I and Case II). Thus, the involvement of plant leaders is limited to making staff available and occasionally hosting the event. However, if plant leader meetings are the central platform for conducting exchange between peer plants, then plant leaders even become knowledge carriers (Case I). The involvement of plant leaders as knowledge carriers is limited if their involvement in technical or shop floor issues are low. For example, in case II, the plant leaders are mainly assigned to organisational tasks. Thus, the exchange between functional experts allows for more technical depth. However, in subnetwork II of case I, the plant leaders are close to the shop floor, and because of this they can discuss technical solutions in detail.

Costs are also a decisive factor for plant leader meetings instead of functional expert meetings. For example, in case II more than five different competence teams, which meet physically at least once a year, create a substantial cost. Large plants have to deploy at least one functional expert for each competence team meeting. Plant leader meetings, however, require the participation of only one representative from each plant.

Table 24: Case comparison of inter-plant exchange and plant leader involvement

Case	Intensity of exchange between peer plants	Role of plant leaders in intra-network knowledge exchange	Main knowledge exchange mechanisms between peer plants	Regular information exchange between headquarter and plants
I	High	Initiate, delegate, participate and carry	Subnetwork I: Competence Teams Subnetwork II: Plant leader meetings	Shared calls with plant leaders from all peer factories
II	Medium	Initiate, delegate	Competence Teams	Calls between HQ and each plant leader
III	Very different between subnetworks – varies from low to high	Participate, delegate and carry	In subnetwork III only: Exchange meetings	In subnetwork III only: Shared calls with plant leaders from all peer factories
IV	Medium	Initiate, delegate and participate	Plant leader meetings and calls on a functional level	Calls between HQ and each plant leader

Table 24 depicts the main difference in the regular information exchange between plant- and network-level. Two case firms conduct monthly calls between network management and each plant leader mainly for reporting purposes. In case I and case III, these regular calls involve all plant leaders of the respective subnetwork at the same time. As such, the purpose of reporting to central has been extended with the aim of creating more transparency between peer plants. These group calls have received positive feedback in both cases. It creates transparency between plants, particularly about current challenges. In the first case, reporting of low- and highlights is an integral part of these calls and has induced valuable discussions on how others dealt with a particular problem. Therefore, joint calls between peer plants and central network management prove beneficial to facilitate inter-plant exchange.

Autonomy for exchange:

The previous chapter presented four cases that pursue fundamentally different approaches towards plant leader autonomy. Whereas, in case II and case IV inter-plant support is mainly decided and delegated from central functions, in cases I and III supporting other plants and making resources available is left to the plant leaders. In the first case, it is the openly communicated objective of central network management that exchange and support among plants should take place autonomously without the interference of central management. However, in case IV it was a deliberate decision by network management to limit decision autonomy of plant leaders and allocate needed resources to a central unit to limit the effects of uncooperative behaviour. In case II, several centrally delegated support examples were reported. For example, regional network management decided that a struggling plant should receive additional support from neighbour plants and give respective orders to the plant leaders.

Table 25: Case comparison of exchange autonomy

Case	Intended decision on inter-plant support	Designated exchange autonomy for selected plant leaders
I	Mainly decentral	Yes, in subnetwork I
II	Mainly central	Yes, in subnetwork I
III	Mainly decentral	Yes, in subnetwork II and III
IV	Mainly central	No, deliberately assigned to a central function

Selected plant leaders enjoy a higher degree of autonomy to organise exchange and support other plants in all cases except case IV. In all other cases, leaders of plants with the highest capabilities and sufficient resources were assigned with additional network-related tasks. For example, in subnetwork I of the first case, the leader of the German facility was assigned with responsibility for the cross-plant value stream. Thus, it is in his interest to support other plants and provide experts to guarantee a smooth flow of material through all plants. In case firm II, selected plant leaders were assigned with responsibility for a second plant (usually a low-capability plant). As such, it was their task to organise the knowledge transfer and support in general to these usually juvenile facilities. Similarly, case firm III delegated responsibility for the ramp-up of a new facility to a capable plant (i.e., to the respective management). Furthermore, in each subnetwork a designated operations leader from the most capable and performing plant organised the cooperation and exchange within the network.

Overall, selected plant leaders were assigned with additional autonomy to pursue inter-plant exchange with at least one facility in the majority of all cases. Decisions on who has to provide support or any form of resources were decided in half of the cases somewhat centrally and in the other half, plant leaders basically have to agree among themselves. The latter approach assumes that plant leaders are not only focused on the performance of their facility but that they also see the bigger picture. Some statements from plant leaders presented in Chapter 3.3.8 substantiate this view.

Incentives:

During the case analysis, two of four case firms changed the remuneration of all managers from individual objectives to overall firm results (i.e., global firm performance). The plant leaders of both firms had previously been evaluated according to their plant's operational performance. As shown in Table 26, case firm III and case firm IV apply a mixed approach of local plant KPIs and overall business results to set the financial bonus of their plant leaders. A common view amongst interviewees was that the bonus system is not the responsibility of operations or network management. Instead, both initiatives to change the incentive system in cases I and II were introduced and advanced by the respective human resources teams. As all interviewees stem from operations, they mention that at least some plant leaders have defined targets that incentivise cooperation or support of other plants (see Table 26). However, the cases show that these targets are not necessarily linked to a financial bonus.

Table 26: Case comparison of incentives

Case	Financial bonus linked to	(Non-financial) target agreement beyond own facility	Main non-financial incentive for inter-plant exchange
I	Global	Yes	Autonomy, acknowledgement and affiliation
II	Global	Yes	Autonomy and career
III	Local + Global	Yes	Autonomy, acknowledgement and affiliation
IV	Local + Global	Yes	Career

Table 26 also presents the primary motivators for inter-plant exchange in the respective case firms based on the researcher's impression gained through the case analysis. Career ambitions appear to be the main motivational forces in the centrally managed networks of case firms II and IV. To provide support according to the central network management's

request improves the career opportunities of the plant leaders. The interviews with network managers from the much smaller case firms I and III show that firm affiliation and acknowledgement are much more critical than in the other cases. As one interviewee put it: "We do it by appreciation and saying 'thank you'" (translated, III.1).
Autonomy also motivates the plant leaders in most cases. Namely, in case I and case II, distinct plant roles are associated with higher autonomy and responsibility for inter-plant exchange. Also, in case firm III, the subnetwork supervision is assigned to one plant (i.e., the respective leader). As such, individuals might pursue a cooperative strategy to qualify their plant for a higher factory level, and thus be assigned with higher autonomy. This finding is in line with other scholars who have outlined that the autonomy of leading plants intrigues the management of other facilities (Cheng & Farooq, 2018; Vereecke et al., 2006).

***Career**:*
The case comparison reveals that there is basically no typical path to become a plant leader, nor is there a standardised next step. Only the fourth case firm has recently started an educational path towards becoming a plant leader. They initiated a trainee program for young professionals, who accompany a senior plant leader for an extended period to qualify for a plant leader assignment. Furthermore, the fourth case firm is the only example that systematically posts plant leaders abroad for a few years. All other firms usually take local employees without any set timeline. The largest firm of the sample is the only one that has standardised the career path for plant leaders to some degree.
The plant leaders who expressed concerns about standardised career steps during the plant leader interviews were all from large corporations of similar size to the fourth case firm (see Chapter 3.3.9). These plant leaders expressed concerns that medium-term assignments in a foreign plant as an intermediate step to qualify for a higher position in headquarters could draw in the wrong people for this position. Similar concerns were expressed by network managers in case firms I, II and III. However, the interviewee from case firm IV emphasised the advantage of having people from the firm's home country, who are willing to stay only for a limited period as plant leaders in foreign countries. These people exhibit a higher degree of compliance with guidelines from network management, as they hope that this behaviour will qualify them for the next position back home.

Table 27: Case comparison of plant leader careers

Case	Structured career paths	Locals for local plants
I	No	Primary yes
II	No	Primary yes
III	No	Primary yes
IV	Initial approaches	No

Overall, the sample exemplifies two distinct approaches towards structuring the plant leader careers within an IMN. First, an unstructured approach with long-term assignments and mainly local people for local plants. Second, a more structured approach with medium-term assignments of people from the firm's home country who plan to go back to a central position after a few years. The first approach appears to be more common for smaller and less structured firms, whereas the more structured careers are probably more common among larger corporations with respective administrative structures.

Implications

1. *Plant leaders can function as organisers of functional-level exchange between plants or participate as knowledge carriers themselves.*
2. *Information exchange between headquarters and plants can boost transparency between factories if leaders of peer plants join this usually remotely conducted exchange.*
3. *Selected plant leaders can take on additional tasks related to inter-plant exchange and thus be assigned with more autonomy.*
4. *In addition to bonus incentivisation of plant leaders, which moves towards overall firm results, non-financial gratification plays a vital role in motivating individual plant leaders in their cooperative behaviour across plant boundaries.*
5. *Structured plant leader careers are relevant to huge corporations. Most (small and medium-sized) firms prefer to hire locals rather than deploy people from the home country for the lead in their foreign plants.*

6.3 Guiding Plant Leader Focus

The initial application of the conceptual matrix with four case firms and substantially more subnetworks provided results for the operationalisation and indicated several implications concerning IMN coordination.

6.3.1 Operationalisation of Conceptual Matrix

Table 28 compares the applied measures for both dimensions of the framework obtained from the case examples. Closer inspection of the table points to several similarities. First, three of four cases suggest typical operational KPIs to evaluate the performance dimension, namely KPIs reflecting safety, quality, delivery and cost performance. As such, the cases confirm that operational plant performance (i.e., performance deviation) reflects how much attentional capacity of the respective plant leader is bound by local topics. In other words, the deviation from target values in safety, quality, delivery or cost performance requires immediate and considerable attention from the manager in charge. Thus, depicting operational plant performance on one axis of the conceptual framework allows drawing conclusions on the attentional capacity and the plant leader's ability to attend to network-related topics.

While the informant of the third case also suggests operational plant performance figures, the third case brings up the idea of selecting appropriate measures based on the contextual situation of the plant. According to the customer requirements of each subnetwork, the third case exemplifies the fact that different aspects are more important for a plant leader of subnetwork I than to a plant leader of subnetwork II. For example, if delayed deliveries result in substantive financial penalties, a plant leader will be primarily focused on keeping a satisfying level of on-time deliveries, and thus, devote significantly more attentional capacity to solving this operational problem. The third case suggests considering only measures that reflect the most relevant factors behind the plant's operation. As such, it appears suitable to weight the operational SQDC-KPIs according to their relevance for the respective subnetwork.

Table 28: Case comparison of matrix operationalisation

Case	X-Axis	Y-Axis
I	Safety, quality, delivery and cost performance	Product competences (qualitatively) Process competences (qualitatively) Complexity (range of products or processes)
II	Safety, quality, delivery and cost performance	Production technology competences (experience in years, # of process innovations, # of participants from the plant in knowledge exchange) Complexity (range of products)
III	Depends on competitive priorities of subnetwork Subnetwork I: cost performance Subnetwork II: delivery reliability and quality performance Subnetwork III: delivery speed and cost performance	General competences (experience in years) Innovation and support (qualitatively)
IV	Operational performance in general (e.g., safety, quality, delivery, productivity, planning performance)	Functional competences (qualitatively) Complexity (range of products) Product competences (qualitatively) Technical product knowhow (qualitatively) Quality understanding (qualitatively)

Due to the mainly qualitative application of the conceptual matrix in the cases, this work does not provide a detailed list of KPIs for measuring safety, quality, delivery and cost performance. However, the insights gained during the case analysis indicate that even within one firm, the relevant KPIs to measure (e.g., delivery performance of plants) varies between subnetworks. For example, in case I, the monthly calls between the central network management and all plant leaders of the same subnetwork go through the same SQDC-KPIs for each plant, but in another subnetwork different KPIs are discussed to evaluate SQDC-performance.

Table 28 also presents the operationalisation of the y-axis in each of the four cases. The interviewed case partners evaluated the capability rating of all plants intuitively. Comparison of plant competences has been the subject of the previous cooperation with most of the case firms. Thus, the list above presents factors that have been identified as relevant for comparing plant competences during the project cooperation and is also relevant to the conceptual framework. Furthermore, the qualitative or quantitative characteristic of each factor is presented in parentheses. Competences solely related to the geographical location (i.e., the strategic site reasons) (Ferdows, 1997) were not included, as these reflect static characteristics rather than variable competences. Since the conceptual design assumes that autonomy and responsibility are an effect of plant competences and operational context (see Chapter 4.1.3), the list of plant competences also refrains from including measures of responsibility or autonomy, which other authors link to plant competences (e.g. Demeter & Szász, 2016; Ferdows, 1997; Vereecke & van Dierdonck, 2002).

What stands out in the right column of Table 28 is the high number of qualitative measures that indicate the challenge of operationalising plant competences based on hard numbers. Whereas most case firms applied qualitative Likert-scales, only case firm II selected quantitative measures. In case I, a self-evaluation by each plant leader provided the required input. In other cases, network management evaluated their plants qualitatively.

Three of the four cases applied plant complexity in terms of product range produced at the facility as one determinant of plant competences. Existing IMN literature also suggests bandwidth as a factor to determine plant competences. However, Ferdows (1997) and Feldmann and Olhager (2013) consider the range of activities performed by a plant instead of a range of products.

Furthermore, the cases indicate that the plant's ability to perform processes and produce products are common measures with which to assess plant competences. Some case firms applied qualitative ratings to assess process or product competences, but cases II and III suggested plant age or plant experience in years. Similarly, Demeter and Szász (2016) and Vereecke et al. (2006) assumed a causal relationship between experience and plant competences (i.e., older plants exhibit higher competences). Moreover, the innovative capability is mentioned as an indicator for plant competences. In addition to the listed measures in Table 28, Roth, Schroeder, Huang, and Kristal (2008) provide a comprehensive list of metrics in operations research.

Eventually, the cross-case comparison underlines that contextual factors of each firm or subnetwork need to be incorporated into the design of the plant competence axis as well. For example, a direct comparison of product competences is limited to subnetworks of plants that actually produce the same products. The evaluation of processes only (e.g., case II) is a potentially more meaningful approach in subnetworks with distinct product portfolios.

Overall, Table 28 provides an orientation for operationalising both axes of the conceptual matrix. First, the cross-case analysis showed that SQDC are suitable determinants to be incorporated into the x-axis. Second, the cases exemplified measures for assessing plant competences, namely the range of products to for assessing the plant's complexity and product or process competences. Finally, the cross-case comparison highlighted that the conceptual design is contingent upon each subnetwork's context.

Implications

1. *The x-axis should incorporate operational plant performance in terms of safety, quality, delivery and cost performance, and weight them according to the relevant customer demands.*
2. *Operationalisation of the y-axis is based on a mainly qualitative assessment of plant competences in terms of things like product range or process-related capabilities, and should incorporate each subnetwork's context.*

6.3.2 Findings from the Application of the Conceptual Matrix

Nine subnetworks from four case firms provide empirical evidence for drawing some conclusions about the application and explanatory power of the conceptual matrix. First, all informants that were involved during the interviews confirmed the idea of guiding their plant leaders according to operational status and competences of the respective facility. However, the trial application also revealed that potential implications range from almost none to significantly different job descriptions according to the plant's classification. For example, though one cluster of subnetwork II in case firm I has six plants spread across the conceptual matrix, the network management refrained from assigning the plant leaders with specific duties or different degrees of autonomy. Although the plants indeed exhibit different degrees of competences, their products and process still lack enough overlap for the plants to provide support for each other. Therefore, the interviewed network management expressed the preference for assigning the same tasks to all plant leaders instead of defining a *primus inter pares*. This implies that the network has to be coordinated centrally; otherwise, no plant leader would likely feel obliged to organise an exchange or provide support to others. The last case exemplified such circumstances. Network management decided to centralise all support functions. Therefore, these functions cannot be assigned to plant leaders according to their attentional capacity as suggested by the conceptual matrix. However, while filling out the conceptual matrix, the network manager began to see the potentials of decentralising competences and responsibilities to selected plant leaders.

Eventually, the cases underlined that the conceptual approach works particularly well for decentralised networks. For centralised networks with decision autonomy assigned to network management, the conceptual framework proved less practically relevant, because there is no question about to whom to assign the autonomy decisions about the inter-plant exchange. Nevertheless, even in centralised networks, the conceptual matrix creates transparency and therefore helps to create inter-plant exchange (see Chapter 3.3.7).

Intended focus:

Various statements from all four cases illustrate the implications of the conceptual matrix. Each plant category within the framework is associated with a particular focus of the plant's manager in charge.

First, Table 29 presents quotes about the focus of plant leaders who manage a plant that is allocated in the upper-left quadrant (i.e., high competences and low operational performance). All statements indicate a strong internal focus on the individual operation to stabilise performance and move further to the right within the framework. Whereas one statement objects to any network involvement until the plant leader has stabilised the operational performance, others highlight that these plant leaders have to seek ideas from other plants to boost their performance. They outline that plant leaders in the first quadrant also have to accept or be open-minded toward solutions that have not been developed within the individual factory. The interviewee in case III underlined that these plant leaders have to accept help from plants that might exhibit a lower competence but higher performance. As such, these plant leaders also have to exemplify open-mindedness to overcome internal resistance (i.e., the *not-invented-here barrier*) (e.g., Hansen, 2009).

Table 29: Statements about the focus of plant leaders in the first quadrant

Case	Statement	Plant Leader Focus
I	"That is no one who engages in the network; it is somebody who has not yet stabilised the own organisation" (translated, I.2).	• Internal
II	"Continuous improvements and efficiency gains are on his agenda to move further to the right" (translated, II.2).	• Internal
III	"He has to help himself, but he also has to listen to what else there is. He has to learn from that and implement what others do better. It is more about open-mindedness and overcome not-invented-here syndrome; this he has to overcome. He has to go on a study trip, and he has to ask for help" (translated, III.1).	• Internal • Seek for ideas • Accept external solutions
IV	"… the one in the top left: concentrate on yourself, you will get offers from others how they can help, basically a peer-coaching. Like-minded plants which can help" (translated, IV.1).	• Internal • Accept external solutions

Second, Table 30 presents quotes about the focus of plant leaders who manage a plant that is allocated in the upper-right quadrant (i.e., high competences and high operational performance). The majority of participants agreed with the statement that these plant leaders should not only be focused on their facility, but should keep the whole subnetwork in sight and mind. All case informants reported that these plant leaders should focus on at least one additional facility (or even the whole network) and establish close ties with other network entities. As their plant is expected to provide support to others, the plant leaders also have to exemplify network thinking to overcome a potential hoarding barrier (e.g., Hansen, 2009).

Table 30: Statements about the focus of plant leaders in the second quadrant

Case	Statement	Plant Leader Focus
I	"He [plant leader in Germany] should also cope with the growth in Poland … he is somebody who is well-connected across the network" (translated, I.2).	• Network (additional plant)
II	"They provide resources; the contribute resources [to the network]" (translated, II.1).	• Network • Providing
IV	"They can help themselves; it is running and has most competences…you have to support, be open if somebody comes, and give them the information" (translated, IV.1).	• Network • Providing

Third, Table 31 presents quotes about the focus of plant leaders who manage a plant that is allocated in the lower-left quadrant (i.e., low competences and low operational performance). The case informants outlined that these individuals should demonstrate a strong internal focus. Several statements also indicate that these plant leaders are not only internally focused but have to actively seize the knowledge of more mature plants. This view was echoed by one informant from the first case who emphasised that plant leaders in the lower-left quadrant have to establish individual-level ties with individuals from more capable plants and approach them with questions regularly. One informant mentioned that these plant leaders sometimes need to be reminded that they should not reinvent the wheel. The interviewee from the third case experienced plant leaders from the lower-left quadrant to be very keen for receiving help. Thus, the barrier of *not-invented here* is usually not a relevant barrier in these plants.

Finally, Table 32 presents quotes about the focus of plant leaders who manage a plant that is allocated in the lower-right quadrant (i.e., low competences and high operational performance). One interviewee from case III argued that these plants probably would not exist in his network due to the challenging business environment. He underlined that plants without sufficient capabilities would not be able to perform, but other cases prove that these plants exist. Some informants even outlined that these plants are performing so well because of the low-competences level, which means that these plants have a lean structure and are typically located in a rather low-cost environment.

Table 31: Statements about the focus of plant leaders in the third quadrant

Case	Statement	Plant Leader Focus
I	"It is about introducing production processes that are already established in Europe. These colleagues need to find contacts… and obtain knowledge. He is in an absorbing position… They are proactive in feeding questions to the network" (translated, I.2).	• Internal • Absorb • Seek for ideas
II	"These are the needy people, the use up resources [from the network]" (translated, II.1).	• Absorb
III	"…he asks for support" (translated, III.1).	• Absorb
IV	"… assume topics that you have, do not invent new things. Because we do not have that much money." (translated, IV.1).	• Internal • Absorb

Due to the low capability level of such facilities, most statements indicate a strong internal focus similar to the previously discussed quadrant. In the first and second cases are plants with a high focus on internal efficiency. Nevertheless, two divergent discourses emerged amongst the case informants. Whereas some stated that plant leaders in the lower-right should focus internally, others emphasised that these plant leaders should also search for and provide support if possible. For example, one statement in Table 32 suggests that these plants are in an ideal position to provide production capacity if needed by others. The conduct of a plant leader in case firm I, who is located in the lower-right quadrant, can be characterised as quite network-focused. Although, the capability level of the plant is rather low, he regularly provides production capacity for other network entities that face current overloads. As such, the cases provide evidence that plant leaders in the lower-right quadrant are primarily focused on internal topics but might pursue a secondary network focus as well. Overall, the cases confirmed that the attentional focus of plant leaders should be guided according to the situational plant context. According to the interviewed network managers from four case firms, focus of plant leaders should range between network topics and a plant's internal aspects.

First, plant leaders of facilities characterised by pronounced capabilities and hugely satisfying operational performance have to devote considerable attention to network-related topics. These plant leaders should play an active role in things like supporting other facilities or organising exchange meetings.

Second, leaders of plants in the upper-left and lower right-quadrant should primarily focus on their internal operation but seize the benefits of the network if possible. Both categories of plant leaders should not refrain from providing support if requested (e.g., provide additional capacity for other plants). As such, their network conduct is rather passive compared to the top-right.

Table 32: Statements about the focus of plant leaders in the fourth quadrant

Case	Statement	Plant Leader Focus
I	"First of all, that one is a change manager… that is someone who motivates people as his main duty. He has to ensure that the site remains good with regard to the KPIs down there. He has to motivate the people permanently, ensure they have the right mindset, ensure they work on the right things. He is the driver for efficiency… first and foremost, he looks internally" (translated, I.1). "He helps if others have problems with capacity" (translated, I.2).	• Internal Focus • Efficiency • Providing
II	"… can they solve their own problems? Are they autonomous?" (translated, II.2).	• Internal Focus
III	"Lower right does probably not exist. They would not be successful. Without capabilities, it would be a coincidence. Capabilities need to be high to get speed… it is somewhat unrealistic for us" (translated, III.1).	

Finally, plant leaders of facilities located in the lower-left should apply a clear internal focus. Still, these plant leaders have both devoted some attention towards the network to absorb knowledge and established solutions from other entities.

Taken together, this cross-case comparison suggests different foci for leaders of plants located in each category of the conceptual framework. The following section, therefore, moves on to discuss how firms guide the focus of their plant leaders accordingly.

Consequences of* categorisation*:

The cases provide evidence that firms apply different degrees of autonomy, assign different duties and set various incentives in order to guide the attention of their plant leaders. As such, these differences among plant leaders hold interesting implications for the conceptual matrix.

First, most cases demonstrate that selected plant leaders are assigned additional network-related duties. However, not all subnetworks of the case firms nominate one superior plant leader (e.g., first cluster of subnetwork II in case firm I). The second column in Table 33 presents network-related tasks that are assigned to selected plant leaders within each firm. Selected plant leaders are entrusted with tasks related to supporting one particular or a few other plants. In most cases, they support plants in the lower-left quadrant of the matrix (see cases I, II and III). As such, it is their task to organise the knowledge flow into the problematic plant or even ramp up another facility. Selected plant leaders also assume a coordinative role for the whole subnetwork (see cases I, II and III). In addition to managing a plant, they also undertake some duties of central network management. For example, they organise the regular knowledge exchange, hold sway over the allocation of production volumes, define standards for the network together with their functional experts' or function as a counterpart with the sales organisation. It is striking that all plant leaders with additional network-related duties are located in a plant in the upper-right quadrant of the conceptual framework. This consistent picture confirms the validity of the conceptual matrix, namely concerning its basic dimensions and operationalisation. The results indicate that the upper-right quadrant is linked to additional cross-plant duties for the respective plant leaders to substantiate their intended network focus.

Table 33: Consequences of categorisation

Case	Network related duties assigned to selected plant leaders	Differences in autonomy	Deviating incentives and objectives
I	• Subnetwork I: Coordinator for value stream (organises exchange, provides support) • Subnetwork II: support growth in another plant	• Development of plant roadmap • Designated resources • Process implementation • Contact to product group	Shared objectives (cost, quality, delivery) with other network sites[62]
II	• Subnetwork I: support satellite plant • Subnetwork I: coordination of regional subnetwork - regional operations leader	• Allocation of production volume between satellite and main facility • Operative functions (e.g., manufacturing engineering) • Authority to issue directives • Process implementation	Cross-plant objectives for satellite relationship[63]
III	• Subnetwork III: responsible for multiple plants, ramp-up of another plant • All subnetworks: coordination of subnetwork - operations cluster leader	• Business unit board participation • Network development	Higher share of business unit results for the subnetwork operations leader
IV	• Organizes best-practice exchange		Network objectives for upper-right plant leaders and internal objectives for lower-left plant leaders[64]

Furthermore, the cases provide evidence that autonomy varies among plant leaders. Additional duties come with higher decision-autonomy. For example, the leader of a plant located in the upper-right quadrant of the value-stream A in case firm I (see Figure 18) enjoys considerable higher autonomy than his colleagues. Whereas he can decide on a future

[62] During project cooperation planned incentives for selected plant leaders.
[63] Before introduction of overall firm objectives.
[64] Proposal of informant, not implemented in case IV.

roadmap for his plant autonomously, his plant leader colleagues have to reconcile with him on the development of their plants. Furthermore, the designated *primus inter pares* in value-stream A is the only plant leader with decision autonomy for designated network resources and acts as the key account towards the sales organisation. Leaders of plants with low capabilities have to coordinate decisions on process implementation with their counterparts in facilities with a higher status. Case II provides a similar example (see Table 33). Here, selected plant leaders even hold the authority to issue directives towards their satellite plant leaders. Additionally, they hold the autonomy to decide on the allocation of production volumes between their facility and the satellite. Thus, some plant leaders are somewhat responsible for two facilities.

The third case conveys the image of higher equality among plant leaders. However, though not immediately evident, there are significant differences in decision power as well. One selected plant leader is assigned with additional power as the operations leader; this person participates in the business unit's management board and coordinates the network development.

Only in case IV, in which the network management decided to separate plant and network-related resources, do plant leaders hold relatively equal decision autonomy concerning network and inter-plant related topics.

Finally, the case comparison also underlines that different incentives were applied to focus the attention of plant leaders accordingly. It should be noted at this point that due to the recent changes to the incentive system in both case firms I and II, the information provided in the last column of Table 33 might be outdated. Nevertheless, the data still exemplifies how different incentives can be used to guide the attention of the relevant decision-makers. For example, in value stream A of case firm I, it was planned to assign shared cost, quality and delivery objectives to the plant leader of the only upper-right facility. In other words, the idea was to link the financial remuneration of this plant leader to the results of other plants as well. Similarly, the informant of case IV suggested assigning these shared objectives only to the plant leaders with network focus. According to his suggestion, plant leaders in the upper-right should have network-related objectives, and the remaining plant leaders should be remunerated based on internal objectives.

In case III, bonus determination is a function of the management level. Therefore, the higher a plant manager is in the corporate hierarchy, the more relevant overall firm or business unit success becomes. The plant leader who is entitled as the operations leader of the subnetwork is on a higher corporate level than the remaining plant leaders. Because of this, he or she receives a bonus that is less dependent on the individual plant's performance but integrates the overall results of the business unit. As such, the third case confirms that this practice applies incentives for guiding the attention of selected plant leaders towards the network as a whole.

The second case exemplifies that differences in incentives between plant leaders mainly stems from their responsibility for a satellite plant. In the past, the incentive of plant leaders with responsibility for two plants was linked to the performance of both facilities.
Overall, the case comparison underlines that especially plant leaders in the upper-right quadrant have targets that go beyond their own facility. The incentives of plant leaders located in the remaining quadrants of the conceptual framework are mainly based on plant-related performance dimensions. However, within the sample of four firms, two recently changed their incentive system (case firms I and II). As such, the sample demonstrated a trend of applying shared objectives or overall firm objectives for all plant leaders.

Implications

1. *Plant context determines the attentional focus of plant leaders. Their attentional capacity ranges between fully occupied by running their operations and partially utilised so that capacity is available for network-related topics.*
2. *Corresponding to their attentional capacity, plant leaders can assume additional network-related tasks. First, selected plant leaders can undertake tasks of central network management to coordinate the network. Second, selected plant leaders can assume responsibility for another facility or build-up another new factory.*
3. *Additional network-related tasks come with higher autonomy for selected plant leaders. Thus, autonomy can vary significantly between plant leaders of one IMN.*
4. *Plant context-linked remuneration can guide the attention of plant leaders. Corresponding to the intended focus of each plant leader on network or plant-related topics, they might be incentivised by plant, by network-related or mixed objectives.*

6.4 Reflection

This research aimed to integrate the individual-level into IMN management practise and theory. Several conclusions can be drawn by comparing the previously presented findings against the current literature base.

6.4.1 Levers to Integrate Plant Leader Perspective in IMNs

The case studies present various approaches in IMN practice that cater to the plant leaders' perspectives. Nevertheless, most of the mechanisms identified were not systematically implemented to facilitate inter-plant exchange. The cases exemplify that manufacturing networks and the respective management routines are typically the results of historical and uncoordinated decisions (Colotla et al., 2003; Friedli et al., 2014, p. 7). Only case I provides an example for a synchronised introduction of various mechanisms to facilitate network thinking and inter-plant exchange by addressing the plant leaders as critical decision-makers. Then again, it is also the first case, which underlines that "decisions related to factory and network issues are often made independently at different times and by different people" (Colotla et al., 2003, p. 1203). Although network management planned, or at least discussed, to change the incentives for selected plant leaders in subnetwork I, the human resources unit overruled these endeavours by implementing new incentive structures for all management levels in the firm. The cases highlight the interdisciplinary character of operations management in general (Chase and Zhang, 1998), and particularly of the IMN domain (Toni & Parussini, 2010). However, the cases underlined that even if taking plant leaders into account means that network management must coordinate their intended policies and rules with other functions of the firm, it should do so in order to realise the full network potentials.

Table 34: Overcoming inter-plant exchange barriers

#	Barrier	Strategy or Mechanism	Intention
1	Heterogeneity	• Delayer global manufacturing network into clusters of peer plants	• Common topics and similarities between plants • Plant leaders share similar challenges
2	Lack of mission	• Designated (sub)network mission with statement about inter-plant exchange • Integration of plant leaders into the network strategy process	• A shared vision for all plant leaders • Higher identification with strategic aims
3	Lack of transparency and personal ties	• Frequent (remote) information exchange with participation of all (peer) plant leaders • Regular (physical) meetings of (peer) plant leaders	• Understanding current issues and challenges of plant leader colleagues • Trigger for subsequent exchange • Create individual-level ties
4	Lack of autonomy	• Assign decision autonomy for (selected) exchange topics	• Create pull and conviction of all involved parties • Overcome cooperation barriers (e.g., not-invented-here)
5	Local objectives	• Assign network or firm related objectives to determine the remuneration of plant leaders	• Create shared goals • Shift focus from local to the network

Table 34 presents IMN coordination mechanisms from the case firms that integrate the individual-level perspective of plant leaders. It takes up the conceptual approach from Chapter 4.1 and substantiates the strategic design and coordination mechanisms (see Figure 13) to guide the attention of plant leaders. Several findings confirm the results of Norouzilame (2018), who also proposes to apply the tactics of delayering, assigning autonomy to plants and actively managing knowledge flows.

The following discussion does not touch upon the topic of career and candidate selection (see Chapter 4.1). The findings from the case studies were very limited since only one case provided some insights in this area. Besides this limitation, the identified mechanisms mainly complement or confirm the existing knowledge base. Furthermore, the findings bring a new perspective to the plant- and network-level view applied in the existing IMN research (see Chapter 2.6.6).

1. The plant leader interviews outlined that manufacturing firms should create clusters of peer plants instead of operating one large and heterogeneous network (see Chapter 3.3.6). The case analysis provided evidence that firms indeed cluster their plants into smaller subnetworks based on characteristics that have been mentioned in IMN research before. In addition to a general discussion on taxonomies of manufacturing networks[65], the topic of how to create subnetworks within the overall network has recently received considerable attention by IMN scholars. This recent research is not motivated by the plant- or individual-level, but mainly stems from the network management perspective. Some scholars argue that it is necessary to create plant clusters for fair performance comparisons of facilities (Reuter, Prote and Stöwer, 2016). A group of researchers proposed to delayer the entire network into subnetworks that share a "coherent manufacturing mission" (Ferdows et al., 2016, p. 64) to find strategies for network managers to handle the growing complexity of global operation (Ferdows, 2018). They defined four types of subnetworks based on product and process complexity (Ferdows et al., 2016). Feldmann and Olhager (2019) analysed internal product group networks and also found four types based on the relationships between plants and internal material flows. Furthermore, the propositions by Scherrer and Deflorin (2017b, p. 413) on the willingness to engage in knowledge exchange for plants that share similarities in product, process and strategic orientation can serve as guidelines for clustering plants into subnetworks as well.
   The insights into practice gained through the cases confirm that the product groups as discussed by Feldmann and Olhager (2019) or the propositions by Scherrer and Deflorin (2017b) are applied to define subnetworks. For example, case firm III clusters its network according to strategic orientation, whereas case firm II applies a process perspective. The approach by Ferdows et al. (2016), however, seems to contradict the idea of inter-plant exchange. To cluster plants that cope with high complexity in one subnetwork and other plants with rather simple and standardised products and processes in another network might provide some benefits for network configuration and strategy definition (Ferdows et al., 2016). However, it separates plants with low capabilities from those plants that could serve as knowledge hubs

[65] See Friedli et al. (2014, pp. 90–92) for an overview of existing network taxonomies.

and provide support. Thus, from an inter-plant exchange perspective, this approach seems to somewhat impede network thinking. Both studies from Ferdows et al. (2016) and Feldmann and Olhager (2019) apply a different focus. They mainly identify implications for network configuration: "This taxonomy is useful for discussions on network configurations in practice" (Feldmann & Olhager, 2019, p. 175). On the contrary, this work and the study of Scherrer and Deflorin (2017b) show that subnetwork definition has quite fundamental implications for network coordination and inter-plant exchange. By structuring the network into congruent subnetworks, IMN management creates conditions for individuals within the plants that motivate them to engage in inter-plant exchange and thus creates macro-level (i.e., network-level) outcomes (Foss et al., 2010).

As is so often the case in IMN research, the topic of coordination still does not receive the appropriate attention (e.g., Cheng, Farooq et al., 2015; Szwejczewski et al., 2016). The discussion on subnetwork definition proves once more that decisions on IMN management need to consider strategy, configuration and coordination at the same time (Friedli et al., 2014).

2. The necessity for defining a transparent and conclusive network strategy is not a new finding from this study. Several well-known scholars in the domain of IMN have discussed strategic dimensions (i.e., network capabilities or network outputs) (e.g., Colotla et al., 2003, pp. 1190–1191; Ferdows, 1989, pp. 6–8; Miltenburg, 2009, p. 178; Shi & Gregory, 1998, pp. 202–204). Other scholars have outlined that these dimensions can serve as a network strategy (Friedli et al., 2014, pp. 48–50; Thomas et al., 2015, p. 1713). Implications of this network strategy for plant leaders result from the link between plant- and network-level (Colotla et al., 2003; Thomas et al., 2015). However, most IMN studies have turned a blind eye towards the actual implementation of a network strategy and the necessary involvement of plant leaders. The case analysis conducted for this work demonstrates that network managers are well aware that strategy implementation is based on the commitment of plant leaders. Statements like "I need to make him responsible" (III.1) or that the IMN is "in the end … a network of plant- and production leaders" (I.2) underline the role of plant leaders for network strategy implementation. This involvement in strategic matters underpins the political role of plant leaders (Smith et al., 2009, p. 430). Furthermore, it confirms their role as agents between headquarters and plant employees (Abdullah & Liang, 2013, p. 662).

   The cases also show quite different approaches towards integrating plant leaders into the network strategy definition. For example, a high rating of the network's learning ability conveys a strong message. However, most case informants were sceptical that a high rating of any strategic dimension could provide more than just an initial step towards the intended outcome. Therefore, in all cases, network management tried to convince the plant leaders of their current network strategy. Network management organised plant leader meetings, applied world-cafe methods or one to one discussions to convey the new strategy to their plant leaders. Some even integrated plant leaders into the network strategy development and review process. However, though one case informant reported positive feedback about productive discussions between plant leaders, in another case this involvement provided little in achieving a meaningful strategy.

All case firms have defined their target network capabilities or network outputs, and therefore confirm that network strategy constitutes an essential contribution to defining a shared mission among the network actors. The high prevalence of a defined network strategy within the sample is due to the case firm's openness towards the network topic and their chosen paths to systematically optimise the network operations. Other scholars (e.g. Thomas et al. (2015), Scherrer and Deflorin (2017b)) even "excluded all companies that lacked a clear manufacturing network strategy" (Thomas et al., 2015, p. 1717). It was not a deliberate choice for the work at hand to exclude firms without a network strategy; the fact that all firms of the sample have developed one allows one to derive conclusions that would otherwise not be possible. Eventually, the cases raise the question of how to increase the identification of plant leaders with these network targets. The existing IMN knowledge does not yet provide the answers. This work outlines that plant management should be integrated into the network strategy definition, but it does not provide a clear picture of how plant leaders should be integrated. The individual-level perspective poses new questions that have been hidden below the plant-level (i.e., the black box) in IMN research (Cheng, Farooq et al., 2015). The triangular relation of network strategy, individual-level and inter-plant exchange calls for more research.

3. Asymmetry of information within IMNs impedes cooperation among subsidiaries (Friedli et al., 2014, p. 148; Luo, 2005). The plant leader interviews confirmed that transparency about the current status of other network facilities would broaden their perspective and foster the willingness to support other plants (see Chapter 3.3.7). Thus, the plant leaders underline the importance for coordinating intra-network information flows (Chew et al., 1990). The cases also provide two examples of network management that coordinates the information flows through the involvement of plant leaders. Other IMN researchers, however, who have looked at inter-plant flows, widely ignore the coordination of administrative information (Gupta & Govindarajan, 1991) between plants and between plants and headquarters. One reason might be that an influential study downgraded the importance of information flows in the context of IMNs: "from a manufacturing strategy perspective, the knowledge flows are the more interesting ones" (Vereecke et al., 2006, p. 1738). Other authors (e.g., Szász et al. (2019)) also excluded information

flows from their research and concentrated on knowledge flows. However, Friedli et al. (2014, pp. 137–144) underline the importance of both knowledge and information flows for the coordination of manufacturing networks. They present an example that underlines how "the lack of a common 'network thinking' in the Seals NW is also reflected by the design of the information and knowledge flows" (Friedli et al., 2014, p. 140). In accordance with their findings, the work at hand provides evidence that network managers who want to facilitate inter-plant exchange should actively coordinate the flows of information. Two case firms create transparency through regular and shared calls of all peer plant leaders. The case informants perceived this approach as a suitable method to crate transparency and reported that it sparks cooperation across plant boundaries. Thus, the intra-network information flows also function as the starting-point for inter-plant knowledge exchange.

Furthermore, this work confirms the importance of relationships between individual plant leaders in an IMN. Knowledge sharing literature has long identified the importance of the relationship between the involved actors (Michailova & Mustaffa, 2012). According to Foss et al. (2010, p. 469), informal networks are one of the highest-ranked antecedents for intra-firm knowledge sharing. For example, Gupta and Govindarajan (2000a), Foss and Pedersen (2002), and Tsai (2002) find inter-personal relations between individuals to be beneficial for knowledge transfer. The plant leader interviews particularly confirm that they value close ties with their colleagues from other plants. Other IMN scholars also see it as a prerequisite for knowledge exchange: "from a managerial perspective, our results revealed that managers should establish individual-level ties between representatives from different plants" (Scherrer & Deflorin, 2017b, p. 413). Similarly, Szász et al. (2019, p. 302) suggests "social interactions between different plants" as an essential building block for knowledge flows between plants.

The analysed cases provide some insights on how IMN management can establish these individual-level ties between plant leaders. Regular physical meetings between peer plant leaders are the primary mechanisms for creating inter-personal relations in most case firms. IMN management organises these meetings, which usually take place once or twice a year in a different plant each time. As the first case exemplifies, these meetings give rise to friendships between plant leaders and meetings that are extended into the weekend. The majority of all case informants agree that these meetings are an integral part of bringing together a network of separate individuals who were previously focused solely on their operations. Personal relationships between plant leaders facilitate autonomous exchange among the respective plants.

4. Existing IMN research recognises the critical role of autonomy distribution within the network (see Chapter 2.6). The work at hand shows that this discussion is particularly relevant to the context of inter-plant exchange. Previous studies focus on

differences of decision autonomy between particular plant roles and lack an inter-plant exchange related discussion (Feldmann & Olhager, 2013; Maritan et al., 2004; Vereecke et al., 2006). However, since these scholars underline the importance of plant context, they confirm the conceptual approach of this work (see Chapter 4.1.3). The autonomy of a plant and the freedom in decision making of the related plant management depend to a significant extent on the plant's capabilities.

Apart from the site role context, Friedli et al. (2014) and Olhager and Feldmann (2018) discuss decision autonomy distribution between the decentralised plant and centralised network levels. However, they cover operational decision categories about things like process decisions, capacity planning or plant focus (Friedli et al., 2014, p. 117; Olhager & Feldmann, 2018, p. 7), and do not consider decision autonomy for inter-plant exchange.

The cases and interviews revealed that, in practice, it is indeed a question of how much decision autonomy a plant leader has in organising or participating in knowledge exchange with other network entities. The interviews revealed that plant leaders prefer autonomy for answering or requesting support from other plants (see Chapter 3.3.5). However, two case firms in the sample follow a somewhat centralised approach and limit the autonomy of their plant leaders concerning inter-plant exchange. This is in line with existing IMN literature, which tends to promote centralisation of decision autonomy in general. For example, Colotla et al. (2003) criticise that too many decisions on the plant-level are taken without consideration of the network. Other scholars also come to a conclusion that “control over management practices in terms of integration and coordination should not be left solely to plant managers” (Cheng & Farooq, 2018, p. 37).

Olhager and Feldmann (2018) find that firms tend to implement either a fully centralised or a fully decentralised approach for all decision categories in their IMNs. The findings from the plant leader interviews, however, indicate a more differentiated picture. Whereas best-practice or regular information exchange is something they prefer to be handled or organised centrally, plant leaders would like to remain responsible for decisions on problem-solving support. The cases, in turn, provide another perspective. Two case firms apply a very centralised approach and limit decision autonomy of plant leaders regarding inter-plant exchange, but at the same time, two case firms give their plant leaders the freedom to decide whether they or their employees should participate in an inter-plant exchange, thus creating a buy-in effect. They promote that plant leaders coordinate problem solving and support requests themselves without the interference of network management. The plant leader interviews underline that decision autonomy for such inter-plant exchange topics can increase the sustainability of the exchange as it builds on a higher commitment from the involved actors, who participate in a more or less voluntary manner. For example, the leader of a plant that frequently provides support for other network entities underlined the importance of being asked from another plant instead of a central function delegating this as a duty: “if the pull comes from the foreign plant, they want to have something and can make use of it, then clearly it will not be blocked!” (translated, I.1). The empirical evidence from the interviews and cases indicates that autonomy can mitigate cooperation barriers like not-invented-here or hoarding (e.g., Hansen, 2009). Decision autonomy for inter-plant exchange can increase a plant’s willingness to participate in things like network knowledge exchange. It is somewhat surprising that current studies on the knowledge exchange within IMNs (e.g., Scherrer & Deflorin, 2017b; Szász et al., 2019) do not consider decision autonomy as a relevant factor.

Though IMN literature stems from plant-level research (Cheng, Farooq et al., 2015), it has not yet adopted the idea of employee empowerment. Smith et al. (2009) identify that successful plant leaders empower their employees and give them a voice. In doing so, management can motivate their subordinates to cooperate (Long, 2018). Likewise, network management has to empower their plant leaders and give them autonomy for selected inter-plant exchange decisions. Long (2018) finds that management can motivate their subordinates to cooperate through empowerment. Some evidence (plant leader statements presented in Chapter 3.3 and the experiences in case I and III) suggests that this successfully proven approach from plant-level also works for the network-level, although further work on decision categories in IMN exchange is required to confirm this finding.

5. In general, the topic of incentives has attracted considerable attention, namely in the knowledge-sharing literature (e.g., Bartol & Srivastava, 2002; Cabrera et al., 2006; Foss et al., 2010, p. 469). However, in the IMN-related literature and operations management research, monetary rewards and their effects on individuals are only a fringe topic. Although the work at hand does not provide an in-depth discussion of incentives, it contributes to the existing knowledge base in the domain of IMN. First, it is consistent with a recent study by Szász et al. (2019), who also underline the importance of incentives in the context of inter-plant exchange. Second, it confirms the suggestions of Luo (2005) and Friedli et al. (2014, pp. 147–154). Namely, the latter proposes to define incentives on network, or even overall firm, level to induce cooperative behaviour of plant leaders (Friedli et al., 2014, pp. 147–148). Among the case firms, two recently changed the determinants for the financial remuneration of their plant leaders from local plant performance to overall firm success. Thereby, these firms intend to foster cooperation and guide the focus of their plant leaders from local topics to the network. The informant from the third case critically reflects on the current practice of mainly local incentives for plant leaders, which he believes is no longer in keeping with the times. Statements from several plant leaders and network managers of the cases, however, question the effect of monetary rewards

bound to overall firm success. According to their perception, these objectives are beyond the direct influence of plant leader behaviour, and therefore do not create a strong motivation to cooperate. However, such objectives are still preferred compared to plant-related objectives, which guide the focus to internal plant optimisation. It emerges from both the cases and the plant leader interviews that shared objectives for the subnetwork as a basis for the financial remuneration of plant leaders are most suitable for creating a cooperative attitude and triggering inter-plant exchange among plant leaders. This result is in line with previous studies, namely Friedli et al. (2014, p. 147). Gupta and Govindarajan (1991) and Bartol and Srivastava (2002) propose to tie the financial bonus of plant leaders to network performance in order to promote cooperation. This work is consistent with the findings of other studies and underlines that incentives are a critical element for network management to consider for promoting inter-plant exchange and cooperation across plant boundaries. Further research should be undertaken to investigate suitable performance dimensions and related KPIs to measure subnetwork success in a meaningful way. In the course of this work, informants from the case firms reported that shared stock-level or shared failure-cost objectives between multiple plant-leaders turned out as strong motivation to cooperate. A systematic analysis of shared objectives would certainly be relevant for practice and contribute to the limited knowledge base in IMN research.

This work is consistent with the findings of other studies and underlines that incentives are a critical element for network management to consider for promoting inter-plant exchange and cooperation across plant boundaries. Further research should be undertaken to investigate suitable performance dimensions and related KPIs to measure subnetwork success in a meaningful way. In the course of this work, informants from the case firms reported that shared stock-level or shared failure-cost objectives between multiple plant-leaders turned out as strong motivation to cooperate. A systematic analysis of shared objectives would certainly be relevant for practice and contribute to the limited knowledge base in IMN research.

6.4.2 Making Plant Leaders Part of IMN Coordination

In the previous section, it was shown how selected IMN coordination tactics were applied by the case firms to guide the attention of their plant leaders and to overcome the impediments to inter-plant exchange as identified during the plant leader interviews (see Chapter 3.3). The conceptual matrix (see Chapter 4.1.3) provides a systematic approach to integrate selected plant leaders into IMN coordination, and thus, to facilitate inter-plant exchange. The cross-case comparison of the conceptual matrix revealed recurrent patterns of plant leader focus, autonomy and incentives as functions of plant context. As shown in Figure 31, a guiding framework of four distinct plant leader foci and respective levers to guide their attention emerged from the cross-case analysis.

The guiding framework presented in Figure 31 summarises the findings from the cross-case comparison in section 6.3.2 and combines them with selected IMN coordination mechanisms, namely autonomy and incentives, to guide the attention of plant leaders according to their situational context:

- Leaders of plants with low capabilities and low plant performance (i.e., in the lower-left quadrant) should focus their attention internally to improve the plant situation. Due to low maturity of the plant, which is expressed through the low capability level, the autonomy of the plant leader is limited (e.g., for decisions regarding production planning or process improvements). Decision autonomy might be delegated to leaders of plants with higher capabilities. The cases provide several examples of plant leaders from the upper-right quadrant, which overtake at least some operational responsibility for one or more plants in the lower-left quadrant.
- Leaders of plants with either high performance and low capabilities or low performance and high capabilities should apply a mixed focus on either improving or maintaining internal performance and seeking for innovations from other plants. These plant leaders should also maintain a supportive attitude for requests from other plants. Their plant's situation and maturity allow for a higher autonomy. In order to create a mixed focus, network management assigns financial rewards based on both local and network objectives.
- Plant leaders of the upper-right quadrant should be guided towards a network focus. Both performance and capabilities of their plants allow for additional responsibilities, and thus, additional attentional capacity for network-related tasks. IMN management can handover responsibility for selected coordination tasks and assign them with additional autonomy that makes them the *primus inter pares*. By focusing these plant leaders on the overall network performance, and by assigning these plant leaders with an active role in inter-plant exchange, network management makes them part of IMN coordination - a domain that is traditionally seen as a task of central management (Cheng & Farooq, 2018; Colotla et al., 2003; Scherrer & Deflorin, 2017a). Bonus relevant objectives linked to the network-level guide their focus respectively.

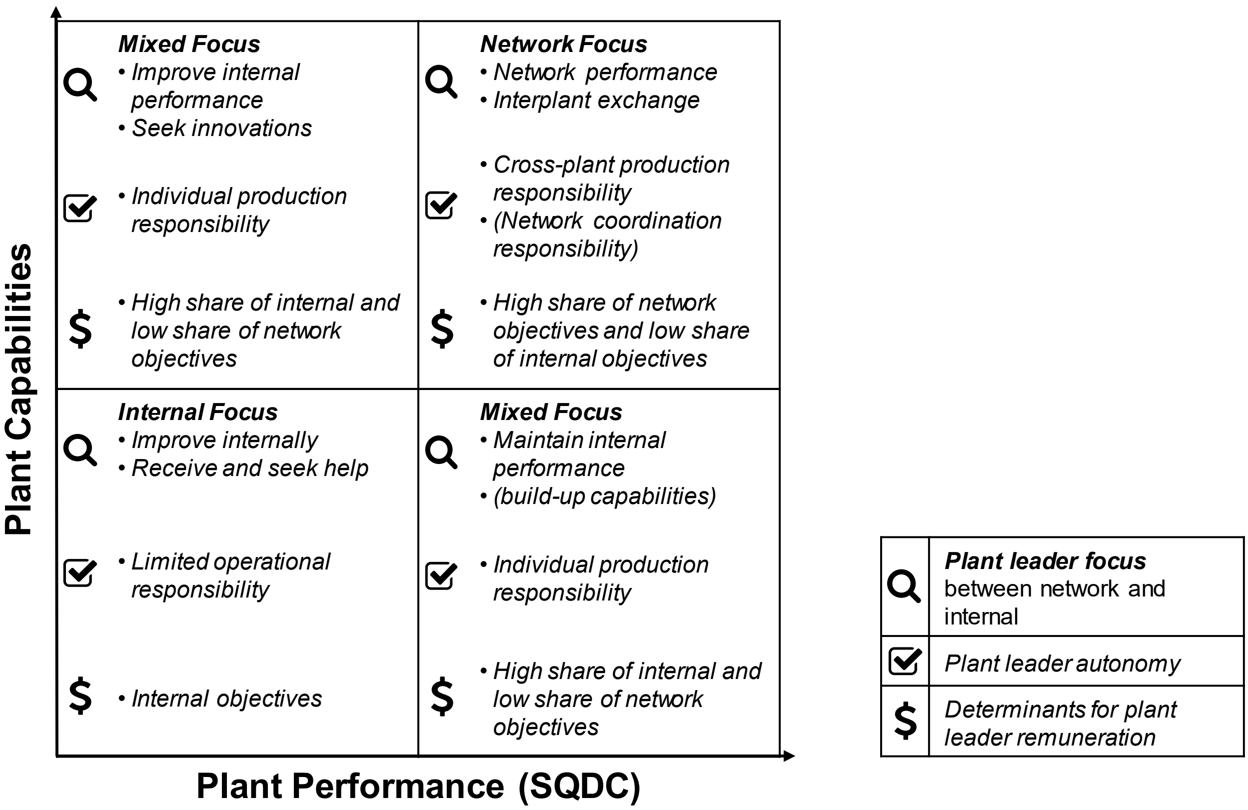


Figure 31: Guiding framework – plant leader focus as a function of plant context

The guiding approach presented in Figure 31 will prove useful in expanding the existing IMN knowledge base about network coordination and the role of plant leaders. The framework dimensions and the operationalisation derived from the cross-case comparison (see Chapter 6.3.1) contribute to the discussion on plant capabilities, which has received considerable attention from IMN scholars. The identified plant competences, which are related to products, processes and complexity (see section 6.3.1), are in line with other studies (e.g., Demeter & Szász, 2016; Feldmann & Olhager, 2013; Thomas et al., 2015; Vereecke et al., 2006). However, the guiding framework (see Figure 31) distinguishes plant competences, and autonomy as consequences of high competences. The existing knowledge base on plant competencies tends to mix both topics. For example, Feldmann and Olhager (2013) define site competence (by referring to Ferdows (1997)) as something for which a plant assumes responsibility. In the context of the guiding framework, this operationalisation would already pre-empt the cause of a high capability rating. However, the application of the conceptual matrix reveals that plant leaders of facilities with high capabilities (i.e., abilities to produce a selected product or handle the complexity or perform processes) are not always granted higher autonomy. The cross-case comparison of the y-axis' operationalisation adds to the growing body of research on plant roles (Cheng & Farooq, 2018) and provides an approach for measuring plant capabilities without referring to plant autonomy.

The guiding framework brings a new aspect into the domain of IMN, and particularly into the discussion on plant roles, by linking plant capabilities with operational performance, which stems from the idea that operational problems occupy and guide the plant leader's attention regarding plant internal topics (see Chapter 4.1). Eventually, the insights gained through the cases give the impression that the guiding framework reflects the overall role of a plant and not only of the respective plant leaders. Star plants (Cheng & Farooq, 2018), or so-called lead plants (e.g., Deflorin et al., 2012; Ferdows, 1997), are located in the upper-right quadrant of the guiding framework in some of the case firms (see Figure 31), and thus provide the plant leader with a network focus. The similarity between plant roles and the guiding framework is somewhat expected. The plant leader, as a representative of the facility, has to act according to the plant mission or plant role. However, the conceptual matrix integrates operational performance, unlike most plant role models that solely build on plant capabilities and location factors.[66] The conceptual approach integrates the plant leader's attentional capacity, and therefore does not mirror yet another plant role model. Even lead plant leaders might not be able to devote any attention to the network if own operational problems keep them busy. Case I provides an example of a designated lead plant that has been set back operationally due to overload and staff problems. Within the conceptual matrix, this plant is located in the upper-left quadrant, and network management wants the plant leader to concentrate on improving internal performance in the interim so that the plant can reclaim the leading position within the network in the long run. This example underlines how the conceptual matrix provides a short- to a medium-term job description for plant leaders. On the contrary, plant roles should be aligned with the network and competitive strategy (e.g., Maritan et al., 2004) and thus reflect a long-term orientation. Due to different time perspectives, plant role and job description of the respective leader must not coincide.

The cases also confirm that plant leaders with strong network focus can change the role of their plants and therefore be assigned with additional responsibilities for the network. For example, in case III, the Turkish plant overtook the operational subnetwork lead primarily due to the engagement and dedication of the local plant leader. This finding also supports the managerial implications of Szász et al. (2019, p. 302), who offer guidance for plant leaders to advance their plant's role. Overall, the guiding framework in combination with previous studies (Cheng et al., 2011; Cheng & Farooq, 2018; Demeter & Szász, 2016) indicates that plants change their roles not only due to growing experience or changing external conditions, but also due to the commitment and drive of the plant's management.

The guiding framework is one of the first attempts in IMN research to open up the black box (i.e., the plants) (Cheng, Farooq et al., 2015), by discussing implications for the individual-level. It combines several coordination levers to guide the attention of key decision-makers in IMNs in accordance with their plant's situation. Previous studies

[66] Cheng and Farooq (2018, pp. 7–8) present the dimension and operationalisation of previous plant role studies.

confirmed that autonomy varies according to plant context (Cheng & Farooq, 2018; Feldmann & Olhager, 2013; Maritan et al., 2004; Vereecke et al., 2006). The guiding framework transfers these findings to another coordination lever, namely to the determinants of variable remuneration.

In addition to contributing to the theoretical debate on network management, this approach also holds substantial implications for network management practice. The guiding framework provides an appropriate tool for improving network coordination. First, the application of the framework builds on an assessment of the current status of each plant. It allows the comparison of plants based on similar measures and discloses the actual plant position within a network. Therefore, this framework also contributes to the transparency demand of plant leaders (see Chapter 3.3.7). It helps to visualise the network situation and identify plants with problems.

Second, the guiding framework provides a systematic approach to set autonomy and incentives according to the intended focus of each plant's position. Each category emerging from the guiding framework comes with a distinct job description and therefore gives network management the chance to clarify its expectations towards each plant leader. Thus, the application of the framework also helps overcome the lack of an openly communicated mission, which constitutes another barrier brought up in the plant leader interviews (see Chapter 3.3.4).

Table 35: Potential operation decisions linked to plant leader autonomy (adapted from Friedli et al., 2014, p. 117; Olhager & Feldmann, 2018, p. 7)

Decision Categories	Policy Areas
Process	Process choice, manufacturing technology, procurement, production cost calculation, product allocation, transfer pricing
Capacity	Capacity levels relative demand, the timing of capacity acquisitions
Facilities	Plant focus, plant roles, plant specialisation, plant strategy
Vertical integration	Make or buy decisions, supplier selection,
Organisation and workforce	Organisational design, employee competence development
Planning and control system	Production IT, long- and short-term planning and control principles,
Quality systems	Quality tools, improvement programs

This thesis does not engage in-depth with the topic of plant leader decision autonomy. The plant leader interviews and cases have indicated different degrees of centralism for inter-plant related decisions (i.e., concerning who organises exchange meetings or who decides on ad-hoc support deployments). The framework depicts different degrees of production-related autonomy for the four types of plant leaders. Olhager and Feldmann (2018) recently derived a list of decision areas in the context of IMN (see Table 35), which extends the centralisation framework by Friedli et al. (2014, p. 117). Responsibility for network coordination (i.e., those decision areas in Table 35 that refer to more than one plant) could, to some extent, be assigned to those plant leaders who manage a plant in the upper-right quadrant of the framework.

To make selected plant leaders part of IMN coordination is, however, contradictory to the recommendations of two well-known IMN scholars, who suggest withdrawing such responsibilities from plant leaders (Cheng et al., 2011; Cheng & Farooq, 2018; Colotla et al., 2003). These scholars remark that coordination responsibility should not be assigned to plant leaders: "Instead, specific persons who can proactively manage the integration and coordination of plants with internal and external entities are needed at the company's headquarter" (Cheng & Farooq, 2018, p. 37). However, all case interviews were conducted with network managers, who are, according to Cheng and Farooq (2018), in the right position for network coordination. Contradictory to Cheng and Farooq (2018), most interviewed network managers were convinced that selected tasks of IMN coordination, like responsibility for inter-plant exchange or organisation of problem-solving, should be assigned to the plant leader level. The allocation of network-related responsibilities also increases the plant leaders' awareness of network topics. Thus, the proposed framework appears as a suitable management tool, particularly in the context of guiding the attention of plant leaders towards inter-plant exchange. The conceptual matrix, or guiding framework (Figure 31), presents an approach to integrate plant leaders into IMN coordination and therefore provides an answer to the last research question (see Chapter 1.2):

How can network management integrate plant leaders into IMN coordination?

Network management can guide the attention of plant leaders based on their attentional capacity. Plant leaders of smoothly running facilities with high capabilities are ideal candidates for facilitating inter-plant exchange. Therefore, IMN management should assign autonomy for inter-plant exchange-related decisions to these selected plant leaders. Furthermore, these individuals can also overtake autonomy for production-related decisions for their own and for plants with low capabilities and problematic operational performance. In order to guide the focus of plant leaders to network-related or internal topics, network management can design incentives accordingly based on internal plant or shared objectives.

7 Summary and Outlook

This final chapter draws upon the entire thesis to provide answers to the research question. It further includes a discussion of the implications for practice and theory. The final section outlines the limitations and explains the emergent themes for future research.

7.1 Findings

This study has set out to explore the individual-level perspective of key decision-makers in IMNs. The findings contributed in several ways to the understanding of IMN coordination and provided the basis for a conceptual framework that suggests making selected plant leaders collaborators with network management. Various sources were used to derive a comprehensive answer to the following main research question:

How can IMN management guide the attention of plant leaders to foster inter-plant exchange?

To structure the research process, three sub-research questions were formulated. Qualitative methods were used to answer these questions, and this investigation considered three different sources: the existing knowledge base on IMNs, interviews with plant leaders as key decision-makers in IMNs and the IMN management perspective through four case firms. The following sections revisit each question and discuss the findings.

(1) What approaches towards IMN coordination exist, and how do these integrate the individual-level perspective?

A systematic review of the existing knowledge base about IMN coordination provided the basis to answer this research question. Firstly, owing to the different and partly vague views of IMN coordination in the literature, it was necessary to specify the term IMN coordination. This work followed some recent publications, according to which IMN coordination considers the design and management of intra-network flows. It comprises flows of physical nature (material, people and technology) and non-physical nature (information and knowledge). The analysed knowledge base concentrated on single measures for managing and guiding these inter-plant flows - namely, autonomy of network entities, standardisation, incentives and specific means for fostering non-physical exchange. Although IMN research, in general, has devoted considerably more attention to the topic of coordination during recent years, the literature search confirmed the lack of studies addressing comprehensive concepts that explore the scope and quality of network flows and inter-plant exchange.

With regard to the second part of RQ1, it was evident that existing approaches towards IMN coordination almost exclusively applied a network- or plant-level perspective. Though not explicitly mentioned, a small number of studies referred to individual-level aspects or pointed to the potential research merits of applying this perspective. Studies outlined that the and individual's motivation and their ties to people in other network units play a critical role for inter-plant exchange. Despite referring to plants as abstract entities without specifying internal aspects, studies described plant conduct by using characteristics that are usually applied to describe humans (e.g., willingness or motivation). Overall, the findings revealed that IMN related studies do not yet systematically take the individual level into account.

(2) What barriers exist that hinder plant leaders from engaging in inter-plant exchange?

This thesis has argued that plant leaders are representatives of the individual-level perspective. Notwithstanding the sample being relatively limited with 12 interviewed plant leaders, this empirical basis offered valuable insights into impediments to inter-plant exchange. First, the perception of the interviewed plant leaders indeed underlined their role as key decision-makers in IMNs. Numerous statements and examples collected during the interviews prove that the plant leaders had a significant impact on their facility's engagement in inter-plant exchange. Beyond this confirmation of the underlying assumption, the interviews revealed eight impediments from the plant leader perspective.

First, the plant leaders outlined that by the nature of their job, they were primarily focused on plant-internal topics. Though convinced that inter-plant exchange holds benefits for the firm, they explained that the strong internal focus was necessary to cope with daily challenges of operations. Eventually, several informants hinted that this prioritisation of internal topics was necessary due to a lack of resources.

Second, another impediment to inter-plant exchange traces back to the lack of clarity about the strategic priorities. Some plant leaders justified their internal focus due to the lack of guidance by their superiors. Therefore, a missing or miscommunicated network strategy that promotes inter-plant exchange, turned out to be another critical impediment.

Third, contingent on the particular kind of exchange, the plant leaders felt that both an excessive degree of centralism and the lack of centrally organised exchange platforms limited the willingness of plant leaders to participate or focus attention towards inter-plant exchange.

Fourth, a particularly prominent topic throughout the interviews was the lack of similarity between facilities. As such, this research confirmed previous findings that overlap between plants concerning strategic orientation, products or performed production processes constitutes a prerequisite for inter-plant exchange. The plant leader interviews produced results that corroborate previous research, in that they suggest delayering a global manufacturing network into congruent subnetworks of peer plants.

Fifth, the interviews match recommendations of earlier studies, which suggested promoting ties between individuals belonging to different plants. Several informants highlighted that the lack of personal relations with other plant leaders constitutes a significant barrier for inter-plant exchange.

Sixth, some plant leaders highlighted that individual-level ties improve the estimate of other factories' capabilities. Thus, personal contact generates transparency about whom to contact if problems occur. The interviews revealed that missing transparency about other plants' capabilities and performance hinders the initiation of exchange across plant boundaries.

Seventh, concerns were expressed about false incentives, which promote inter-plant competition, guide the attention of plant leaders to internal topics and thus impede inter-plant exchange.

Finally, a common view amongst interviewees was that the promotion of the plant leader position as an intermediate career step draws in unsuitable candidates characterised by an improper mindset that hampers inter-plant exchange.

Overall, the analysis of 12 plant leader interviews confirmed previous findings and contributed additional evidence that suggests considering the individual-level perspective for the design of IMN coordination measures and policies.

(3) How can network management integrate plant leaders into IMN coordination?

A combination of both findings from the plant leader interviews and IMN literature formed the conceptual basis to identify approaches that integrate the individual-level perspective into IMN management. Four case studies gave centre stage to three themes: network strategy, coordination mechanisms and the application of a conceptual framework to guide plant leader attention.

First, the interviews with six network managers from the case firms revealed that approaches towards network strategy varied widely. Even though all firms ranked inter-plant exchange related network capabilities as at least important, the process of strategy definition and refinement varied in terms of plant leader involvement. Whilst network management in some firms confronted their plant representatives with a top-down strategy, the sample of case firms also demonstrated that plant leaders can be integrated in a bottom-up manner into the strategy definition process. Although most informants underlined that strategic decisions on network configuration require a top-down approach, IMN coordination appears to benefit from plant leader involvement in strategy definition, not least because convincing plant leaders of the network mission becomes much easier if they are involved in the strategy definition.

Second, a comparison of coordination mechanisms throughout the four case firms revealed vast differences and similarities. Whereas two case firms guided the attention of their plant leaders somewhat internally by assigning responsibility for inter-plant exchange to network management, the two remaining case examples pursued a rather decentralised approach. Similarly, no clear picture emerged concerning means of exchange and incentives. Although it appeared that network management was becoming increasingly aware of the individual-level effects of things like incentives or meetings to create individual-level ties, appropriate implementation was often still missing in the case firms. However, one peculiarity was evident in the majority of the cases, which confirmed the conceptual approach. In three out of four cases, selected plant leaders were assigned with coordination duties and responsibility for the network.

Finally, the conducted case studies confirmed the applicability of the conceptual approach (i.e., a matrix based on two dimensions). All network managers confirmed that plant context (i.e., unit performance and capabilities) forms a suitable basis for defining the designated plant leader focus and designing selected IMN coordination mechanisms accordingly. First, the informants confirmed that the application of the conceptual framework in numerous subnetworks generated a rigour and informative reflection of the network. Second, the interviewed network managers attested that the framework supports the nomination of plant leaders, who are designated to overtake some additional duties of network coordination. Furthermore, the framework recommends distinct measures for guiding the attention of plant leaders internally or towards the network. As such, the conceptual framework proved useful as a management tool that supports network management, by making selected plant leaders' part of the solution and guiding their attention accordingly.

Taken together, both the plant leader interviews and the cross-case analysis answer the main research question. First, the plant leader interviews demonstrated starting points for network management to facilitate inter-plant exchange. Second, the case study process revealed a number of measures for guiding the attention of plant managers. In addition to the conceptual framework, which combines various actions to guide the attention of individual plant leaders according to their contextual situation, the cases pointed out seven separate measures that network management might apply to foster inter-plant exchange: (1) delayer network into clusters of peer plants, (2) define designated (sub)network mission highlighting inter-plant exchange, (3) integrate plant leaders into the network strategy process, (4) conduct information exchange with participation of all (peer) plant leaders to create transparency, (5) host regular (physical) meetings of (peer) plant leaders to create individual-level ties, (6) assign decision autonomy for (selected) exchange topics to selected plant leaders, and (7) set network or firm related objectives to determine the remuneration of plant leaders in order to motivate cooperative behaviour.

7.2 Contribution to Theory and Practice

The findings of this study contribute to the existing knowledge base in the field of global operations and have a number of practical implications for IMN managers.

First, the systematic review of literature enhanced the understanding of the IMN coordination concept. The identified lack of studies integrating the individual-level perspective did not only confirm the intention of this research, but it also highlighted previous calls from scholars to intensify IMN research beyond the plant or network level (e.g. Cheng, Farooq et al., 2015; Luo, 2005). Second, the plant leader interviews provided several noteworthy contributions to this gap. This study is one of the first comprehensive assessments taking plant leaders as relevant decision-makers for the management of IMNs. The identification of eight impediments to inter-plant exchange contributed in several ways to the understanding of the individual-level perspective. One identified barrier confirmed the propositions of Scherrer and Deflorin (2017b), which stated that similarity in strategic orientation, products and processes is a prerequisite for inter-plant exchange. As such, the study at hand adds to the growing body of research that suggests delayering an IMN into clusters of peer plants (Ferdows et al., 2016). Furthermore, it sheds new light on the design of IMN incentive systems, which Friedli et al. (2014) and Luo (2005) discussed from a central-management perspective. By doing so, this study again confirms recent findings by Szász et al. (2019), who also highlight the importance of a well-designed incentive system. The conceptual framework, which was operationalised and refined during the case studies, combined several coordination mechanisms for guiding the focus of individuals, and thus added a comprehensive approach to the literature, which was formerly and primarily focused on single measures. In doing so, this thesis has gone some way towards enhancing the understanding of plant context (i.e., plant performance and plant capabilities) as decisive variables not only for the plant leaders attentional focus, but as relevant factors for the steering of subsidiaries in general. Finally, the approach of making selected plant leaders part of IMN coordination, which was confirmed reasonable by all case informants, offers an alternative to previous IMN research that tended to promote centralism somewhat and primarily regarded plant leaders as executors of central directives.

In addition to its scientific contributions, this thesis also has several practical applications. First, it raises awareness about the benefits of operating an IMN. Many firms lack a comprehensive and systematic approach for managing their IMNs (Friedli et al., 2014), and therefore fail to benefit from advantages like network learning or mobility. This research provides a pragmatic approach for network managers seeking to take advantage of these potentials. Four key priorities that resulted from the plant leader interviews help to address these shortcomings (Wiech & Friedli, 2020). First, network managers should cluster peer plants into subnetworks. Second, an unambiguous and openly communicated network mission that provides resources for inter-plant exchange is needed. Third, network management should implement mechanisms and platforms to create inter-personal ties between plant leaders. Fourth, network management should design an incentive system that promotes inter-plant exchange based on shared objectives.

Furthermore, the conceptual framework, which has been refined in real-world settings during the case studies, has a number of important implications for network managers. First, the matrix brings transparency to the network. Based on the capability and operational performance dimensions, it helps to create clarity about the current network set-up not only for plan leaders, but also for network management itself. Suggestions to operationalise both dimensions of the matrix from four case firms can be used by network managers also hoping to apply this matrix for their network.

Second, the matrix provides a powerful approach for designing IMN coordination mechanisms according to plant leaders' situational context. As such, it supports the formulation of adequate job descriptions. The matrix encourages management to enhance inter-plant exchange by involving selected plant leaders into IMN coordination. The conceptual approach of this thesis supports practitioners in the task of managing complex manufacturing operations.

7.3 Limitations and Further Research

This is one of the first studies to integrate the individual-level into IMN research, and therefore, some limitations need to be acknowledged. This work in general, but particularly its limitations, presents a starting point for future research.

First, the findings and recommendations of this thesis build on the mandatory requirement that firms aim for the potentials of inter-plant exchange (i.e., internal learning and cooperation among plants), but there are presumably firms that actively promote inter-plant competition. Namely, the performance-focused nature of operations tends to facilitate competition between manufacturing subsidiaries. This poses the question of whether decision-makers are aware of the consequences. Further research might explore the circumstances in which IMN management tends to promote competition or inter-plant exchange. Further work needs to be done to establish whether the prioritisation of particular network capabilities correlates with a competitive or collaborative IMN coordination policy. In order to develop a better understanding of the mechanisms behind cooperative behaviours in IMNs, additional studies that delve into the effects of IMN coordination are needed. For example, the results of this work suggest applying shared objectives instead of linking a plant leader's bonus to local performance figures. Further research needs to more closely examine specific performance dimensions and measures that reflect the success of inter-plant exchange.

From a methodological point of view, the applied case study approach limits the generalisability of the results. Although several measures were taken to ensure the validity of this research, a more diverse sample would certainly increase generalisability. Further studies need to be carried out in order to validate the findings for manufacturing firms located outside of Europe. Future research could assess how Japanese manufacturing firms, known for successfully transferring practices into their globally dispersed branches (Voss et al., 1995), coordinate their network and integrate the plant leader perspective.

The conducted plant leader interviews also lack representativeness. As discussed by Wiech and Friedli (2020), although a number of the interviewed plant leaders were located across the globe in places as diverse as Serbia and India, all originated from German-speaking areas. Therefore, large-scale empirical studies with plant leaders from various cultural backgrounds need to be carried out in order to validate the identified impediments. It could also be useful to examine whether personal characteristics of the plant leaders are linked to the network conduct of the facility. Like Smith et al. (2009), who interviewed industry-leading plant leaders, future studies could compare the personal characteristics of plant leaders who demonstrate strong network thinking to plant leaders who are more internally focused. However, identification of these polar examples will undoubtedly be a challenging task.

Another limitation of this work stems from the inductive approach, applied during both the plant leader interviews and the case studies. Much like in the study of Smith et al. (2009, p. 441), this work is potentially biased by the *perceptual lens* of the interviewed managers. The main results of this work are obtained through the interpretation of statements from plant leaders and network managers. However, it was a deliberate choice to engage with representatives from the plant and network level and enrich theory based on their perception. Furthermore, where possible, the findings were corroborated with supplemental data generated through, for example, prior project cooperation.

Furthermore, the operationalisation of the conceptual framework also calls for additional research. The case-study interviews with practitioners revealed difficulties in finding a fair comparison of manufacturing units concerning plant capabilities and operational plant performance. The proposed operationalisation of both dimensions resulting from the case studies is somewhat high-level. It lacks defined KPIs, particularly for plant capabilities. Continued efforts are needed to make both plant capabilities and plant performance more measurable.

In general, this work has shown that the individual-level merits more recognition by IMN research. More studies are required to account for plant leaders and other relevant representatives of the individual level in IMNs. Moreover, scholars should consider applying less prominent theoretical approaches to their research. Ocasio's (1997) attention-based view, as demonstrated in this thesis, is well-suited for engaging in the individual-level perspective. Another possible area of future research would be to investigate the effectiveness of IMN coordination mechanisms, for example, those proposed in this work, to guide the attention of plant leaders.

References

Abdullah, N. A. H. N. and Liang, L. Y. (2013). Knowledge sharing between multinational corporation's headquarters and subsidiaries: the impact of management's role, compensation system and cultural differences. *Journal of Economics and Behavioral Studies*, *5*(10), 660–668.

Abele, E., Meyer, T., Näher, U., Strube, G. and Sykes, R. (Eds.). (2008). *Global Production: A Handbook for Strategy and Implementation*. Berlin, Heidelberg: Springer Verlag.

Abele, E. and Reinhart, G. (2011). *Zukunft der Produktion: Herausforderungen, Forschungsfelder, Chancen*. München: Hanser Verlag.

Abrams, L. C., Cross, R., Lesser, E. and Levin, D. Z. (2003). Nurturing interpersonal trust in knowledge-sharing networks. *Academy of Management Perspectives*, *17*(4), 64–77.

Acar, Y. and Atadeniz, S. N. (2015). Comparison of integrated and local planning approaches for the supply network of a globally-dispersed enterprise. *International Journal of Production Economics*, *167*, 204–219.

Atteslander, P. (2010). *Methoden der empirischen Sozialforschung* (13th ed.). *ESV basics*. Berlin: Erich Schmidt Verlag.

Azevedo, A.L. and Sousa, J.P. (2000). A component-based approach to support order planning in a distributed manufacturing enterprise. *Journal of Materials Processing Technology*, *107*(1), 431–438.

Baker, M. J. (2000). Writing a literature review. *Marketing Review*, *1*(2), 219–247.

Bandyopadhyay, S. and Pathak, P. (2007). Knowledge sharing and cooperation in outsourcing projects — a game theoretic analysis. *Decision Support Systems*, *43*(2), 349–358.

Barnett, M. L. (2008). An attention-based view of real options reasoning. *The Academy of Management Review*, *33*(3), 606–628.

Barratt, M., Choi, T. Y. and Li, M. (2011). Qualitative case studies in operations management: trends, research outcomes, and future research implications. *Journal of Operations Management*, *29*(4), 329–342.

Bartlett, C. A. and Ghoshal, S. (1989). *Managing Across Borders: The Transnational Solution*. Boston: Hutchinson Business Books.

Bartol, K. M. and Srivastava, A. (2002). Encouraging knowledge sharing: the role of organizational reward systems. *Journal of Leadership & Organizational Studies*, *9*(1), 64–76.

Benninghaus, C. (2019). Impact of Digitalization on the Strategic Management of International Manufacturing Networks: A configurations perspective (Dissertation). Institute of Technology Management, St. Gallen.

Bernard, H. R. (2013). *Social Research Methods: Qualitative and Quantitative Approaches* (2nd ed.). Los Angeles: Sage Publishing.

Bhatnagar, R., Chandra, P. and Goyal, S. K. (1993). Models for multi-plant coordination. *European Journal of Operational Research*, *67*(2), 141–160.

Bitran, G. R., Marieni, D. M., Matsuo, H. and Noonan, J. W. (1985). Multiplant MRP. *Journal of Operations Management*, *5*(2), 183–203.

Block, F., Keller, M. R., Schrank, A. and Whitford, J. (2012). *A strategy to foster advanced manufacturing networks in the united states* (Scholars Strategy Network). Retrieved September 12, 2019, from https://scholars.org/sites/scholars/files/ssn_strategy_brief_block_keller_schrank_whitford_on_advanced_manufacturing.pdf.

Bock, G.-W., Zmud, R. W., Kim, Y.-G. and Lee, J.-N. (2005). Behavioral intention formation in knowledge sharing: examining the roles of extrinsic motivators, social-psychological forces, and organizational climate. *MIS Quarterly*, *29*(1), 87–111.

Boscari, S., Danese, P. and Romano, P. (2016). Implementation of lean production in multinational corporations: a case study of the transfer process from headquarters to subsidiaries. *International Journal of Production Economics*, *176*, 53–68.

Brandenburger, A. M. and Nalebuff, B. (1996). *Co-opetition* (1st ed.). New York: Currency Doubleday.

Brennan, L., Ferdows, K., Godsell, J., Golini, R., Keegan, R., Kinkel, S., Srai, J. S. and Taylor, M. (2015). Manufacturing in the world: where next? *International Journal of Operations & Production Management*, *35*(9), 1253–1274.

Burgess, D. (2005). What motivates employees to transfer knowledge outside their work unit? *Journal of Business Communication*, *42*(4), 324–348.

Cabrera, Á., Collins, W. C. and Salgado, J. F. (2006). Determinants of individual engagement in knowledge sharing. *International Journal of Human Resource Management*, *17*(2), 245–264.

Chacón, E., Besembel, I. and Hennet, J.-C. (2004). Coordination and optimization in oil and gas production complexes. *Computers in Industry*, *53*(1), 17–37.

Chase, R. B. and Zhang, A. (1998). Operations management: internationalization and interdisciplinary integration. *International Journal of Operations & Production Management*, *18*(7), 663–667.

Chatha, K. A. and Butt, I. (2015). Themes of study in manufacturing strategy literature. *International Journal of Operations & Production Management*, *35*(4), 604–698.

Chen, T.-L., Lin, J. T. and Wu, C.-H. (2014). Coordinated capacity planning in two-stage thin-film-transistor liquid-crystal-display (TFT-LCD) production networks. *Omega*, *42*(1), 141–156.

Cheng, Y., Chaudhuri, A. and Farooq, S. (2016). Interplant coordination, supply chain integration, and operational performance of a plant in a manufacturing network: a mediation analysis. *Supply Chain Management*, *21*(5), 550–568.

Cheng, Y. and Farooq, S. (2018). The role of plants in manufacturing networks: a revisit and extension. *International Journal of Production Economics*, *206*, 15–32.

Cheng, Y., Farooq, S. and Johansen, J. (2011). Manufacturing network evolution: a manufacturing plant perspective. *International Journal of Operations & Production Management*, *31*(12), 1311–1331.

Cheng, Y., Farooq, S. and Johansen, J. (2014). Global Operations: A Review and Outlook. In J. Johansen, S. Farooq and Y. Cheng (Eds.), *International Operations Networks* (pp. 161–179). London: Springer Verlag.

Cheng, Y., Farooq, S. and Johansen, J. (2015). International manufacturing network: past, present, and future. *International Journal of Operations & Production Management*, *35*(3), 392–429.

Cheng, Y., Farooq, S., Johansen, J. and O'Brien, C. (2019). The management of international manufacturing networks: a missing link towards total management of global networks. *Production Planning & Control*, *30*(2-3), 91–95.

Cheng, Y. and Johansen, J. (2013). Operations network development: internationalisation and externalisation of value chain activities. *Production Planning & Control*, *25*(16), 1351–1369.

Cheng, Y., Johansen, J. and Hu, H. (2015). Exploring the interaction between R&D and production in their globalisation. *International Journal of Operations & Production Management*, *35*(5), 782–816.

Cheng, Y., Madsen, E. S. and Liangsiri, J. (2010). Transferring knowledge in the relocation of manufacturing units. *Strategic Outsourcing: an International Journal*, *3*(1), 5–19.

Chew, W. B., Clark, K. B. and Bresnahan, T. (1990). Measurement, Coordination and Learning in a Multi-plant Network. In R. S. Kaplan (Ed.). *Measures for Manufacturing Excellence* (pp. 129–162). Boston: Harvard Business School Press.

Choi, S. Y., Kang, Y. S. and Lee, H. (2008). The effects of socio-technical enablers on knowledge sharing: an exploratory examination. *Journal of Information Science*, *34*(5), 742–754.

Christodoulou, P. A., Fleet's, D., Hanson, P., Phaal, R., Probert, D. and Shi, Y. (2007). *Making the Right Things in the Right Places: A Structured Approach to Developing and Exploiting 'Manufacturing Footprint' Strategy*. Cambridge: University of Cambridge Institute for Manufacturing.

Christopher, M. and Holweg, M. (2011). "Supply Chain 2.0": managing supply chains in the era of turbulence. *International Journal of Physical Distribution & Logistics Management*, *41*(1), 63–82.

Colotla, I., Shi, Y. and Gregory, M. J. (2003). Operation and performance of international manufacturing networks. *International Journal of Operations & Production Management*, *23*(10), 1184–1206.

Cooper, H. M. (1988). Organizing knowledge syntheses: A taxonomy of literature reviews. *Knowledge in Society*, *1*(1), 104–126.

Coughlan, P. and Coghlan, D. (2002). Action research for operations management. *International Journal of Operations & Production Management*, *22*(2), 220–240.

Creswell, J. W. and Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Los Angeles, London, New Delhi: Sage Publishing.

Cyert, R. M. and March, J. G. (1963). *A Behavioral Theory of the Firm*. *Prentice-Hall international series in management*. New York: Prentice-Hall, Englewood Cliffs.

De Meyer, A. and Vereecke, A. (2009). How to optimize knowledge sharing in a factory network? *McKinsey Quarterly*, 1–7.

Deflorin, P., Dietl, H., Scherrer-Rathje, M. and Lang, M. (2012). The lead factory concept: benefiting from efficient knowledge transfer. *Journal of Manufacturing Technology Management*, *23*(4), 517–534.

Demeter, K. (2014). Operating internationally—The impact on operational performance improvement. *International Journal of Production Economics*, *149*, 172–182.

Demeter, K. and Losonci, D. (2019). Transferring lean knowledge within multinational networks. *Production Planning & Control*, *30*(2-3), 211–224.

Demeter, K. and Szász, L. (2016). The diversity of European manufacturing plant roles in international manufacturing networks. *Journal of East European Management Studies*, *21*(2), 184–208.

Dutton, J. E. and Jackson, S. E. (1987). Categorizing strategic issues: links to organizational action. *The Academy of Management Review*, *12*(1), 76–90.

Edwards, R. and Holland, J. (2013). *What is Qualitative Interviewing?* (1st ed.). *The 'What is?' Research Methods Series*. London: Bloomsbury Academic.

Eisenhardt, K. M. (1989). Building theories from case study research. *The Academy of Management Review*, *14*(4), 532–550.

Eisenhardt, K. M. and Graebner, M. E. (2007). Theory building from cases: opportunities and challenges. *The Academy of Management Journal*, *50*(1), 25–32.

Emerald Publishing Limited. (2019). Advanced search tips: wild cards. Retrieved March 26, 2019, from https://www.emeraldinsight.com/search/advanced.

European Commission. (2008). *NACE Rev.2: statistical classification of economic activities in the european community*. Luxembourg: Office for Official Publications of the European Communities.

F.M.C.L. (2002). Get the low-down on what jobs offer: the factory manager. *Food Manufacture*, *77*(7), 55.

Feldman, H. D. (1988). The senior production manager: working within a network of human relationships. *International Journal of Operations & Production Management*, *8*(4), 50–64.

Feldmann, A. and Olhager, J. (2013). Plant roles: site competence bundles and their relationships with site location factors and performance. *International Journal of Operations & Production Management*, *33*(6), 722–744.

Feldmann, A. and Olhager, J. (2019). A taxonomy of international manufacturing networks. *Production Planning & Control*, *30*(2-3), 163–178.

Feldmann, A., Olhager, J., Fleet, D. and Shi, Y. (2013). Linking networks and plant roles: the impact of changing a plant role. *International Journal of Production Research*, *51*(19), 5696–5710.

Ferdows, K. (1989). Mapping International Factory Networks. In K. Ferdows (Ed.). *Managing International Manufacturing* (pp. 3–23). Amsterdam: Elsevier Science Publishers.

Ferdows, K. (1997). Making the most of foreign factories. *Harvard Business Review*, *75*(2), 73–88.

Ferdows, K. (2006). POM Forum: transfer of changing production know-how. *Production and Operations Management*, *15*(1), 1–9.

Ferdows, K. (2018). Keeping up with growing complexity of managing global operations. *International Journal of Operations & Production Management*, *38*(2), 390–402.

Ferdows, K., Vereecke, A. and de Meyer, A. (2016). Delayering the global production network into congruent subnetworks. *Journal of Operations Management*, *41*, 63–74.

Flick, U. (2018). *An Introduction to Qualitative Research* (6th ed.). Los Angeles: Sage Publishing.

Foss, N. J., Husted, K. and Michailova, S. (2010). Governing knowledge sharing in organizations: levels of analysis, governance mechanisms, and research directions. *Journal of Management Studies*, *47*(3), 455–482.

Foss, N. J. and Pedersen, T. (2002). Transferring knowledge in MNCs: the role of sources of subsidiary knowledge and organizational context. *Journal of International Management*, *8*(1), 49–67.

Fredriksson, A. and Jonsson, P. (2019). The impact of knowledge properties on international manufacturing transfer performance. *Production Planning & Control*, *30*(2-3), 197–210.

Fredriksson, A. and Wänström, C. (2014). Manufacturing and supply chain flexibility: Towards a tool to analyse production network coordination at operational level. *Strategic Outsourcing: an International Journal*, *7*(2), 173–194.

Friedli, T., Mundt, A. and Thomas, S. (2014). *Strategic Management of Global Manufacturing Networks: Aligning Strategy, Configuration, and Coordination*. Berlin, Heidelberg: Springer Verlag.

Frost & Sullivan. (2019). Global Trade Wars Impact: Forecast to 2020. Retrieved September 28, 2019, from https://cds.frost.com/p/44959#!/ppt/c?id=9AE6-00-05-00-00&hq=global%20trade%20wars.

Galia, F. (2008). Intrinsic-extrinsic motivations, knowledge sharing and innovation in french firms. *ICFAI Journal of Knowledge Management*, *6*(1), 56–80.

Gassmann, O. (1997). *Internationales F&E-Management: Potentiale und Gestaltungskonzepte transnationale F&E-Projekte*. München, Wien: Oldenbourg.

Gassmann, O. (1999). Praxisnähe mit Fallstudienforschung. *Wissenschaftsmanagement*, *3*(5), 11–16.

Ghazilla, R. A. R., Sakundarini, N., Abdul-Rashid, S. H., Ayub, N. S., Olugu, E. U. and Musa, S. N. (2015). Drivers and barriers analysis for green manufacturing practices in malaysian SMEs: a preliminary finding. *Procedia CIRP*, *26*, 658–663.

Gooderham, P., Minbaeva, D. B. and Pedersen, T. (2010). Governance mechanisms for the promotion of social capital for knowledge transfer in multinational corporations. *Journal of Management Studies*, *48*(1), 123–150.

Günther, E. and Scheibe, L. (2005). Analyse der Hemnisse. In R. Barth, C. Erdmenger and E. Günther (Eds.). *Umweltfreundliche öffentliche Beschaffung* (1st ed., pp. 143–181). Heidelberg: Physica-Verlag.

Günther, E. and Stechemesser, K. (2010). Hemmnisse analysieren und überwinden. *Ökologisches Wirtschaften - Fachzeitschrift*, *25*(3), 39–42.

Gupta, A. K. and Govindarajan, V. (1991). Knowledge flows and the structure of control within multinational corporations. *The Academy of Management Review*, *16*(4), 768–792.

Gupta, A. K. and Govindarajan, V. (2000a). Knowledge flows within multinational corporations. *Strategic Management Journal*, *21*(4), 473–496.

Gupta, A. K. and Govindarajan, V. (2000b). Knowledge management's social dimension: lessons from nucor steel. *Sloan Management Review*, *42*(1), 71–80.

Hansen, M. T. (2009). *Collaboration: How Leaders Avoid the Traps, Build Common Ground, and Reap Big Results*. Boston: Harvard Business Review Press.

Hansen, M. T., Mors, M. L. and Løvås, B. (2005). Knowledge sharing in organizations: multiple networks, multiple phases. *The Academy of Management Journal*, *48*(5), 776–793.

Hautaluoma, J. E., Dickinson, T. L. and Inada, A. R. (1992). Trait patterns, background characteristics, managerial styles, and job practices of industrial middle managers. *Journal of Social Psychology*, *132*(2), 201–215.

Hayes, R. H., Pisano, G. P., Upton, D. and Wheelwright, S. C. (2005). *Operations, strategy, and technology: Pursuing the competitive edge*. Hoboken, NJ: Wiley.

Hayes, R. H. and Wheelwright, S. C. (1984). *Restoring Our Competitive Edge: Competing Through Manufacturing*. New York: John Wiley & Sons Ltd.

Hermann, J. (2011). *Warum passen sich Unternehmen nicht an die Auswirkungen des Klimawandels an?: Hemnisse und Barrieren gegenüber der Klimawandelanpassung*. Diplomarbeit (Dresdner Beiträge zur Lehre der betrieblichen Umweltökonomie No. 51). Retrieved February 11, 2019, from http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-114891.

Hill, T. (1993). *Manufacturing strategy: The Strategic Management of the Manufacturing Function* (2nd ed.). Houndsmills: Macmillan.

Hoffman, A. J. and Ocasio, W. (2001). Not all events are attended equally: toward a middle-range theory of industry attention to external events. *Organization Science*, *12*(4), 414–434.

Honer, A. (1994). Das explorative Interview: zur Rekonstruktion der Relevanzen von Expertinnen und anderen Leuten. *Schweizerische Zeitschrift Für Soziologie*, *20*(3), 623–640.

Hum, S.-H. and Leow, L.-H. (1992). The perception of the strategic role of manufacturing amongst operations managers: an empirical study based on a newly industrialized economy. *International Journal of Operations & Production Management*, *12*(11), 15–23.

Husted, K. and Michailova, S. (2002). Diagnosing and fighting knowledge-sharing hostility. *Organizational Dynamics*, *31*(1), 60–73.

Ivanov, D., Sokolov, B. and Pavlov, A. (2013). Dual problem formulation and its application to optimal redesign of an integrated production–distribution network with structure dynamics and ripple effect considerations. *International Journal of Production Research*, *51*(18), 5386–5403.

Jacob, F. and Strube, G. (2008). Why Go Global? The Multinational Imperative. In E. Abele, T. Meyer, U. Näher, G. Strube and R. Sykes (Eds.), *Global Production: A Handbook for Strategy and Implementation* (pp. 2–33). Berlin, Heidelberg: Springer Verlag.

Jaehne, D. M., Li, M., Riedel, R. and Mueller, E. (2009). Configuring and operating global production networks. *International Journal of Production Research*, *47*(8), 2013–2030.

Kádár, B., Egri, P., Pedone, G. and Chida, T. (2018). Smart, simulation-based resource sharing in federated production networks. *CIRP Annals*, *67*(1), 503–506.

Kemmoe, S., Pernot, P.-A. and Tchernev, N. (2014). Model for flexibility evaluation in manufacturing network strategic planning. *International Journal of Production Research*, *52*(15), 4396–4411.

Klassen, R. D. and Whybark, D.C. (1994). Barriers to the management of international operations. *Journal of Operations Management*, *11*(4), 385–396.

Knudsen, M. P. and Madsen, E. S. (2014). The managerial issues related to transferring shop floor knowledge in manufacturing relocation. *International Journal of Operations & Production Management*, *34*(11), 1389–1416.

Kohn, A. (1993). Why incentive plans cannot work. *Harvard Business Review*, *71*(5), 54–63.

Kubicek, H. (1977). Heuristische Bezugsrahmen und heuristisch angelegte Forschungsdesigns als Elemente einer Konstruktionsstrategie empirischer Forschung. In R. Köhler (Ed.), *Empirische und handlungstheoretische Forschungskonzeptionen in der Betriebswirtschaftslehre* (1st ed., pp. 3–36). Stuttgart: Poeschel.

Lang, M., Deflorin, P., Dietl, H. and Lucas, E. (2014). The impact of complexity on knowledge transfer in manufacturing networks. *Production and Operations Management*, *23*(11), 1886–1898.

Lara, A. A., Trujano, G. and García-Garnica, A. (2005). Modular production and technological up-grading in the automotive industry: a case study. *International Journal of Automotive Technology and Management*, *5*(2), 199–215.

Lebreton, B. G. M., van Wassenhove, L. N. and Bloemen, R. R. (2010). Worldwide sourcing planning at Solutia's glass interlayer products division. *International Journal of Production Research*, *48*(3), 801–819.

Lee, G. L., Burcher, P. G. and Sohal, A. S. (2004). The changing roles of production and operations managers in Britain from the 1970s to the 1990s. *International Journal of Operations & Production Management*, *24*(4), 409–423.

Levy, Y. and Ellis, J. T. (2006). A systems approach to conduct an effective literature review in support of information systems research. *Informing Science: the International Journal of an Emerging Transdiscipline*, *9*, 181–212.

Lim, M., Tan, K. and Leung, S.H. (2013). Using a multi-agent system to optimise resource utilisation in multi-site manufacturing facilities. *International Journal of Production Research*, *51*(9), 2620–2638.

Lin, B. and Vassar, J. A. (1992). The service factory: implications for manufacturing managers. *Industrial Management & Data Systems*, *92*(1), 18–22.

Linstone, H. A., Turoff, M. and Helmer, O. (Eds.). (1975). *The Delphi Method: Techniques and applications*. Reading: Addison-Wesley.

Long, C. P. (2018). To control and build trust: How managers use organizational controls and trust-building activities to motivate subordinate cooperation. *Accounting, Organizations and Society*, *70*, 69–91.

Luo, Y. (2005). Toward coopetition within a multinational enterprise: a perspective from foreign subsidiaries. *Journal of World Business*, *40*(1), 71–90.

Lützner, R. (2017). Shared Factories: A Focused Factory Perspective on the Management of Co-Located Manufacturing Units in International Manufacturing Networks (Dissertation). Institute of Technology Management, St. Gallen.

Macmillan Education. Barrier - definition and synonyms. Retrieved February 18, 2019, from https://www.macmillandictionary.com/dictionary/american/barrier.

Mahnke, V., Pedersen, T. and Venzin, M. (2005). The impact of knowledge management on MNC subsidiary performance: the role of absorptive capacity. *Management International Review*, *45*(2), 101–119.

Mahnke, V., Pedersen, T. and Venzin, M. (2009). Does Knowledge Sharing Pay? A Multinational Subsidiary Perspective on Knowledge Outflows. In J. L. C. Cheng, E. Maitland and S. J. Nicholas (Eds.). *Managing Subsidiary Dynamics: Headquarters Role, Capability Development, and China Strategy* (pp. 123–149). Bingley: Emerald Group Publishing Limited.

Malmberg, B. (1995). Problems of time-space co-ordination: a key to the understanding of multiplant firms. *Progress in Human Geography*, *19*(1), 47–60.

Manthou, V. and Vlachopoulou, M. (2001). Agile Manufacturing Strategic Options. In A. Gunasekaran (Ed.), *Agile Manufacturing: The 21st Century Competitive Strategy* (pp. 685–702). Oxford: Elsevier Science Publishers.

Maritan, C. A., Brush, T. H. and Karnani, A. G. (2004). Plant roles and decision autonomy in multinational plant networks. *Journal of Operations Management*, *22*(5), 489–503.

Martinez, J. I. and Jarillo, J. C. (1989). The evolution of research on coordination mechanisms in multinational corporations. *Journal of International Business Studies*, *20*(3), 489–514.

Mascarenhas, B. (1984). The coordination of manufacturing interdependence in multinational companies. *Journal of International Business Studies*, *15*(3), 91–106.

Maswood, S. J. (2017). *Revisiting Globalization and the Rise of Global Production Networks*. New York: Palgrave Macmillan.

McNamara, G. and Bromiley, P. (1999). Risk and return in organizational decision making. *The Academy of Management Journal*, *42*(3), 330–339.

Meijboom, B. and Voordijk, H. (2003). International operations and location decisions: a firm level approach. *Tijdschrift Voor Economische En Sociale Geografie*, *94*(4), 463–476.

Meijboom, B. and Vos, B. (1997). International manufacturing and location decisions: balancing configuration and co-ordination aspects. *International Journal of Operations & Production Management*, *17*(8), 790–805.

Mengel, S. (2017). The Alignment of International Manufacturing Networks: Towards a Fit between Strategy, Configuration, and Coordination (Dissertation). Institute of Technology Management, St. Gallen.

Meuser, M. and Nagel, U. (2009). The Expert Interview and Changes in Knowledge Production. In A. Bogner, B. Littig and W. Menz (Eds.), *Interviewing Experts* (pp. 17–42). London: Palgrave Macmillan.

Michailova, S. and Mustaffa, Z. (2012). Subsidiary knowledge flows in multinational corporations: research accomplishments, gaps, and opportunities. *Journal of World Business*, *47*(3), 383–396.

Miles, M. B. and Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook* (2nd ed.). Thousand Oaks: Sage Publishing.

Miltenburg, J. (2009). Setting manufacturing strategy for a company's international manufacturing network. *International Journal of Production Research*, *47*(22), 6179–6203.

Minbaeva, D. B., Mäkelä, K. and Rabbiosi, L. (2012). Linking HRM and knowledge transfer via individual-level mechanisms. *Human Resource Management*, *51*(3), 387–405.

Minbaeva, D. B. and Santangelo, G. D. (2017). Boundary spanners and intra-MNC knowledge sharing: the roles of controlled motivation and immediate organizational context. *Global Strategy Journal*, *8*(2), 220–241.

Mintzberg, H. (1973). *The Nature of Managerial Work*. New York: Harper & Row.

Möller, K. (2006). *Wertschöpfung in Netzwerken (Habil.-Schrift)*. *Controlling*. München: Vahlen.

Mourtzis, D. (2016). Challenges and future perspectives for the life cycle of manufacturing networks in the mass customisation era. *Logistics Research*, *9*(1), 1–20.

Mundt, A. (2012). The Architecture of Manufacturing Networks: Integrating the Coordination Perspective (Dissertation), St. Gallen.

Netland, H.T. and Aspelund, A. (2014). Multi-plant improvement programmes: a literature review and research agenda. *International Journal of Operations & Production Management*, *34*(3), 390–418.

Nigro, G.L., La Diega, S.N., Perrone, G. and Renna, P. (2003). Coordination policies to support decision making in distributed production planning. *Robotics and Computer-Integrated Manufacturing*, *19*(6), 521–531.

Norouzilame, F. (2018). Coordination of International Manufacturing Networks (Dissertation). School of Innovation, Design and Engineering, Mälardalen.

Norouzilame, F. and Wiktorsson, M. (2018). Coordination within international manufacturing networks: a comparative study of three industrial Practices. *American Journal of Industrial and Business Management*, *08*, 1603–1623.

Noruzi, F., Stenholm, D., Sjögren, P. and Bergsjö, D. (2018). A holistic model for inter-plant knowledge transfer within an international manufacturing network. *Journal of Knowledge Management*, *12*(2), 1.

Nunamaker, J. F., Briggs, R. O., Derrick, D. C. and Schwabe, G. (2015). The last research mile: achieving both rigor and relevance in information systems research. *Journal of Management Information Systems*, *32*(3), 10–47.

Ocasio, W. (1997). Towards an Attention-Based View of the Firm. *Strategic Management Journal*, *18*(S1), 187–206.

Ocasio, W. (2011). Attention to attention. *Organization Science*, *22*(5), 1286–1296.

Ocasio, W. (2012). Situated Attention, Loose and Tight Coupling, and the. In A. Lomi and R. Harrison (Eds.). *The Garbage Can Model of Organizational Choice: Looking Forward at Forty* (pp. 293–317). Emerald Group Publishing Limited.

Ocasio, W., Laamanen, T. and Vaara, E. (2018). Communication and attention dynamics: an attention-based view of strategic change. *Strategic Management Journal*, *39*(1), 155–167.

Okoli, C. (2015). A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems*, *37*, 879–910.

Okoli, C. and Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, *42*(1), 15–29.

Olhager, J. and Feldmann, A. (2018). Distribution of manufacturing strategy decision-making in multi-plant networks. *International Journal of Production Research*, *56*(1-2), 692–708.

Petersen, C. G., Aase, G. R. and Heiser, D. R. (2011). Journal ranking analyses of operations management research. *International Journal of Operations & Production Management*, *31*(4), 405–422.

Pontrandolfo, P. and Okogbaa, O. G. (1999). Global manufacturing: a review and a framework for planning in a global corporation. *International Journal of Production Research*, *37*(1), 1–19.

Porter, M. E. (1986). Changing patterns of international competition. *California Management Review*, *28*(2), 9–40.

Prasad, S. and Babbar, S. (2000). International operations management research. *Journal of Operations Management*, *18*(2), 209–247.

Reuter, C., Prote, J.-P. and Stöwer, M. (2016). Evaluation of performance differences between manufacturing sites. *Procedia CIRP*, *50*, 342–347.

Roosevelt, F. D. (1912). *Speech at Troy: Franklin D. Roosevelt- "The Great Communicator" The Master Speech Files, 1898, 1910-1945 Series 1: Franklin D. Roosevelt's Political Ascension*. New York. Retrieved October 26, 2018, from http://www.fdrlibrary.marist.edu/_resources/images/msf/msf00015.

Ross, L. and Nisbett, R. E. (1991). *The Person and the Situation: Perspectives of Social Psychology*. *McGraw-Hill series in social psychology*. New York: Mcgraw-Hill Book Company.

Roth, A. V., Schroeder, R. G., Huang, X. and Kristal, M. M. (2008). *Handbook of Metrics for Research in Operations Management: Multi-Item Measurement Scales and Objective Items*. Los Angeles: Sage Publishing.

Rowley, J. and Slack, F. (2004). Conducting a literature review. *Management Research News*, *27*(6), 31–39.

Rudberg, M. and Olhager, J. (2003). Manufacturing networks and supply chains: an operations strategy perspective. *Omega*, *31*(1), 29–39.

Rudberg, M. and West, B. M. (2008). Global operations strategy: coordinating manufacturing networks. *Omega*, *36*(1), 91–106.

Saldaña, J. (2016). *The Coding Manual for Qualitative Researchers* (3rd ed.). London: Sage Publishing.

Saunders, M. N.K., Lewis, P. and Thornhill, A. (2012). *Research Methods for Business Students* (6th ed.). *Always learning*. Harlow: UK Pearson.

Sayem, A., Feldmann, A. and Ortega-Mier, M. (2018). Coordination in international manufacturing: the role of competitive priorities and the focus of globally dispersed facilities. *Sustainability*, *10*(5), 1–20.

Scherrer, M. and Deflorin, P. (2017a). Linking QFD and the manufacturing network strategy: integrating the site and network perspectives. *International Journal of Operations & Production Management*, *37*(2), 226–255.

Scherrer, M. and Deflorin, P. (2017b). Prerequisite for lateral knowledge flow in manufacturing networks. *Journal of Manufacturing Technology Management*, *28*(3), 394–419.

Schweitzer, M. (1978). Wissenschaftsziele und Auffassungen in der Betriebswirtschaftslehre. In M. Schweitzer (Ed.). *Auffassungen und Wissenschaftsziele der Betriebswirtschaftslehre* (pp. 1–14). Darmstadt: Wiss. Buchges.

Scott, J. L. and Yih-Tong Sun, P. (2005). An investigation of barriers to knowledge transfer. *Journal of Knowledge Management*, *9*(2), 75–90.

Sergeeva, A. and Andreeva, T. (2016). Knowledge sharing research. *Journal of Management Inquiry*, *25*(3), 240–261.

Shi, Y. and Gregory, M. (1998). International manufacturing networks—to develop global competitive capabilities. *Journal of Operations Management*, *16*(2), 195–214.

SHRM. (2019a). About SHRM. Retrieved April 26, 2019, from SHRM: https://www.shrm.org/about-shrm/Pages/default.aspx.

SHRM. (2019b). Job Description: Plant Manager. Retrieved April 26, 2019, from SHRM: https://www.shrm.org/resourcesandtools/tools-and-samples/job-descriptions/pages/cms_001460.aspx.

Simon, H. A. (1947). *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization*. New York: Macmillan.

Sipe, L. R. and Ghiso, M. P. (2004). Developing conceptual categories in classroom descriptive research: some problems and possibilities. *Anthropology & Education Quarterly*, *35*(4), 472–485.

Skinner, W. (1974). The focused factory. *Harvard Business Review*, *52*(3), 113–121.

Smith, A. D., Plowman, D. A., Duchon, D. and Quinn, A. M. (2009). A qualitative study of high-reputation plant managers: political skill and successful outcomes. *Journal of Operations Management*, *27*(6), 428–443.

Snag. (2019). Plant Manager Job Description:What Do Plant Managers Do? Retrieved April 26, 2019, from snag.: https://www.snagajob.com/job-descriptions/plant-manager/.

Staughton, R. and Johnston, R. (2009). Establishing and developing strategic relationships – the role for operations managers. *International Journal of Operations & Production Management*, *29*(6), 564–590.

Strauss, A. L. and Corbin, J. M. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park: Sage Publishing.

Szász, L., Rácz, B.-G., Scherrer, M. and Deflorin, P. (2019). Disseminative capabilities and manufacturing plant roles in the knowledge network of MNCs. *International Journal of Production Economics*, *208*, 294–304.

Szulanski, G. (1996). Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal*, *17*, 27–43.

Szulanski, G. (2000). The process of knowledge transfer: a diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, *82*(1), 9–27.

Szwejczewski, M., Sweeney, M. T. and Cousens, A. (2016). The strategic management of manufacturing networks. *Journal of Manufacturing Technology Management*, *27*(1), 124–149.

Taggart, J. H. (1998). Configuration and coordination at subsidiary level: foreign manufacturing affiliates in the UK. *British Journal of Management*, *9*(4), 327–339.

Taudes, A., Trcka, M. and Lukanowicz, M. (2002). Organizational learning in production networks. *Journal of Economic Behavior & Organization*, *47*(2), 141–163.

Thomas, S., Scherrer-Rathje, M., Fischl, M. and Friedli, T. (2015). Linking network targets and site capabilities. *International Journal of Operations & Production Management*, *35*(12), 1710–1734.

Thomé, A. M. T., Scavarda, L. F. and Scavarda, A. J. (2016). Conducting systematic literature review in operations management. *Production Planning & Control*, *27*(5), 408–420.

Tomczak, T. (1992). Forschungsmethoden in der Marketingwissenschaft: Ein Plädoyer für den qualitativen Forschungsansatz. *Marketing: Zeitschrift Für Forschung Und Praxis*. (2), 77–87.

Toni, A. F. de and Parussini, M. (2010). International manufacturing networks: a literature review. *Proceedings of the 17th International Annual EurOMA Conference*, *Porto*, 1–10.

Tranfield, D., Denyer, D. and Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, *14*(3), 207–222.

Tsai, W. (2002). Social structure of “coopetition” within a multiunit organization: coordination, competition, and intraorganizational knowledge sharing. *Organization Science*, *13*(2), 179–190.

Tseng, C.-H. (2015). Determinants of mnc’s knowledge inflows to subsidiaries: a perspective on internalization advantages. *Management International Review*, *55*(1), 119–150.

Tsiakis, P. and Papageorgiou, L. G. (2008). Optimal production allocation and distribution supply chain networks. *International Journal of Production Economics*, *111*(2), 468–483.

Ulrich, H. (1984). Die Betriebswirtschaftslehre als anwendungsorientierte Sozialwissenschaft. In T. Dyllick and G. Probst (Eds.), *Management* (pp. 168–199). Bern: Haupt.

Ulrich, P. and Hill, W. (1976). Wissenschaftstheoretische Grundlagen der Betriebswirtschaftslehre (Teil I). *Wirtschaftswissenschaftliches Studium: Zeitschrift Für Ausbildung Und Hochschulkontakt*. (7), 304–343.

UNCTAD. (2018). *Global Value Chains and Development: Investment and Value Added Trade in the Global Economy. A Preliminary Analysis*. *United Nations publication*. New York, Geneva.

Váncza, J., Monostori, L., Lutters, D., Kumara, S. R., Tseng, M., Valckenaers, P. and van Brussel, H. (2011). Cooperative and responsive manufacturing enterprises. *CIRP Annals*, *60*(2), 797–820.

Vereecke, A. and van Dierdonck, R. (2002). The strategic role of the plant: testing Ferdows’s model. *International Journal of Operations & Production Management*, *22*(5), 492–514.

Vereecke, A., van Dierdonck, R. and de Meyer, A. (2006). A typology of plants in global manufacturing networks. *Management Science*, *52*(11), 1737–1750.

Vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R. and Cleven, A. (2009). Reconstructing the giant: on the importance of rigour in documenting the literature search process. *ECIS 2009 Proceedings*, 2206–2217.

Voss, C. (1995). Alternative paradigms for manufacturing strategy. *International Journal of Operations & Production Management*, *15*(4), 5–16.

Voss, C., Blackmon, K., Hanson, P. and Oak, B. (1995). The competitiveness of european manufacturing — a four country study. *Business Strategy Review*, *6*(1), 1–25.

Voss, C., Tsikriktsis, N. and Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management*, *22*(2), 195–219.

Wæhrens, V. B., Cheng, Y. and Madsen, E. S. (2012). The replication of expansive production knowledge: the role of templates and principles. *Baltic Journal of Management*, *7*(3), 268–286.

Walder, A. G. (1989). Factory and manager in an era of reform. *The China Quarterly*. (118), 242–264.

Webster, J. and Watson, R. T. (2002). Analyzing the past to prepare for the future: writing a literature review. *MIS Quarterly*, *26*(2), xiii–xxiii.

Wiech, M., Benninghaus, C., Schlauri, S., Drost, R. and Friedli, T. (2018). Strategische Positionierung von Standorten: Implikationen für internationale Produktionsnetzwerke. *Zeitschrift Für Wirtschaftlichen Fabrikbetrieb*, *113*(1-2), 22–26.

Wiech, M. and Friedli, T. (2020). Using Plant Leaders' Perspectives to Overcome Barriers to Inter-Plant Exchange. *Journal of Manufacturing Technology Management*. (ahead-of-print).

Wiech, M., Walter, H. and Friedli, T. (2018). Management of international manufacturing networks: a site portfolio approach. *Proceedings of the 25th International Annual EurOMA Conference*, *Budapest*, 1–10.

WTO. (2018). Total merchandise trade in US dollar at current prices (millions) for 1997 and 2017. Retrieved October 20, 2018, from http://stat.wto.org/StatisticalProgram/WSDBViewData.aspx?Language=E.

Yeung, H. W.-c. and Coe, N. (2015). Toward a dynamic theory of global production networks. *Economic Geography*, *91*(1), 29–58.

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). Thousand Oaks, CA: Sage Publishing.

Yuan, X.-M., Low, J.W. and Yeo, W. (2012). A network prototype for integrated production-distribution planning with non-multi-functional plants. *International Journal of Production Research*, *50*(4), 1097–1113.

Appendix

A. Systematic Literature Review

A.1 Search Strings

Search String	Term A	Term B
1	coordination	"manufacturing network*"
2	co-ordination	"manufacturing network*"
3	coordination	"production network*"
4	co-ordination	"production network*"
5	coordination	"plant network*"
6	co-ordination	"plant network*"
7	coordination	"factory network*"
8	co-ordination	"factory network*"
9	coordination	multiplant
10	co-ordination	multiplant
11	coordination	multi-plant
12	co-ordination	multi-plant

A.2 Search Settings

Database	*EBSCO (Business Source Premier)*	*Science Direct*	*ProQuest (ABI/INFORM Collection)*	*Emerald*
Search Fields	*(TI) Title*	*Title, abstract, keywords*	*(TI) Document Title*	*Abstract*
	(AB) Abstract or Author-Supplied Abstract	-	*(AB) Abstract*	*Publication Title*
Search Filter	*Scholarly (Peer Reviewed) Journals*	*Research articles*	*Peer reviewed*	*Accepted Articles*
	-	-	*Scholarly Journals & Conference Proceedings*	-

A.3 Literature Sample

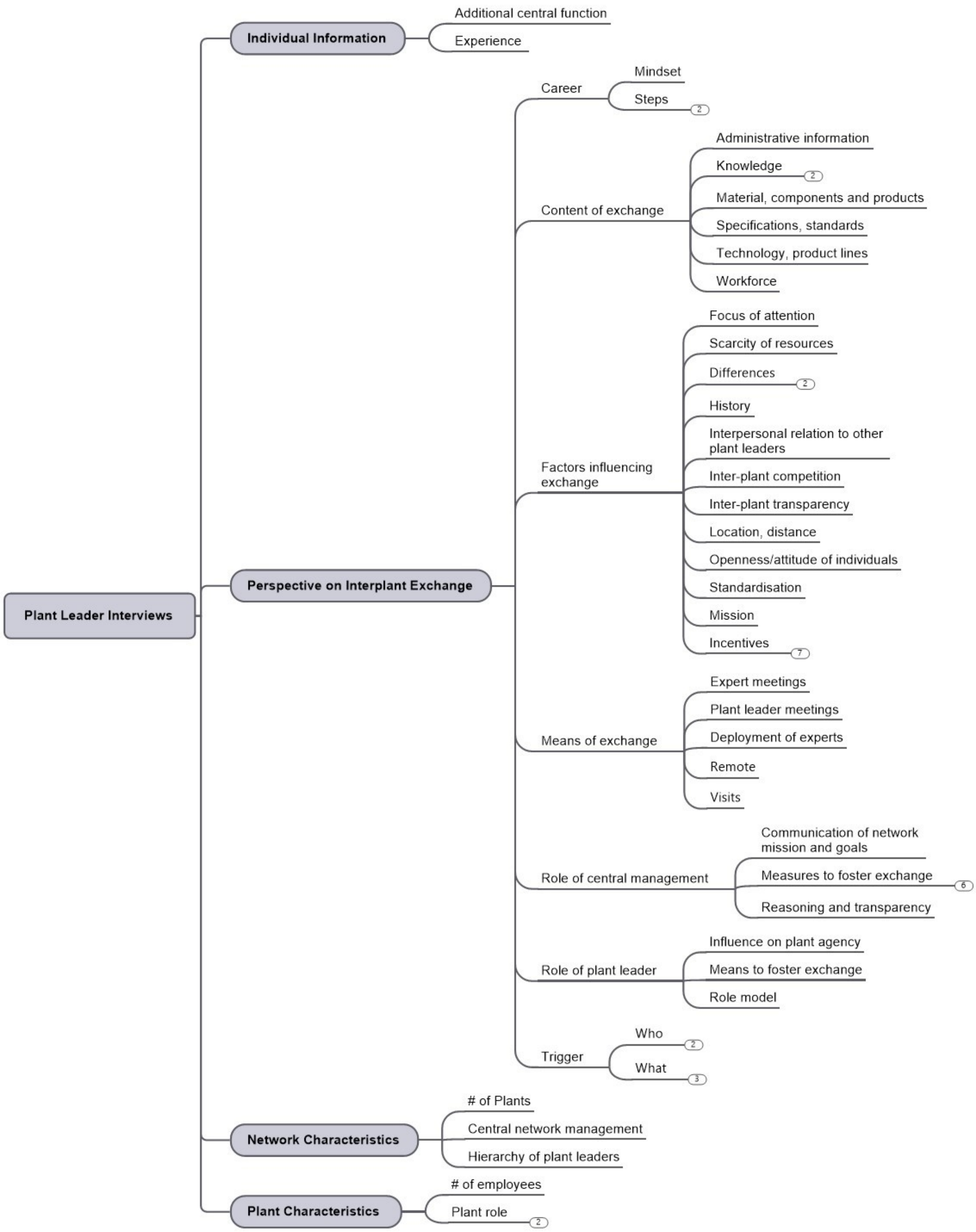
Search String													Author(s) + (Publication Year)
1	2	3	4	5	6	7	8	9	10	11	12	AS[67]	
x	x												Acar and Atadeniz (2015)
	x												Azevedo and Sousa (2000)
								x		x	x		Bhatnagar et al. (1993)
								x	x				Bitran et al. (1985)
				x	x					x	x		Boscari et al. (2016)
		x											Chacón, Besembel, and Hennet (2004)
												x	Chen et al. (2014)
x													Cheng et al. (2016)
x	x												Cheng and Farooq (2018)
												x	Cheng, Farooq et al. (2015)
												x	Cheng et al. (2011)
												x	Cheng and Johansen (2013)
												x	Cheng, Johansen et al. (2015)
												x	Cheng et al. (2010)
												x	Colotla et al. (2003)
												x	Deflorin et al. (2012)
												x	Demeter and Losonci (2019)
												x	Feldmann et al. (2013)
												x	Ferdows (2006)
												x	Fredriksson and Jonsson (2019)
		x											Fredriksson and Wänström (2014)
												x	Ivanov, Sokolov, and Pavlov (2013)
		x											Jaehne et al. (2009)
		x	x										Kádár et al. (2018)
												x	Kemmoe et al. (2014)
												x	Lang et al. (2014)
				x									Lara et al. (2005)
		x											Lebreton et al. (2010)
									x				Lim et al. (2013)
												x	Luo (2005)
								x	x				Malmberg (1995)
												x	Maritan et al. (2004)
												x	Mascarenhas (1984)
												x	Meijboom and Vos (1997)
												x	Miltenburg (2009)
x													Mourtzis (2016)
												x	Netland and Aspelund (2014)
		x	x										Nigro et al. (2003)
												x	Noruzi et al. (2018)
												x	Norouzilame and Wiktorsson (2018)
												x	Olhager and Feldmann (2018)
x													Pontrandolfo and Okogbaa (1999)

[67] Alternative Search (AS) – relevant articles cited in the *direct hits* or based on discussion with other researchers

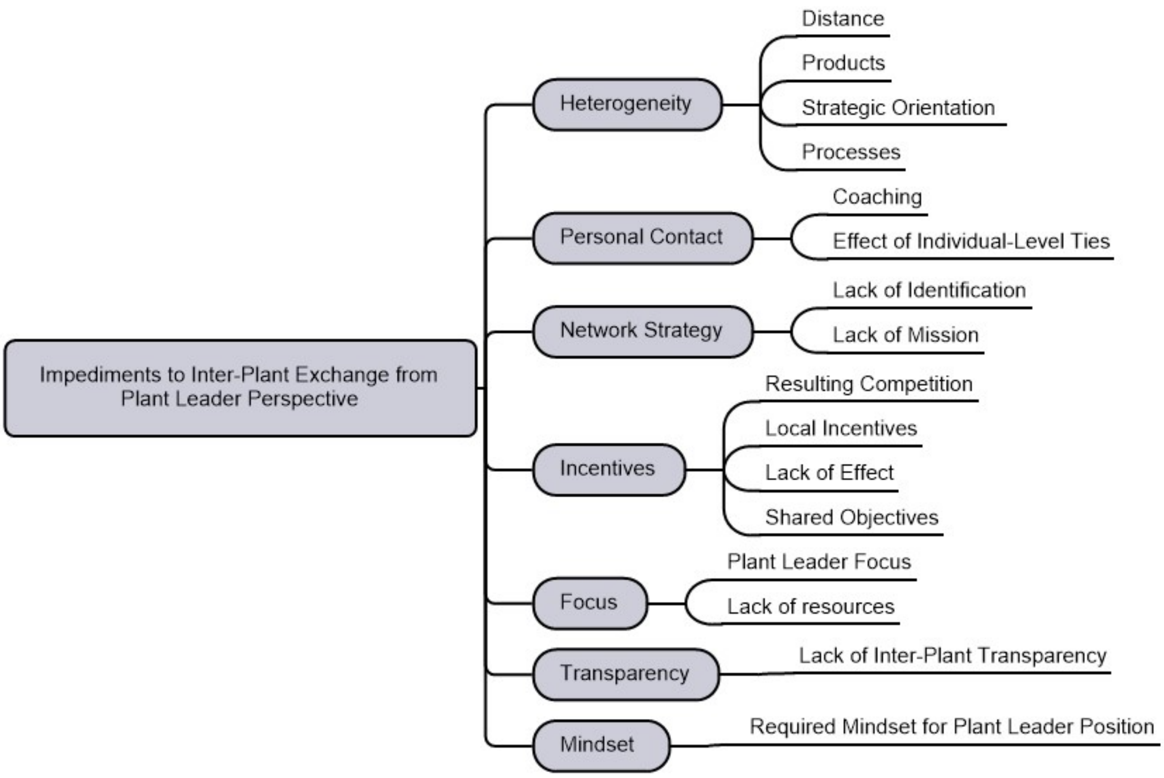
x	x												Rudberg and West (2008)
x	x												Rudberg and Olhager (2003)
												x	Sayem et al. (2018)
x													Scherrer and Deflorin (2017a)
x													Scherrer and Deflorin (2017b)
												x	Shi and Gregory (1998)
												x	Szász et al. (2019)
x													Szwejczewski et al. (2016)
												x	Taggart (1998)
		x	x										Taudes et al. (2002)
												x	Tsiakis and Papageorgiou (2008)
												x	Vereecke et al. (2006)
												x	Wæhrens et al. (2012)
												x	Yuan et al. (2012)
10	**5**	**7**	**3**	**2**	**1**	**0**	**0**	**3**	**3**	**2**	**2**	**32**	**56**

B. Plant Leader Interviews

B.1 Coding (First Step)



B.2 Coding (Second Step)



C. Case Studies

C.1 Case Study Interview Schedule

Case.#	Date	Type	Duration	Function
II.1	03.07.2019	Face to face	150 min	Global operations staff function
I.1	05.07.2019	Face to face	120 min	Value stream manager for subnetwork I
III.1	09.07.2019	Video conference	150 min	General manager with network responsibility
IV.1	11.07.2019	Face to face	150 min	Global operations staff function
I.2	12.07.2019	Face to face	130 min	Network manager for subnetwork II
II.2	19.07.2019	Face to face	150 min	Global network coordinator

C.2 Interview Guidline

Main Theme	Subitem
What is your professional background?	Previous assignments, operations background
Please describe your current position.	Job title, scope of responsibility, tasks, # of plants
What are the products/output of your network?	Industry, products, production processes
How does your firm manage/steer the manufacturing network?	Central network management, designated operations function
Please characterize/define your network.	# of plants, global dispersion, structure, drivers for global footprint
How does your firm create subnetworks of plants with similar characteristics?	Plant characteristics (e.g. products, processes, customers)
Does your firm have a network strategy? (If) What is your network strategy?	Strategic priorities
How does the network strategy address inter-plant exchange (e.g. knowledge flows between plants, cooperative behaviour of plants)?	
How does your firm assign resources for inter-plant exchange? How does it balance cost-pressure and resources for interplant exchange?	Prioritization, assign additional (designated) resource to plants or central
How is the network strategy communicated to the plant leaders or how are they integrated in strategy definition?	
What is your experience with incentives for plant leaders?	
How can IMN management motivate plant leader for inter-plant exchange?	Level reward is based on, kind of reward
How much decision autonomy for particular exchange dimensions is assigned to plant leaders in your network? What are the effects?	
How does IMN management create transparency between peer plants?	
How does your firm create interpersonal ties between plant leaders? What are the experiences?	Platforms, meetings, projects
How does network management incorporate the career ambitions of individual plant leaders?	Designated path after plant leader assignment
How are individuals selected for the plant leader position?	Internal/external, previous functions
Which personal eligibility is required?	Characteristics
Discussion of conceptual framework:	Operationalisation of axes, focus of respective plant leaders, associated duties and mechanisms, implications

Curriculum Vitae

Michael Wiech	Date of birth 01.03.1990 Place of birth Erbach, Germany Nationality German
Professional Experience	2016- 2019 Institute of Technology Management, St. Gallen Research Associate 2015 – 2016 Institute of Production Management, Technology and Machine Tools Technical University of Darmstadt Student assistant 2014 Continental Automotive, Babenhausen Intern in project management, ramp up and lean production 2011 G&H Grinding, Homberg (Ohm) Basic technical internship 2010 Bundeswehr, Hamburg Military service as "Sportsoldier" in gliding
Education	2016 – 2020 University of St. Gallen PHD Program 2014 – 2016 Technical University of Darmstadt Industrial Engineering – Mechanical Engineering (Master of Science) 2012 National University of Singapore Exchange semester 2010 – 2014 Technical University of Darmstadt Industrial Engineering (Bachelor of Science) 2002 – 2009 Gymnasium Michelstadt