

THESIS FOR THE DEGREE OF LICENTIATE OF ENGINEERING

Utilisation of shared demand-related
information for operations planning and control

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Abstract

The purpose of the licentiate thesis is to identify determinants of information utilisation and explore how these determinants impact the utilisation of shared demand-related information in a supplier's operations planning and control processes. The thesis focuses on direct determinants of information utilisation, as well as direct determinants of information quality (IQ), which in turn impact utilisation. Two separate case studies are performed in the European automotive industry, and the findings are presented in three academic papers, appended the thesis. Information utilisation can be divided into four levels: utilisation as potential usage, utilisation as intended usage, utilisation as actual usage, and utilisation as efficient and effective usage; and how determinants impact the utilisation of shared demand-related information depends on the level of utilisation. This research shows how a set of information, inter- and intra-organisational factors in a dyadic relationship impacts both potential and intended usage, where potential usage is related to a set of IQ dimensions and intended usage includes a supplier's willingness and ability to utilise shared demand-related information in its OPC processes. Furthermore, the research shows how actual usage is directly dependent on intended usage and IQ, and efficient and effective usage is related to performance. This research extends previous information sharing research to include the utilisation of shared information. By contributing to the complex relationships between information sharing, IQ, and performance; this research helps explaining the conflicting results regarding the value of information sharing and IQ, seen in previous research. Further, the research can help practitioners to improve their information sharing, IQ, and information utilisation practices, in order to achieve efficient and effective information utilisation, and thereby improve OPC performance.

Keywords: Information sharing, Information quality, Information utilisation, Operations Planning and Control, Supply chain management.

List of appended papers

Paper I:

Information quality deficiencies in delivery schedules and their impact on production scheduling.

Myrelid, P.

An earlier version of the paper was published in the proceedings of the EurOMA conference, Amsterdam, the Netherlands, 2012.

Paper II:

Supply chain information utilisation – conceptualisation and antecedents.

Jonsson, P. and Myrelid, P.

Under revision for International Journal of Operations and Production Management. An earlier version of the paper was published in the proceedings of the EurOMA conference, Palermo, Italy, 2014.

Paper III:

Determinants of information quality in supply chains.

Myrelid, P. and Jonsson, P.

An earlier version of the paper is accepted for publication in the proceedings of the EurOMA conference, Neuchâtel, Switzerland, 2015.

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Gothenburg, May 2015

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1 Introduction

This chapter provides a short background of the research area operations planning and control (OPC) and explains the importance of utilising shared demand-related information in the OPC processes. Furthermore, the chapter describes an identified research problem within the research area, on which the rest of the thesis is based. Moreover, the chapter introduces the purpose and scope of the thesis, and ends up with a thesis disposition.

1.1 Background

The operations planning and control (OPC) processes (often also called the manufacturing planning and control processes) are vital for any manufacturing company, as they support the decision of when, what, and how much to produce, in order to balance supply and demand (Jacobs *et al.*, 2011; Jonsson and Mattsson, 2009). For a company to stay competitive in today's ever-changing business environment (see e.g. Christopher and Holweg, 2011), it continuously needs to improve its OPC processes and increase customer satisfaction at the same time as it reduces the need for resources (Slack *et al.*, 2010). In order to succeed, companies can no longer work in isolation, instead they need to include their customers and suppliers in their strive for competitive advantage (Cooper *et al.*, 1997; Spekman *et al.*, 1998; Tan *et al.*, 1999).

The OPC processes are based on demand-related information (Jacobs *et al.*, 2011; Jonsson and Mattsson, 2009), e.g. point-of-sales data, forecasts, planned orders, firm orders, and inventory levels (Jonsson and Mattsson, 2013). The information can either be available internally, or shared by other actors in the supply chain (Barratt and Barratt, 2011), where demand-related information is shared by downstream actors (i.e. customers or customers' customers). Information sharing between supply chain actors has been extensively studied in academia for several decades (see e.g. Cachon and Fisher, 2000; Forrester, 1958; Lee and Whang, 2000; Yu *et al.*, 2001; Zhou and Benton, 2007) and it has been pointed out as important for supply chain performance (Paulraj *et al.*, 2008; Ramayah and Omar, 2010), as it improves decision-making (Lee and Whang, 2000; Sahin and Robinson, 2002) in the OPC processes. Also the quality of the shared information is pointed out as important for the OPC processes (Gustavsson and Jonsson, 2008; Petersen *et al.*, 2005). Previous information sharing-research has mostly focused on the value of information sharing and information quality (IQ), as well as on their characteristics and determinants (i.e. how they can be achieved).

1.2 Research problem

Even though many researchers show a positive relationship between information sharing and performance (e.g. Laosirihongthong *et al.*, 2011; Paulraj *et al.*, 2008; Ramayah and Omar, 2010; Sanders *et al.*, 2012), the actual value of information sharing is neither clear nor consistent in previous research (Jonsson and Mattsson, 2013; Ketzenberg *et al.*, 2007). Some researchers are unable to confirm a relationship between information sharing and performance (e.g. Field and Meile, 2008; Krause *et al.*, 2007; Liu *et al.*, 2013; Tan *et al.*, 2010) and some even argue that more information sharing does not necessarily improve performance (e.g. Chan and Chan, 2009; Fabbe-Costes and Jahre, 2008). Even though the determinants of information sharing is extensively studied in

previous research (by e.g. Chen *et al.*, 2014; Lee *et al.*, 2010; Li and Lin, 2006), few companies have reached the full potential with information sharing in practice, despite their investments in information sharing initiatives (Fawcett *et al.*, 2009). Thus, there is a need to extend the knowledge about the relationship between information sharing and performance, in order to understand how the potential benefits with information sharing in supply chains can be reached.

Several researchers argue that IQ is a mediator between information sharing and performance (e.g. Barratt and Oke, 2007; Hartono *et al.*, 2010; Wiengarten *et al.*, 2010) and thus explain the conflicting results regarding the value of information sharing with the existence of IQ deficiencies in shared information. However, the relationship between IQ and performance is neither indisputable, as e.g. Forslund and Jonsson (2007) were unable to significantly show such relationship. It is thus evident that, even though IQ is accepted as a mediator between information sharing and performance, it is not the only one.

Shared information needs to be utilised in order for the potential benefits with information sharing to be reached, however, information utilisation is not explicitly studied in previous research. Still, Rota *et al.* (2002) state that a supplier's ability to balance supply and demand depends on its ability to utilise shared demand-related information and Weber and Kantamneni (2002) indicate that a company's competitiveness partly depends on its ability to utilise information. The relationship between information sharing and OPC performance can thus, simplified, be described as a three-stage process, mediated by both IQ and information utilisation (see Figure 1). As previous research has not explicitly studied information utilisation, it is a rather unexplored concept in the literature. It is not clear how information utilisation is achieved, i.e. what determinants there are of information utilisation and how they impact the utilisation of shared demand-related information in a supplier's OPC processes. Still, this understanding is important, as it helps explain the conflicting results regarding the value of information sharing and it clarifies how the potential benefits with information sharing can be reached.

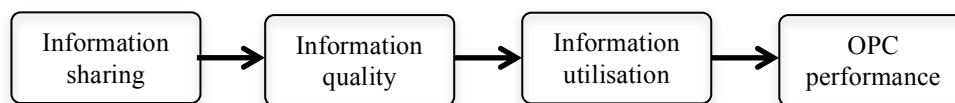


Figure 1 – Relationship between information sharing and OPC performance.

1.3 Purpose

The purpose of this licentiate thesis is to identify determinants of information utilisation and explore how these determinants impact the utilisation of shared demand-related information in a supplier's operations planning and control processes.

1.4 Scope

This research focuses on the utilisation of shared demand-related information in automotive industry suppliers' OPC processes. The automotive industry is an appropriate setting for this research, as manufacturers in the automotive industry often shares large amounts of demand-related information with their suppliers (see e.g. Reekers and Smithson, 1996), which is considered a prerequisite for

information utilisation. Further, customer demand in the automotive industry is often unstable (Holweg *et al.*, 2011), which creates planning difficulties for suppliers in automotive supply chains. Consequently, automotive industry suppliers have access to large amounts of demand-related information and can potentially benefit from utilising such information in their OPC processes.

OPC processes are performed on operational, tactical, and strategic planning levels (Jacobs *et al.*, 2011; Jonsson and Mattsson, 2009) and the research in this thesis focuses on the operational and tactical levels. It should be noted that this does not mean that information sharing, IQ, and information utilisation is irrelevant for strategic planning or that strategic planning is of less importance than operational and tactical planning. However, shared demand-related information is utilised in the operational and tactical OPC processes (i.e. forecasting process, production planning process, master production scheduling (MPS) process, material planning process, and order delivery process) in most companies and the scope is therefore relevant for this research.

Several types of demand-related information is shared between actors in a supply chain, e.g. point-of-sales data, forecasts, planned orders, firm orders, and inventory levels (Jonsson and Mattsson, 2013). Even though point-of-sales data are extensively studied in previous research (Huang *et al.*, 2003), it has limited value (Jonsson and Mattsson, 2013) for suppliers in automotive supply chains and are thus excluded from this research.

Supply chain information sharing can be performed between several actors in a supply chain, not only adjacent ones (Huang *et al.*, 2003). However, this research still focuses on information sharing in dyadic relationships and thus focuses on determinants of information utilisation related to the actors in such relationships (i.e. customers, suppliers, and their relationships). Yet, this research will hopefully be extended to include more tiers in the supply chain in a later stage of the research process.

1.5 Thesis outline

Chapter 1 (*Introduction*) presents the background, research problem, purpose, and scope of this thesis. Chapter 2 (*Literature review*) summarises previous research related to information sharing, IQ, and information utilisation and identifies gaps in this research. Chapter 3 (*Research questions*) develops and presents two research questions and their internal relationships in relation to the identified research gaps. Chapter 4 (*Methodology*) describes how the research has been planned, executed, and presented. Chapter 5 (*Summary of appended papers*) summarises the three papers that are appended to this thesis. Chapter 6 (*Results*) provide the answers to the two developed research questions separately. Chapter 7 (*Discussion*) discusses the results of the thesis in relation to previous research and in relation to the overall research problem. Chapter 8 (*Concluding remarks*) concludes the thesis and highlights its academic and managerial contributions, as well as presents its limitations and ideas for future research.

2 Literature review

This chapter reviews previous research related to information sharing, IQ, and information utilisation, separately. In the end of the chapter, a summary of the literature review is presented, where gaps identified in previous research are highlighted.

2.1 Information sharing

This section reviews previous research related to information sharing. The section is divided into definition and importance of information sharing, information sharing characteristics, and determinants of information sharing.

2.1.1 Definition and importance of information sharing

The concept of information sharing is extensively studied in previous research, and in a supply chain context, it refers to the extent to which crucial and/or proprietary information are available to members of the supply chain (Hsu *et al.*, 2008). In previous research, information sharing is both treated as an own concept, but it is also included in the wider concepts of supply chain integration (e.g. Flynn *et al.*, 2010; Frohlich and Westbrook, 2001; Yu *et al.*, 2013) and supply chain collaboration (Holweg *et al.*, 2005; Skjoett-Larsen *et al.*, 2003; Stank *et al.*, 2001).

Numerous researchers argue for the benefits with information sharing. Many researchers have tested and shown a positive relationship between information sharing and performance (Laosirihongthong *et al.*, 2011; Ramayah and Omar, 2010; Sanders *et al.*, 2012; Yu *et al.*, 2001), both for customers and suppliers (Paulraj *et al.*, 2008). Information sharing can increase the performance of many different supply chain processes, e.g. purchasing (Cai *et al.*, 2006), forecasting (Babai *et al.*, 2013), logistics (Ha *et al.*, 2011; Prajogo and Olhager, 2012), delivery (Li *et al.*, 2005), and innovation (Corsten *et al.*, 2011) processes, by improving the decision-making (Lee and Whang, 2000; Sahin and Robinson, 2002) in these processes. Information sharing also increases the organisational flexibility (Hall *et al.*, 2010; Vereecke and Muylle, 2006; Yigitbasioglu, 2010), reduces supply chain uncertainty (Datta and Christopher, 2011; Hung *et al.*, 2011; Jayaraman *et al.*, 2008), and mitigates the bullwhip effect (Cannella and Ciancimino, 2010; Chatfield *et al.*, 2004; Ma *et al.*, 2013; Wikner *et al.*, 1991). Thus, by creating more effective resource utilisation (Yigitbasioglu, 2010) and a need for less inventory (Simatupang and Sridharan, 2005; Wu and Cheng, 2008), information sharing can reduce costs (Liao and Chang, 2010; Sahin and Robinson Jr, 2005) and improve customer satisfaction (Bastl *et al.*, 2012; Rollins *et al.*, 2011) in the supply chain. Further, information sharing improves product quality (Carr and Kaynak, 2007; Vereecke and Muylle, 2006), advances organisational learning (Rebolledo and Nollet, 2011), and improves buyer-supplier relationships (Chu and Wang, 2012; Hsu *et al.*, 2008; Lösch and Lambert, 2007), by enabling collaboration (Nyaga *et al.*, 2010; Roh *et al.*, 2013; Sheu *et al.*, 2006).

Even though many researchers argue for the benefits with information sharing, the conclusions regarding its actual value are neither clear nor consistent (Jonsson and Mattsson, 2013; Ketzenberg *et al.*, 2007). Several researchers are unable to confirm a relationship between information sharing and performance

(e.g. Field and Meile, 2008; Krause *et al.*, 2007; Liu *et al.*, 2013; Tan *et al.*, 2010) and Fabbe-Costes and Jahre (2008) and Chan and Chan (2009) argue that full information sharing is not necessarily better than partial information sharing. Other researchers are also unable to show a relationship between information sharing and e-collaboration (Chan *et al.*, 2012), customer satisfaction (Youngdahl *et al.*, 2003), and product modularity (Lau *et al.*, 2010). Furthermore, both Taylor (2000) and Fawcett *et al.* (2009) explain that the potential benefits with information sharing seem to be difficult to reach in practice.

One reason for why the conclusions regarding the value of information sharing is unclear and inconsistent is because the value depends on the type of shared information, as well as on the stability of the information (Jonsson and Mattsson, 2013). Cachon and Fisher (2000) explain that information sharing is more important when demand is unpredictable and Lehtonen *et al.* (2005) mention product introductions and promotions as situations when information sharing is valuable. It has also been shown that information sharing is more valuable when small batch sizes are used (Hussain and Drake, 2011; Hussain and Saber, 2012) and when information horizons are long (Altug and Muharremoglu, 2011). The different types of information shared in supply chains and the situations when they are important are further described in the following section.

2.1.2 Information sharing characteristics

Mohr and Nevin (1990) define four facets of information sharing: content, modality, direction and frequency, where content refers to the types of information. In supply chains, different types of information are shared, e.g. quality information, performance information, financial information, and production information (Lösch and Lambert, 2007). After an extensive literature review, Huang *et al.* (2003) divide production information into six categories; product information, process information, inventory information, resource information, order information, and planning information. The planning information can be both supply-related (e.g. supplier inventory levels, lead times, delayed deliveries) and demand-related (e.g. point-of-sales data, forecasts, planned orders, firm orders, customer inventory levels) (Jonsson and Mattsson, 2013). Of the demand-related information, most focus in previous research has been on point-of-sales data, inventory levels, and demand variance (Huang *et al.*, 2003), while orders and forecasts are less studied. The value of the different types of shared information is conflicting in previous research, for example, Lee *et al.* (2000) conclude that the value of sharing point-of-sales data is quite high, while Lehtonen *et al.* (2005) show that point-of-sales data can be valuable in some situations and not in others, and Jonsson and Mattsson (2013) conclude that point-of-sales data is not valuable in any of their studied situations. Further, Forslund and Jonsson (2007) are unable to empirically show any value of forecast information sharing, while Jonsson and Mattsson (2013) show that forecasts and customer orders are valuable to share when demand is unstable. Moreover, Vigtil (2007) show the importance of sharing inventory levels in vendor-managed inventories, however, Cachon and Fisher (2000) show that the value is limited.

There are several different modes for sharing information in supply chains. Lösch and Lambert (2007) mention face-to-face, emails, telephone, fax, and regular mail, while Hieber (2002) additionally mention EDI, groupware systems, Internet applications, supply chain management software applications, business data warehouses, and internal portals. Further, Southern (2011) believes that webcasts, online education, and web-seminars will increase in the future. Also, Jonsson and Gustavsson (2008) argue that the use of more automated and integrated information sharing modes (e.g. EDI and Internet applications) often improves the quality of the shared information

Except for direction and frequency (Mohr and Nevin, 1990), shared information can also be described by its permanence, horizon, accuracy (Holweg and Pil, 2008), diversity, and formality (Cai *et al.*, 2006). Jonsson (2008) also distinguish between routine and spontaneous information, where routine information is formalised, while spontaneous does not have to be. The direction of shared information can be either vertical, horizontal, or external (Forza and Salvador, 2001) and be either unidirectional (i.e. one way-communication) or bidirectional (i.e. two-way communication) (Holweg and Pil, 2008). The frequency of shared information is related to the number of information exchanges (Cai *et al.*, 2006). The permanence of shared information refers to how long in advance the information is shared and updated, and the horizon of the information refers to the time frame the information covers (Holweg and Pil, 2008). Accuracy is related to the quality of information (Wang *et al.*, 1996), which is further treated in a later section in this review. The diversity of shared information includes the number of distinct types of shared information (Cai *et al.*, 2006), whereas the formality of information separate formal information from informal (Narasimhan and Nair, 2005) and deals with the degree to which the information sharing follow certain rules or policies (Cai *et al.*, 2006). All these dimensions differ between different types of shared information.

Information can either be available internally (Barratt and Barratt, 2011) or shared between different supply chain actors, for example, between customers and retailers, between manufacturers and suppliers, or between all actors in the chain (Lumsden and Mirzabeiki, 2008). Fabbe-Costes and Jahre (2007) differ between dyadic (upstream, downstream, or both separately), triadic (upstream and downstream) or extended (more than three parties) information sharing. Information sharing can be valuable for one actor in the chain (for example the leader firm, see e.g. Mukhopadhyay *et al.*, 2011), but invaluable or even hurtful for other actors. Several studies show that information sharing is more valuable downstream in supply chains (e.g. Lau *et al.*, 2004; Lumsden and Mirzabeiki, 2008), however, others show the opposite (e.g. Chiang and Feng, 2007). Porterfield *et al.* (2010) explain this inconsistency by showing that upstream and downstream actors benefit from different types of shared information.

Different types of shared demand-related information are used in different planning processes at the supplier. The planning processes range from short-term to long-term planning (Stadtler, 2005) and different types of information are differently important for the planning levels. Operational planning (short-term) deals with order planning, transport planning, material planning, and demand fulfilment (Huang *et al.*, 2003; Stadtler, 2005), and order information,

production schedules, delivery schedules, inventory levels, shipments, lead times, and shipping notices are important for operational planning (Li *et al.*, 2006; Moberg *et al.*, 2002; Patnayakuni *et al.*, 2006; Rai *et al.*, 2006). Tactical planning (medium-term) deals with master planning, production planning, distribution planning, and demand planning (Huang *et al.*, 2003; Stadtler, 2005), and forecasts, performance metrics, and purchasing and logistics information is important for tactical planning (Hsu *et al.*, 2008; Patnayakuni *et al.*, 2006; Rai *et al.*, 2006). Strategic planning (long-term) deals with strategic network planning and facility planning (Huang *et al.*, 2003; Stadtler, 2005), and pricing strategies, marketing strategies, distribution strategies, product development information, market trends, point-of-sales data, and long-term forecasts are important for strategic planning (Li *et al.*, 2006; Moberg *et al.*, 2002; Patnayakuni *et al.*, 2006; Rai *et al.*, 2006).

2.1.3 Determinants of information sharing

In previous research, several determinants of information sharing are discussed (see Table 1). The determinants of information sharing can be categorised into four categories; business context factors, information factors, inter-organisational factors, and intra-organisational factors. The business context factors are related to the need for shared information, because of organisational size (Vijayasathy, 2010), customer and supplier dependency (Yigitbasioglu, 2010), supply chain strategy (Roh *et al.*, 2013), and environmental uncertainty (Li and Lin, 2006). These factors are therefore seen as drivers for information sharing, rather than determinants of it, and are thus excluded from this research.

The information factors consider IQ factors (described in Section 2.2) and supply chain information sharing factors, including network governance, information technology, traditional communication, informal communication, frequent communication, and connectivity. Both Lee *et al.* (2010) and Moberg *et al.* (2002) show that IQ impacts strategic information sharing, however, they are both unable to significantly show any relationship between IQ and operational information sharing. Network governance refers to coordination between organisations based on informal social systems, rather than hierarchical authority (Paulraj *et al.*, 2008). Information technology refers to the use of information technology in any sense, e.g. use of information systems (Dimitriadis and Koh, 2005; Kärkkäinen *et al.*, 2007), the Internet (Kehoe and Boughton, 2001), or EDI (Tan *et al.*, 2010) for sharing information. Traditional communication refers to communication with traditional information sharing modes (i.e. telephone, fax, email, and face-to-face contact), unlike the more advanced information technology modes (Carr and Kaynak, 2007). Carr and Kaynak (2007) show that traditional communication is related to the extent of information sharing, however, that advanced communication is not. Informal communication refers to the social, personal relationships between individuals (Cai *et al.*, 2010) at the different organisations. In contrast to formal communication, informal communication is less structured (Patnayakuni *et al.*, 2006). Frequent communication refers to the intensity of information sharing (Jäckel *et al.*, 2006) and connectivity refers to the partners ability to connect to each other, which is enabled by information technology (Fawcett *et al.*, 2007).

Table 1 – Determinants of information sharing.

| | Business context factors | | | | Information factors | | | | | | | Inter-organisational factors | | | | | | | Intra-organisational factors | | | | | | |
|----------------------------------|---------------------------------|----------------------|-----------------------|------------------|----------------------------|--------------------|------------------------|---------------------------|------------------------|------------------------|--------------|-------------------------------------|------------|-----------------|---------------|---------------|-------------|---------------------|-------------------------------------|------------------------|--------------------------|------------------------|------------------------|------------------------------|---|
| | Manufacturing context | Supply chain context | Environmental context | Information need | Information quality | Network governance | Information technology | Traditional communication | Informal communication | Frequent communication | Connectivity | Trust | Commitment | Interdependence | Shared vision | Participation | Willingness | Cultural similarity | Long-term relationship | Top management support | Skills and understanding | Information technology | Information management | Internal information sharing | |
| Cagliano <i>et al.</i> (2006) | x | | | | | | | | | | | | | | | | | | | | | | | | |
| Cai <i>et al.</i> (2010) | | | x | | | | | | x | | | x | | | | | | | | | | | | | |
| Carr and Kaynak (2007) | | | | | | | | x | | | | | | | | | | | | | | | | | x |
| Chen <i>et al.</i> (2014) | | | | | | | | | | | | x | x | | x | | | | | | x | | x | | |
| Corsten <i>et al.</i> (2011) | | | | | | | | | | | | x | x | | | | | | | | | | | | |
| Dimitriadis and Koh (2005) | | | | | | | | x | | | | | | | | | | | | | | x | x | | |
| Fawcett <i>et al.</i> (2007) | | | | | | | | | | | x | | | | | | | x | | | | | | | |
| Ha <i>et al.</i> (2011) | | | | | | | | | | | | x | | | | | | | | | | | | | |
| Hung <i>et al.</i> (2011) | | | | | | | | | | | | x | x | | | | | | | | | | | | |
| Kehoe and Boughton (2001) | | | | | | | | x | | | | | | | | | | | | | | | | | |
| Khouja and Kumar (2002) | | | | | | | | x | | | | | | | | | | | | | | | | | |
| Klein (2007) | | | | | | | | | | | | | x | | | | | | | | | | | | |
| Klein and Rai (2009) | | | | | | | | x | | | | x | | x | | | | | | | | | | | |
| Kärkkäinen <i>et al.</i> (2007) | | | | | | | | x | | | | | | | | | | | | | | | | | |
| Lee <i>et al.</i> (2010) | | x | | | x | | | | | | | x | x | x | x | | | x | | | x | | | | |
| Li and Lin (2006) | | | x | | | | | | | | | x | | | x | | | | | | x | | | | |
| Lu and Yang (2011) | | | | | | | | | | x | x | | | | | | | | | | | | | | |
| Moberg <i>et al.</i> (2002) | | | | | | x | | | | | | | x | | | | | | | | | | | | |
| Müller and Gaudig (2011) | | x | | x | | | x | | | x | | | | | | | | | | | | | | x | |
| Nagati and Rebolledo (2013) | | | | | | | | | | | | | | | | | x | | | | | | | | |
| Patnayakuni <i>et al.</i> (2006) | | | | | | | | x | | x | | x | x | | | | | | x | | | | | | |
| Paulraj <i>et al.</i> (2008) | | | | | | | x | x | | | | | | | | | | | x | | | | | | |
| Roh <i>et al.</i> (2011) | | x | | | | | | | | | | | | | | | | | | | | | | | |
| Sheu <i>et al.</i> (2006) | | x | | | | | | | | | | x | | x | | | | | x | | | | | | |
| Stefansson (2002) | | | | | | | | x | | | | | | | | | | | | | | | | | |
| Tan <i>et al.</i> (2010) | | | | | | | | x | | | | | | | | | | | | | | | | | |
| Vanpoucke <i>et al.</i> (2009) | | | | x | | | | x | | | | x | | x | | | | | | | | | | | |
| Vijayarathy (2010) | | x | | | | | | | | | | x | x | x | | | | | | | | | | | |
| Whipple <i>et al.</i> (2009) | | | x | | | | | | | | | | | | | | | | | | | | | | |
| Yigitbasiglu (2010) | | | | x | | | | | | | | | | | | x | | | | | | | | | |
| Yu <i>et al.</i> (2013) | | | | | | | | | | | | | | | | | | | | | | | | | x |
| Zhou and Benton (2007) | | | x | | | | | | | | | | | | | | | | | | | | | | |

The inter-organisational factors consider supply chain relationship factors, including trust, commitment, interdependence, shared visions, participation, willingness, cultural similarity, and long-term relationships. Trust refers to the sincerity, honesty, and truthfulness of information (Chen *et al.*, 2014; Li and Lin, 2006) and also includes trust in the information sender and its decisions (Hung *et al.*, 2011). Commitment refers to the willingness of maintaining a long-term relationship with a collaborating partner (Chen *et al.*, 2014; Hung *et al.*, 2011) and the willingness of investing in the relationship (Li and Lin, 2006). Interdependence refers to the extent in which supply chain partners believe that the relationship is necessary (Lee *et al.*, 2010) and thus to their need of maintaining the relationship (Sheu *et al.*, 2006). Shared vision refers to the extent to which the collaborating partners have the same goals and understanding about the relationship (Li and Lin, 2006). Participation refers to the involvement and frequency of communication between collaborating

partners (Jonsson and Gustavsson, 2008) and willingness refers to a company's openness to share relevant, honest, and frequent information in a supply chain (Fawcett *et al.*, 2007). Cultural similarity refers to the extent to which the collaborating partners have similar beliefs, values, and management practices (Lee *et al.*, 2010). Long-term relationship refers to the length of time for which the supply chain partners have had a relationship (Lee *et al.*, 2010), but also the willingness to develop such relationship for the future (Sheu *et al.*, 2006).

The intra-organisational factors can be divided into three sub-categories, human factors, technological factors, and organisational factors. Top management support and skills and understanding are human factors, where top management support refers to the top management's willingness to support the relationship with necessary resources (Chen *et al.*, 2014) and is important both at customers and suppliers (Lee *et al.*, 2010). Skills and understanding refer to the individual's ability to source, seek, and process information (Dimitriadis and Koh, 2005). Information technology is a technological factor and is not only important for inter-organisational information sharing, but also for intra-organisational information sharing (Dimitriadis and Koh, 2005). Information management and internal information sharing are organisational factors, where information management refers to both pruning, cleaning, and analysing data (Jonsson and Gustavsson, 2008; Schnetzler and Schönsleben, 2007), and internal information sharing refers to information sharing performed within an organisation (Carr and Kaynak, 2007), in contrast to between organisations in a supply chain.

2.2 Information quality

This section reviews previous research related to IQ. The section is divided into definition and importance of IQ, IQ characteristics, and determinants of IQ.

2.2.1 Definition and importance of information quality

In the ISO 9000 standard (2005), quality is defined as “the totality of features and characteristics of a product or service that bear on its ability to satisfy stated and implied needs”. As quality is customer focused (Deming, 2000), the definition refers to the stated and implied needs of a customer (i.e. the user of the product or service). The division into stated and implied needs indicate that quality is both objective and subjective (Shewhart, 1931) and thus needs to be both objectively and subjectively assessed. Quality can be assessed from two different standpoints, either by meeting (or even exceeding) customer demands or by having freedom from deficiencies (Juran *et al.*, 2010), where the latter is more straightforward. IQ refers to the quality of information (Lee *et al.*, 2002; Wang *et al.*, 1996), where the information in itself is the service assessed. Thus, IQ is defined as the ability to satisfy stated and implied needs of an information user (Gustavsson and Wänström, 2009), i.e. a supplier receiving shared demand-related information from a customer.

The importance of IQ is highlighted in previous research and it shows that high IQ beneficially impact a large number of different processes and systems, e.g. planning processes (Gustavsson and Jonsson, 2008; Petersen *et al.*, 2005), forecasting processes (Eksoz *et al.*, 2014), design processes (Bruch and Bellgran, 2013), information management processes (Schnetzler and

Schönsleben, 2007), delivery processes, (Li *et al.*, 2005), e-business processes (Bhakoo and Chan, 2011; Cullen and Taylor, 2009), warehousing systems (Min, 2009), and APS systems (Ivert, 2012). Furthermore, high IQ improves both product quality (Ding *et al.*, 2014), flexibility (Gosain *et al.*, 2004) and performance (Bartlett *et al.*, 2007; Hartono *et al.*, 2010; Wiengarten *et al.*, 2010; Zhou *et al.*, 2014), by increasing the use of shared information (Bruch and Bellgran, 2013) and information systems (Hazen *et al.*, 2014b), and thereby improves decision-making (Hazen *et al.*, 2014a). By reducing the bullwhip effect (Chatfield, 2013; Chatfield *et al.*, 2004), high IQ helps reducing supply chain uncertainty (Holweg *et al.*, 2011; Hung *et al.*, 2011), as well as inventories and backlogs (Claudio and Krishnamurthy, 2009; Rossin, 2007) in the supply chain. Furthermore, high IQ beneficially impacts buyer-supplier relationships (Legner and Schemm, 2008; Lösch and Lambert, 2007) and increases the intensity of information sharing (Baihaqi and Sohal, 2013) in these relationships. However, the relationship between IQ and performance is not indisputable. Forslund and Jonsson (2007) are unable to significantly show a relationship between forecast IQ and supply chain performance, and Claassen *et al.* (2008) are unable to show a relationship between IQ and VMI success.

2.2.2 Information quality characteristics

IQ is a multidimensional concept (Gustavsson and Wänström, 2009; Lee *et al.*, 2002; Wang *et al.*, 1996), with several internally related dimensions (Fisher *et al.*, 2012), however, there is no specific set of dimensions that are always included in the concept. Instead, researchers include different IQ dimensions in their IQ-related research and they also use different terms to describe these dimensions. The IQ dimensions included in previous research are summarised in Table 2, according to their content (i.e. the terms used here do not correspond to all references, but the content does). In Table 2, it is seen that a few dimensions (timely, reliable, complete, relevant, and accessible) are covered in most IQ-related research, however, other dimensions (e.g. concise, consistent, valid, secure, credible, understandable, ease of operation, appropriate amount, and objective) are less commonly covered. Traditionally, reliability has often been the only IQ dimension in focus (Wang *et al.*, 1996), and even though most researchers now include more dimensions, far from all IQ dimensions are covered in IQ-related research.

The division of quality into stated and implied needs reflects the division of IQ into inherent and pragmatic IQ dimensions (English, 1999). Inherent IQ dimensions describe information in relation to stated restrictions, policies and procedures (e.g. written agreements), while pragmatic IQ dimensions describe information in relation to implied needs by the information user (Gustavsson and Wänström, 2009). Both inherent and pragmatic dimensions are assessed by the information user, where inherent dimensions are objectively measured in relation to the stated requirements, while pragmatic dimensions are subjectively judged by the user. There is no distinct division between inherent and pragmatic IQ dimensions (Gustavsson and Wänström, 2009), however, Lee *et al.* (2002) include timely, reliable, complete, concise, consistent, and secure as inherent dimensions; and relevant, accessible, credible, understandable, ease of operation, appropriate amount, objective, and valid as pragmatic dimensions. Similarly, Gustavsson and Wänström (2009) indicate that timely, reliable, complete,

concise, and valid are inherent dimensions; and relevant, accessible, credible, understandable, and appropriate amount are pragmatic dimensions. The only distinction between the two divisions is that Lee *et al.* (2002) include the valid dimension as pragmatic, while Gustavsson and Wänström (2009) include it as an inherent dimension. The reason for this distinction is that Lee *et al.* (2002) use the dimension in wider terms and relate it both to the validity and the understandability of information. As understandability is a pragmatic dimension, validity is here described as inherent. In Table 2, it is seen that inherent dimensions are slightly more covered in previous research, compared to pragmatic ones.

Table 2 – Information quality dimensions.

| | Inherent dimensions | | | | | | | | Pragmatic dimensions | | | | | | |
|-----------------------------------|---------------------|----------|----------|---------|------------|-------|--------|--|----------------------|------------|----------|----------------|-------------------|--------------------|-----------|
| | Timely | Reliable | Complete | Concise | Consistent | Valid | Secure | | Relevant | Accessible | Credible | Understandable | Ease of operation | Appropriate amount | Objective |
| Auramo <i>et al.</i> (2005) | | x | | | | | | | x | | | | | | |
| Baihaqi and Sohal (2013) | x | x | x | | | | | | x | | | | | | |
| Barratt and Oke (2007) | x | x | | x | | | | | x | | x | | | | |
| Bruch and Bellgran (2013) | | x | | | x | | | | x | | | | | | |
| Claassen <i>et al.</i> (2008) | x | x | x | | | | | | x | | | | | | |
| Chen <i>et al.</i> (2014) | x | x | x | | | | | | x | | | | | | |
| Cullen and Taylor (2009) | x | x | | | | | | | | x | x | | | | |
| Ding <i>et al.</i> (2014) | x | x | | | | | | | x | | | | | | |
| Eksoz <i>et al.</i> (2014) | x | | x | | | | | | | x | x | | | | |
| Forslund and Jonsson (2007) | x | x | | | | | | | | x | | | | | |
| Goodhue and Thompson (1995) | x | | x | x | x | | | | x | x | | | | | |
| Gustavsson and Jonsson (2008) | x | x | x | x | | x | | | x | x | x | x | | | |
| Gustavsson and Wänström (2009) | x | x | x | x | | x | | | x | x | x | x | | x | |
| Hazen <i>et al.</i> (2014a) | x | x | x | | x | | | | | | | | | | |
| Hazen <i>et al.</i> (2014b) | x | x | | | | | | | | x | | | | | |
| Hung <i>et al.</i> (2011) | x | | x | | | | | | x | | | | | | |
| Ivert (2012) | | x | | | | | | | | | | | | | |
| Johansson and Johansson (2004) | x | x | x | x | x | x | x | | x | x | x | x | x | x | x |
| Jonsson and Gustavsson (2008) | x | x | x | x | | x | | | | | x | | | | |
| Kärkkäinen <i>et al.</i> (2007) | x | x | | | | | | | | x | | | | | |
| Lee <i>et al.</i> (2002) | x | x | x | x | x | x | x | | x | x | x | x | x | x | x |
| Lee <i>et al.</i> (2010) | x | x | | | | | | | | | | x | | | |
| Li and Lin (2006) | x | x | x | | | | | | x | | | | | | |
| Li <i>et al.</i> (2005) | x | x | x | | | | | | x | | | | | | |
| Lu and Yang (2011) | x | x | | | | | | | x | | | | | | |
| Lösch and Lambert (2007) | x | x | x | | | | | | x | x | | | | | |
| Manecke and Schoensleben (2004) | x | x | x | | | | | | | x | | x | x | | |
| Min (2009) | x | x | | | | | | | x | | | | | | |
| Simatupang and Sridharan (2005) | x | x | | | x | | | | | | | | | | |
| Simatupang and Sridharan (2005) | x | x | | | x | | | | | | | | | | |
| Petersen <i>et al.</i> (2005) | x | x | x | | x | | | | | x | | | | | |
| Schnetzler and Schönsleben (2007) | x | x | x | x | x | | | | x | x | | x | x | | |
| Wang <i>et al.</i> (1996) | x | x | x | x | x | x | x | | x | x | x | x | | x | x |
| Wiengarten <i>et al.</i> (2010) | x | | x | | | | | | x | | | | | | |
| Zhou <i>et al.</i> (2014) | x | x | x | | | | | | x | x | | | | | |

The inherent dimensions are objectively measured in relation to stated requirements (e.g. written agreements). Timeliness refers to the age of the data (Wang *et al.*, 1996), thus how current and up-to-date it is (Lee *et al.*, 2002). The

information also needs to be delivered in time and at correct intervals (Gustavsson and Wänström, 2009) in order to be timely. Reliability refers to how correct, accurate, free of error (Lee *et al.*, 2002), flawless, precise (Wang *et al.*, 1996), and sound (Bruch and Bellgran, 2013) information is. Reliable demand information reflects true demand and has low forecast errors (Gustavsson and Jonsson, 2008). Completeness refers to the extent to which the information is comprehensive for the planning tasks (Gustavsson and Wänström, 2009), both in terms of breath, depth (Lee *et al.*, 2002), and scope (Wang *et al.*, 1996). Complete information includes all necessary values, and explanation of values, needed to perform a task (Gustavsson and Jonsson, 2008). Conciseness refers to how well-presented, well-organised (Wang *et al.*, 1996), and compact (Lee *et al.*, 2002) information is. Concise information can be used directly, without any reworking of format, content, or structure (Gustavsson and Wänström, 2009). Consistency refers to the data continuously being presented in the same format (Lee *et al.*, 2002) and being compatible with previous data (Wang *et al.*, 1996). The information needs to be presented in a reliable structure (Bruch and Bellgran, 2013) in order to be consistent. Validity refers to the extent to which the information measures what it should measure (Gustavsson and Wänström, 2009). The customer needs to use the same measures and definitions as the supplier (Gustavsson and Jonsson, 2008) and the information needs to be interpretable, in terms of languages, symbols, and units (Johansson and Johansson, 2004) in order to be valid. Security refers to how restricted the access to the information is. For information to be secure, it can only be assessed by people who should see the information (Lee *et al.*, 2002) secure information relates to data of proprietary nature (Wang *et al.*, 1996).

The pragmatic dimensions are subjectively judged by the information user, and the user itself can also impact these dimensions. Relevance refers to how relevant, value-adding, and adequate information is (Claassen *et al.*, 2008; Li *et al.*, 2005; Wang *et al.*, 1996) for the task at the information user (Gustavsson and Jonsson, 2008; Gustavsson and Wänström, 2009). It is related to the usefulness and usability of information (Lee *et al.*, 2002; Wang *et al.*, 1996), and information needs to be presented on an appropriate level of detail (Goodhue and Thompson, 1995) in order to be relevant. Accessibility refers to how easy it is to access, obtain, and retrieve information when needed by the information user (Gustavsson and Jonsson, 2008; Gustavsson and Wänström, 2009; Lee *et al.*, 2002), without further processing (Forslund and Jonsson, 2007). Information needs to be both easy to locate (Goodhue and Thompson, 1995) and quickly available (Lee *et al.*, 2002; Wang *et al.*, 1996) in order to be accessible. Credibility refers to how credible, believable, and trustworthy information is for the information user (Gustavsson and Jonsson, 2008; Jonsson and Gustavsson, 2008; Lee *et al.*, 2002). It is also related to the reputation of the information, both in terms of actual data and the data source (Lee *et al.*, 2002; Wang *et al.*, 1996). Information needs to be regarded as true (Gustavsson and Wänström, 2009) in order to be credible. Understandability refers to how easy it is for the information user to comprehend the information (Lee *et al.*, 2002). Gustavsson and Wänström (2009) also relate understandability to how easy it is to use the information, which here is included in the ease of operation dimension. Information needs to be both readable and clear (Wang *et al.*, 1996) in order to be understandable. Ease of operation refers to how easy it is to aggregate,

combine, and manipulate the information to meet the needs of the information user (Lee *et al.*, 2002). It is related to how easy it is to process the information (Manecke and Schoensleben, 2004) and information needs to be easy to update, reproduce, and integrate (Wang *et al.*, 1996) in order to be easy to operate. Appropriate amount refers to the volume of information, which should neither be too much or too little in relation to the needs of the information user (Lee *et al.*, 2002). It is related to how much filtration that is necessary before the information user can utilise the information (Gustavsson and Wänström, 2009). Objectivity refers to how objective and unbiased information is (Wang *et al.*, 1996) and requires the information to be both objectively collected and presented (Lee *et al.*, 2002).

2.2.3 Determinants of information quality

In previous research, some determinants of IQ are discussed (see Table 3), however, most determinants are only covered by a few researchers. Only trust (e.g. Chen *et al.*, 2014; Hung *et al.*, 2011), information technology (e.g. Auramo *et al.*, 2005; Kärkkäinen *et al.*, 2007), and information management (e.g. Gustavsson and Jonsson, 2008; Schnetzler and Schönsleben, 2007) are discussed in any larger extent. Also, most determinants of IQ are discussed on an overall quality level (i.e. in relation to a combination of IQ dimensions) and only a few researchers (e.g. Johansson and Johansson, 2004; Jonsson and Gustavsson, 2008) discuss the determinants in relation to specific IQ dimensions. The determinants of IQ can be categorised into four categories (the same as the determinants of information sharing): business context factors, information factors, inter-organisational factors, and intra-organisational factors.

Table 3 - Determinants of information quality.

| | Business context factors | Information factors | Inter-organisational factors | Intra-organisational factors |
|-----------------------------------|--------------------------|---------------------|------------------------------|------------------------------|
| | Supply chain context | Information need | Information technology | Informal communication |
| | | | Frequent communication | Feedback |
| | | | Trust | Commitment |
| | | | Shared vision | Participation |
| | | | Cultural similarity | |
| | | | Top management support | Skills and understanding |
| | | | Information technology | Information management |
| Auramo <i>et al.</i> (2005) | | | x | |
| Barratt and Oke (2007) | | | x | x |
| Chen <i>et al.</i> (2014) | | | x | x |
| Gustavsson and Jonsson (2008) | | x | | x |
| Hazen <i>et al.</i> (2014a) | | | | x |
| Hung <i>et al.</i> (2011) | | | x | x |
| Ivert (2012) | | x | | x |
| Johansson and Johansson (2004) | | | | x |
| Jonsson and Gustavsson (2008) | | | x | x |
| Jäckel <i>et al.</i> (2006) | | | x | x |
| Kärkkäinen <i>et al.</i> (2007) | | | x | |
| Li and Lin (2006) | x | | | |
| Lu and Yang (2011) | | | x | x |
| Manecke and Schoensleben (2004) | | | x | |
| Min (2009) | | | | x |
| Schnetzler and Schönsleben (2007) | | | | x |

The business context factors are related to the need for shared information of high quality and are therefore seen as drivers for IQ, rather than determinants of it (similar as the relationship between business context factors and information sharing), and these factors are thus excluded from this research.

The information factors consider supply chain information sharing factors and they are defined in the same way as the determinants of information sharing. Jonsson and Gustavsson (2008) empirically show a relationship between information technology and some inherent IQ dimensions and Auramo *et al.* (2005) show a relationship between information technology and reliability of shared information, however, Li and Lin (2006) were unable to significantly show any relationship between information technology and overall IQ. Furthermore, the informality of information is only studied on an overall IQ level (Barratt and Oke, 2007), but the frequency of communication is related to the completeness, conciseness, reliability, timeliness, and credibility of information (Jonsson and Gustavsson, 2008). Gustavsson and Jonsson (2008) also show that high information sharing frequency is positively related to IQ for orders but negatively related for forecasts. Feedback is the only information factor not included as a determinant of information sharing, and refers to the reverse flow of information (Jäckel *et al.*, 2006) and is only studied in relation to the reliability of information (Ivert, 2012).

The inter-organisational factors consider supply chain relationship factors and they are defined in the same way as the determinants of information sharing. In previous research, trust is related to previous information reliability (Chen *et al.*, 2014) and is specifically important for the complete, concise, reliable, timely, and credible IQ dimensions (Jonsson and Gustavsson, 2008). Commitment is only studied on an overall IQ level in previous research, with conflicting results. While e.g. Hung *et al.* (2011) show a positive impact of commitment on IQ, Li and Lin (2006) were unable to significantly show this impact. Further, shared vision is only studied in relation to overall IQ, and here Li and Lin (2006) are able to show a positive impact. Participation is studied by Jonsson and Gustavsson (2008), who show a direct relationship to the valid and credible IQ dimensions. Cultural similarity is only studied by Lu and Yang (2011), who studied it on an overall IQ level.

The intra-organisational factors can be divided into three sub-categories, human factors, technological factors, and organisational factors, and they are defined in the same way as the determinants of information sharing. Top management support (Chen *et al.*, 2014) and skills and understanding (Jäckel *et al.*, 2006) are only studied in relation to overall IQ in previous research. Jonsson and Gustavsson (2008) study automatic data communication and registration as important for complete, concise, reliable, timely, and valid IQ dimensions, and Johansson and Johansson (2004) discuss information technology in relation to accessibility, ease of operation, and timeliness. Also, information life-cycle management is shown to be important for complete, timely, and valid IQ dimensions (Jonsson and Gustavsson, 2008).

2.3 Information utilisation

This section reviews previous research related to information utilisation. The section is divided into definition and importance of information utilisation, information utilisation characteristics, and determinants of information utilisation.

2.3.1 Definition and importance of information utilisation

Very few identified papers explicitly discuss information utilisation and there is no clear definition of the concept. Instead, utilisation of shared information is often taken for granted in previous research. It is obvious that previous research studying the linkage between information sharing or IQ and performance (e.g. Bartlett *et al.*, 2007; Paulraj *et al.*, 2008; Sanders *et al.*, 2012; Wiengarten *et al.*, 2010; Yu *et al.*, 2001) implicitly presume information utilisation. Tokar *et al.* (2011) explain that information sharing alone does not improve performance, the information also needs to be utilised. Additionally, Bendoly *et al.* (2009) show that there is a relationship between information utilisation and profitability, and Wikner *et al.* (1991) argue that better use of information flow reduces demand amplifications. Further, Rota *et al.* (2002) argue that information utilisation is important in order to balance supply and demand. Davis *et al.* (2011) conclude that both retailers and suppliers can benefit from information utilisation, and Robinson *et al.* (1995) explain the benefits of using both upstream and downstream information. Thus, in order to be competitive in today's business environment, information utilisation is crucial (Dreyer *et al.*, 2009; Weber and Kantamneni, 2002).

2.3.2 Information utilisation characteristics

As information utilisation is not explicitly studied in previous research, it is not clear how the concept can be characterised. However, several studies implicitly discuss information utilisation, by including utilisation related items when studying information sharing and/or IQ. Paulraj *et al.* (2008) and Lee *et al.* (2010), among others, include information usefulness when studying information sharing, which are related to information utilisation. Further, studies on IQ (e.g. Jonsson and Gustavsson, 2008; Li and Lin, 2006) include specific IQ dimensions that assesses the ease of use and usefulness of shared information and are thus also related to information utilisation. Furthermore, Fawcett *et al.* (2007) explain that potentially useful information does not improve decision-making if the information is unavailable, which indicate that both usefulness and ease of use are important aspects of information utilisation.

2.3.3 Determinants of information utilisation

Only one determinant of information utilisation is identified in previous research, namely IQ. Moorman *et al.* (1992) conclude that IQ determines in what extent market research information is utilised. Further, Bruch and Bellgran (2013) argue that higher IQ increases the likeliness of information utilisation, and Lee *et al.* (2010) state that supply chain information will not be utilised if there is a lack of confidence in IQ. Further, Lee and Whang (2000) argue that companies must develop capabilities for utilising shared information in an effective way, however, they do not specifically discuss different capabilities.

2.4 Summary of the literature review

Previous research indicates the importance of information sharing, IQ, and information utilisation for OPC performance, and describes the overall relationships between the three concepts. However, it does not completely explain how certain information factors impact specific IQ dimensions, how the perceived IQ impact information utilisation, and how information utilisation impact OPC performance. Furthermore, previous research extensively studies determinants of information sharing, and partially determinants of IQ, however, it does not completely clarify the relationships between the determinants and specific IQ dimensions. It neither studies any determinants of information utilisation, except for IQ. A summary of what is covered in previous research, and what is not, is illustrated in Figure 2.

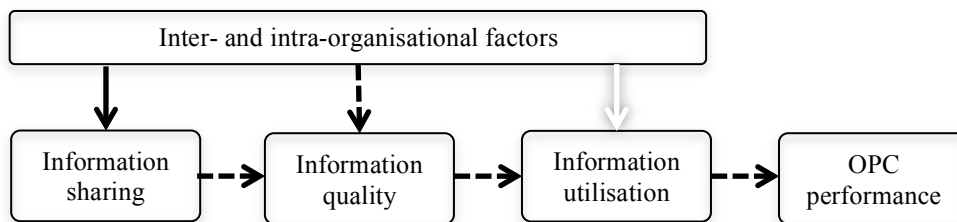


Figure 2 – Summary of the literature review (solid lines are extensively studied, dotted lines are partially studied or indicated, and the white line is not at all studied in previous research).

3 Research questions

This chapter relates the purpose of the thesis to the gaps identified in previous research. Relevant research areas are identified and motivated, and ends up in two research questions. In the end of the chapter, an explanation for how the research questions are related to each other, and to previous research, is presented.

3.1 Development of research questions

The purpose of this licentiate thesis is to identify determinants of information utilisation and explore how these determinants impact the utilisation of shared demand-related information in a supplier's OPC processes. The only direct determinant of information utilisation identified in previous research is IQ (Bruch and Bellgran, 2013; Lee *et al.*, 2010; Moorman *et al.*, 1992), however, it is not fully explained how this determinant impacts information utilisation, especially not in OPC processes. Some researchers study IQ in relation to OPC performance (e.g. Forslund and Jonsson, 2007; Gustavsson and Jonsson, 2008; Petersen *et al.*, 2005), however, none of them explicitly study the impact of IQ on utilisation. As IQ is an important mediator between information sharing and information utilisation (implied by e.g. Paulraj *et al.*, 2008; Sanders *et al.*, 2012; Yu *et al.*, 2001), it is important to understand how IQ impacts the utilisation of shared demand-related information in a supplier's OPC processes. Such understanding helps explaining why potential benefits with information sharing are not always reached and can thus be used to further the knowledge about the complex relationship between information sharing and performance.

Bruch and Bellgran (2013) argue that higher IQ increases the likeliness of information utilisation, indicating that IQ is not the only direct determinant of utilisation. Furthermore, Lee and Whang (2000) argue that companies must develop capabilities for effectively utilising shared information, also indicating that more than one direct determinant of information utilisation exists. The literature review (Sections 2.1.3 and 2.2.3) shows several determinants of information sharing and IQ and some of the studies include information utilisation-related items (e.g. ease of use and usefulness) in the information sharing and IQ constructs (e.g. Chen *et al.*, 2014; Jonsson and Gustavsson, 2008; Paulraj *et al.*, 2008). This indicates that the three concepts are interrelated and treated as a mix in previous research. The determinants of information sharing and IQ might thus also be direct determinants of information utilisation. It seems reasonable that some of the determinants of information sharing and IQ also can have direct impact on information utilisation, for example, as production planners have significant influence on the OPC processes (Berglund and Guinery, 2008), their skills and understanding to process information (Dimitriadis and Koh, 2005) should likely impact how shared information is interpreted and utilised in the processes. Furthermore, as both internal and external information technology is important for information sharing and IQ (Dimitriadis and Koh, 2005; Jonsson and Gustavsson, 2008) and the functionality of the internal planning system determines how planning is performed (Ivert and Jonsson, 2011), the functionality of the system should likely also impact how shared demand-related information is utilised in the system. Thus, despite not explicitly studied in previous research, some inter- and intra-organisational factors should also directly impact information utilisation. It

is important to understand how other determinants of information utilisation than IQ directly impact the utilisation of shared demand-related information in a supplier's OPC processes, as it helps explaining why potential benefits with information sharing are not reached, even when the shared information is of high quality. Together with the importance of understanding how IQ directly impact information utilisation, this motivates a first research question (RQ1):

RQ1:

How do determinants of information utilisation directly impact the utilisation of shared demand-related information in a supplier's operations planning and control processes?

As explained for RQ1, IQ directly impacts information utilisation (Bruch and Bellgran, 2013; Lee *et al.*, 2010; Moorman *et al.*, 1992). As the literature review (Section 2.2.3) shows that certain information sharing factors (e.g. frequent and informal communication) in turn directly impact IQ (Barratt and Oke, 2007; Jäckel *et al.*, 2006), the determinants of information sharing and IQ indirectly impact information utilisation. However, the literature review (Section 2.1.3) shows that determinants of information sharing are already extensively studied in previous research and do thus not need any further attention here. Yet, even though determinants of IQ are partially studied in previous research, the IQ-related research explicitly studying demand-related information (e.g. Forslund and Jonsson, 2007; Gustavsson and Jonsson, 2008; Jonsson and Gustavsson, 2008) does not fully explain how demand-related IQ deficiencies occur. Further, only a few researchers (Johansson and Johansson, 2004; Jonsson and Gustavsson, 2008) study determinants of specific IQ dimensions, and they do not provide a complete picture of how determinants of IQ impact specific IQ dimensions. Still, because of the multi-dimensionality of the IQ concept (Gustavsson and Wänström, 2009; Lee *et al.*, 2002; Wang *et al.*, 1996), it is necessary to separate specific IQ dimensions in order to fully understand how the determinants of IQ impact the quality of shared demand-related information, and thereby indirectly the utilisation of it. In the same way as it is important to understand how determinants of information utilisation directly impact the utilisation of shared demand-related information in a supplier's OPC processes, it is thus important to also understand how determinants of IQ directly impact specific IQ dimensions of shared demand-related information, as such understanding helps explaining why potential benefits with information sharing are not always reached. This motivates a second research question (RQ2):

RQ2:

How do determinants of information quality directly impact specific information quality dimensions of shared demand-related information?

3.2 Relationships between research questions and previous research

How the two research questions are related to each other, as well as to the gaps identified in previous research, are illustrated in Figure 3. RQ1 explores direct determinants of information utilisation, i.e. IQ factors as well as inter- and intra-organisational factors. RQ2 explores direct determinants of specific IQ

dimensions, i.e. information sharing factors as well as inter- and intra-organisational factors. No research question is formulated regarding the gap related to the relationship between information utilisation and OPC performance, instead this gap is saved for future research.

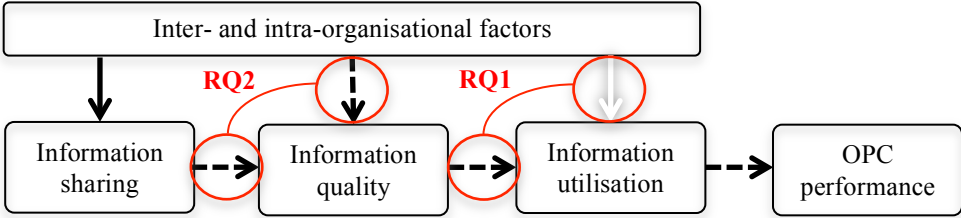


Figure 3 - Relationships between research questions and gaps in previous research (solid lines are extensively studied, dotted lines are partially studied or indicated, and the white line is not at all studied in previous research).

4 Methodology

This chapter describes the overall research process, the research design and case selections, the data collection and analysis, the research quality, and the presentation of the research results.

4.1 Research process

The research process started in February 2011. In the beginning of the process, the scope of the research was not clearly defined and the initial time was spent on scanning previous research and setting the scope of the research. During this time, a pre-study was also performed, which enabled the author to gain a practical understanding of potential research problems. After one year, a research proposal was presented. During 2012, the first study was designed and executed. The design of the second study was also performed during 2012 and the data collection of the second study was performed during 2012 and 2013. Preliminary data analysis of the second study was also performed during 2013. Due to parental leave, the research was paused during 2014, but picked up again during 2015. The second study was finalised in the beginning of 2015. During 2015, the two studies were also brought together, and summarised in this cover for the licentiate thesis.

From January 2012, the research has been part of a larger research project called: Managing production and supply networks in turbulent environments; in which information sharing, IQ and information utilisation are important parts. The research project is funded by the Swedish Governmental Agency for Innovation Systems (VINNOVA). Two project conferences have been held within the project, providing feedback on the research, one in January 2013 and one in May 2014.

4.2 Research design

Both Flick (2009) and Bryman and Bell (2011) argue that the research questions are the starting point of the research process, and should guide the decisions about the research design, case selection, data collection, data analysis, and presentation of results. Maxwell (2005) provides a slightly different approach to research design, and argues that the research questions does not have to be the starting point, instead he argues that it is an iterative process. Still, Maxwell (2005) agrees that there has to be a fit between the research questions and the other aspects of the research design. Thus, the research design used in this research needs to match the research questions formulated in Section 3.1. Overall, the research questions in this thesis was formulated in the beginning of the research process, however, they have developed during the process, which explains why exact wordings and formulations are not necessarily correspondent between the thesis cover and the appended papers. However, the main content of the research questions has remained the same during the research process.

Both research questions formulated in this thesis are of an explorative nature, aiming at achieving a greater understanding of different determinants of information utilisation and IQ. Marshall and Rossman (2010) argue that research is exploratory when the researcher studies a phenomena which are little understood in previous research, which is true for information utilisation and partly IQ, as neither the information sharing concept and its determinants, nor

the determinants of specific IQ dimensions are explicitly studied in previous research. The focus on understanding makes a qualitative approach suitable (Marshall and Rossman, 2010; Maxwell, 2005), where case studies are particularly suitable (Yin, 2009), as no other approach enables the same deep understanding as requested by the research questions. Qualitative case studies are appropriate when there is a lack of previous research (Eisenhardt, 1989), as in this case, and when the aim is to construct, adapt, extend, and refine theories (Dubois and Araujo, 2007), rather than testing them. Further, case studies are appropriate for understanding the interaction between a phenomenon and its context (Dubois and Gadde, 2002), and the context is considered important for exploring determinants of information utilisation.

The licentiate thesis is based on two separate case studies, case study 1 and case study 2, and the two case studies are performed in succeeding order. Case study 1 is designed to get a deeper understanding of the relationships between information sharing, IQ, and information utilisation (Figure 1) and thus focuses on determinants of IQ and information utilisation related to the shared information. Case study 2 is designed to get a deeper understanding of all sorts of potential determinants of IQ and information utilisation and thus focuses on determinants related to both the shared information, as well as to a set of inter- and intra-organisational factors. Both case studies are thus complementary and designed to answer both research questions (as illustrated in Figure 4), but with slightly different focus.

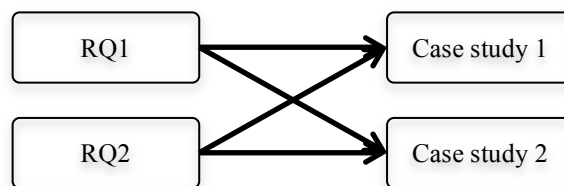


Figure 4 - Relationships between case studies and research questions.

4.3 Case selection

Both case studies included in this licentiate thesis is performed in the automotive industry. Case study 1 is performed in a supply network, including one manufacturing customer (called the OEM), and one of its suppliers. The studied supplier acts as both a first-, second-, and third-tier supplier to the OEM, depending on the products delivered. Except for the OEM and the supplier, the case study also includes three intermediate companies in the supply network (called tier 1, tier 2a, and tier 2b). The case was selected according to maximal variation sampling (as described by Flick, 2009), as we wanted to include companies in different tiers of the supply chain. By studying a supply network instead of unrelated suppliers in different tiers, it not only enabled us to identify different IQ deficiencies in different tiers, it also enabled us to determine the actual consequences of the deficiencies, as they impact the same planning process. Also, the different customers in the network have different relationships with the supplier, which enabled us to identify a rich variety of IQ deficiencies. The relationships between the OEM, the supplier, tier 1, tier 2a, and tier 2b are illustrated in Figure 5.

Case study 2 includes a manufacturing customer (called the OEM) and three of its first-tier suppliers. None of the studied companies in case study 2 are the same as in case study 1, meaning a total of nine case companies are included in this licentiate thesis. The OEM was selected first, because it shares lots of different types of demand-related information with its suppliers. The suppliers were selected, together with the OEM, according to maximal variation sampling and convenience sampling (as described by Flick, 2009). It was stated that the suppliers should differ in type of products, manufacturing strategy, delivery pattern, firm size, organisational complexity, planning processes, and relationship with the OEM, however, for convenience reasons no long-distance supplier was included, even though it would have increased the variation further. The relationships between the OEM and the three suppliers are illustrated in Figure 6.

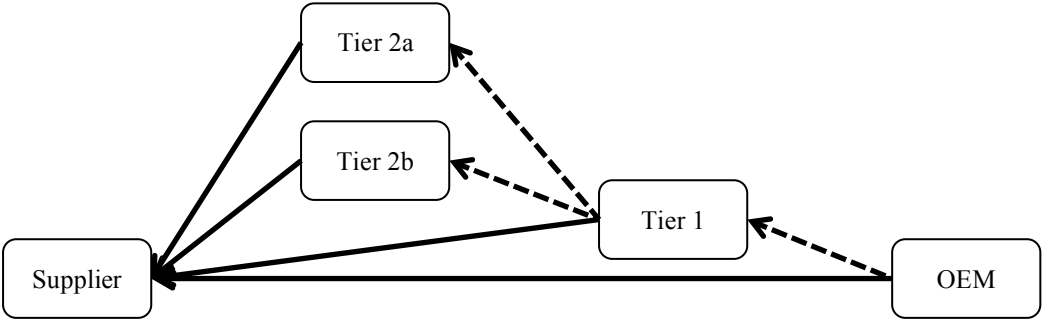


Figure 5 - Companies in case study 1 (solid lines show shared demand-related information in focus in the study, and dotted lines show shared demand-related information not in focus).

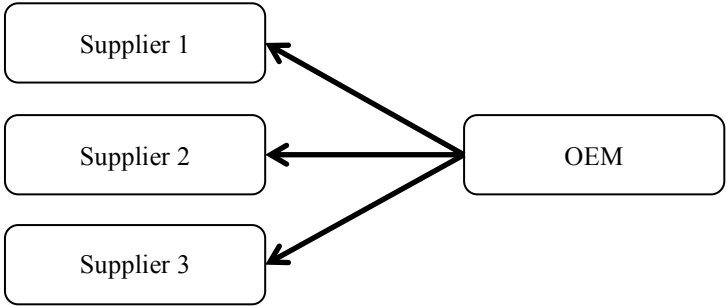


Figure 6 - Companies in case study 2 (lines show shared demand-related information in focus).

4.4 Data collection

The data collection performed in the two case studies are summarised in Table 4. The main data collection technique used in both case studies are semi-structure interviews (as described by Flick, 2009). The openness of the interview questions allowed the researchers to explore the studied phenomena, seen through the eyes of the interviewees (for interview guides, see Appendix A). Complementary to the interview data, both case studies also included observations of the OPC processes in focus, as well as the information utilisation in the processes, internal documents, and reviews of the shared information in focus. In case study 1, reviews of the delivery schedules was of a quantitative nature. Further, in case study 2, a survey was used to validate the interview data (for survey design, see Appendix B).

Table 4 - Data collection in the two case studies.

| Data collection | Case study 1 | Case study 2 |
|-------------------------------|--|--|
| Semi-structured interviews | 5 interviews, 3 interviewees (see Table 5) | 27 interviews, 22 interviewees (see Table 6) |
| Observations | Production scheduling process Information utilisation | Forecasting process Production planning process MPS process Materials planning process Order delivery process Information utilisation |
| Internal documents | Data analysis documents | Process descriptions |
| Reviews of shared information | Delivery schedules | Delivery schedules Production programs Webcasts Online planning system |
| Survey | - | 16 respondents |

In Table 5 and Table 6, a detailed description of all interviews performed within the two case studies are presented. There, it is seen how many interviews that was performed in each case company, which positions and responsibilities the interviewees had, who performed the interviews, and how many interviews that were performed with each interviewee.

Table 5 - Interviews performed in case study 1.

| Case company | Interviewee | Interviewer | Number of interviews |
|--------------|---------------------------------|-------------|----------------------|
| Supplier | Material and production planner | Myrelid | 2 |
| Supplier | Material and production planner | Myrelid | 1 |
| Supplier | Logistics manager | Myrelid | 2 |

Table 6 - Interviews performed in case study 2.

| Case company | Interviewee | Interviewer | Number of interviews |
|--------------|------------------------------------|---------------------|----------------------|
| OEM | 2 information managers | Myrelid | 1 |
| OEM | Information manager | Myrelid | 1 |
| OEM | Production manager | Myrelid and Jonsson | 1 |
| OEM | Purchasing manager | Myrelid | 1 |
| Supplier A | Customer service manager | Myrelid and Jonsson | 1 |
| Supplier A | Forecasting responsible | Myrelid and Jonsson | 2 |
| Supplier A | 3 customer service representatives | Myrelid and Jonsson | 3 |
| Supplier A | Process manager | Myrelid and Jonsson | 1 |
| Supplier A | Supply chain planner | Myrelid | 1 |
| Supplier B | Logistics manager | Myrelid | 2 |
| Supplier B | Customer service representative | Myrelid | 2 |
| Supplier B | Production planner | Myrelid | 1 |
| Supplier B | Marketing manager | Myrelid | 1 |
| Supplier B | Material planner | Myrelid | 1 |
| Supplier C | Customer service manager | Myrelid | 3 |
| Supplier C | Customer service representative | Myrelid | 2 |
| Supplier C | Information receiver | Myrelid | 1 |
| Supplier C | Material planner | Myrelid | 1 |
| Supplier C | Production planner | Myrelid | 1 |

4.5 Data analysis

One of the main difficulties with qualitative research is the data analysis, because of the large amount of data (Bryman and Bell, 2011), so also in this research. Creswell (2012) describe a qualitative data analysis in four steps: (1) organising the data, (2) reading and reflecting of the data, (3) describing, classifying, and interpreting the data, and (4) representing and visualising the

data. In both case studies, organising the qualitative data was performed by structuring all available data according to its content, for each case company and relationship respectively. By reading and reflecting of the data, the researchers formulated details for how the data should be analysed. These two steps was an on-going process, performed simultaneously with the data collection. By performing these two steps simultaneously with the data collection, it enabled the researchers to identify gaps in the data collection at an early stage, which could be corrected in the next data collection phase. In both case studies, step three and four was the most straightforward steps. After step two, which was the most difficult step in both case studies, it was evident how the data should be classified and interpreted. In both cases, the visualisation of the data analysis was presented in tables.

Eisenhardt (1989) discuss two types of case study analyses: within-case analysis and cross-case analysis, where cross-case analysis requires at least two cases (Yin, 2009). Both case studies included in this thesis include both within-case and a cross-case analyses. The within-case analyses are based on the case descriptions and aims at exploring case-specific relationships, while the cross-case analyses are based on the within-case analyses and searches for common patterns between the case companies. However, in case study 1, the within-case analysis and cross-case analysis is performed simultaneously. In both case studies, the analyses are performed from a supplier perspective, as information is utilised and IQ is assessed at the suppliers.

Except for qualitative data, case study 1 also include some quantitative data. This data was analysed in a completely different way than the qualitative data. Here, the details of how the data should be analysed was decided before the data was collected, and the data analysis was thus very straightforward.

4.6 Research quality

The quality of quantitative research is often assessed through the quality criteria of internal and external validity, reliability and objectivity (Guba and Lincoln, 1989). However, even though e.g. LeCompte and Goetz (1982) have tried to adapt the criteria to also fit qualitative research, they are not undoubtedly suitable for qualitative research. Instead, an alternative for qualitative research is to assess research quality through the quality criteria of credibility, transferability, dependability, and conformability (Bryman and Bell, 2011; Halldorsson and Aastrup, 2003), which are more suitable for qualitative research. As the research presented in this thesis is qualitative, the second set of quality criteria is chosen for assessing the quality of the research.

4.6.1 Credibility

Credibility (related to the quantitative criteria of internal validity) refers to the match between the study results and the interviewee's experience of reality (Halldorsson and Aastrup, 2003). Credibility can be achieved through the use of respondent validation and triangulation (Bryman and Bell, 2011), where triangulation can be performed in terms of methods, data, investigator, and theory (Croom, 2009; Flick, 2009).

In this research, respondent validation was used to assure credibility, however slightly different in the two case studies. In case study 1, three different types of validation was used to assure the matching view between the researcher and the supplier: (1) follow-up interviews, where the result from the previous interview was discussed and clarified; (2) a project conference, where preliminary findings were presented, discussed, and validated; and (3) paper validation, where the supplier read and validated the final paper, in which the results were presented. The two first types of validation used in case study 1 was also used for case study 2. Also, in case study 2, the interviewees at the OEM acted as a project team, with which a continuous discussion of uncertainties and preliminary findings were taken place. However, no paper validation has been performed in case study 2 yet. In both of the cases, the result of the different types of validation confirmed our view of the research, as no mismatches were identified.

In this research, method triangulation was used to assure credibility. In both case studies, interviews were the main data source, however, observations, reviews of internal documents, and group discussions (during project conferences and a focus group) were also used in both case studies to complement the interview data. Further, in case study 1, quantitative data was used to complement the interview data, and in case study 2, a survey was used to validate the interview data. Also, in case study 2, investigator triangulation was used in some extent, as two researchers participated in some of the interviews and shared the same view of the studied phenomena.

4.6.2 Transferability

Transferability (related to the quantitative criteria of external validity) refers to the study's ability to make general claims about the world (Halldorsson and Aastrup, 2003). Because of the limited amount of cases in qualitative research, it is difficult to make generalisations of the results, however, by providing thick descriptions of the case context (Bryman and Bell, 2011), the reader of the findings is able to determine the transferability to its specific situation.

Because of the limited number of case companies included in the two studies, it is difficult to generalise the findings of the research. However, as the purpose of the research is explorative, generalisation is not considered substantial. Instead, generalisation of the findings will become more important after the licentiate thesis, when a quantitative study is planned. Thus, the only way this research assures transferability of the findings is by the detailed descriptions of the case contexts that are included in the papers, as they allow the readers of the papers to determine the transferability to their specific situations.

4.6.3 Dependability

Dependability (related to the quantitative criteria of reliability) refers to the stability of data over time (Guba and Lincoln, 1989). It is achieved through detailed records of the different parts of the research process, e.g. problem formulation, case selection, interview notes, and analysis decisions, in order to enable reviews of how the research has been performed (Bryman and Bell, 2011).

In this research, detailed records has been taken of the different parts of the research process, however the interview guides and interview notes creates a huge amount of data. Thus, even though it is possible to review all documents to get a holistic view of the research process, such a review would be very time consuming and all documents are thus not included in this thesis.

4.6.4 Confirmability

Confirmability (related to the quantitative criteria of objectivity) refers to the integrity of the findings, and it must be possible to track the data to its source and not to the bias of researcher (Halldorsson and Aastrup, 2003). In order to achieve confirmability, the personal values of the researcher must be set aside, which is a task for other researchers to assess (Bryman and Bell, 2011).

It is impossible for a researcher to perform interviews without in some extent influence the result of them (by e.g. the questions asked or reactions to answers), however, the researcher has tried to set its personal values aside and influence the research as little as possible. Confirmability is easier to achieve in case study 2, as there has been two researchers involved in the research process. However, also in case study 1, the researcher has continuously discussed the research with her two supervisors, and all three papers has been presented and discussed in conferences and research seminars together with other researchers.

4.7 Presentation of results

The results of the two case studies are presented in three academic papers, appended this thesis. Case study 1 ends up in one paper, paper I, while case study 2 ends up in two papers, paper II and paper III. The relationships between the two case studies and the three papers are illustrated in Figure 7.

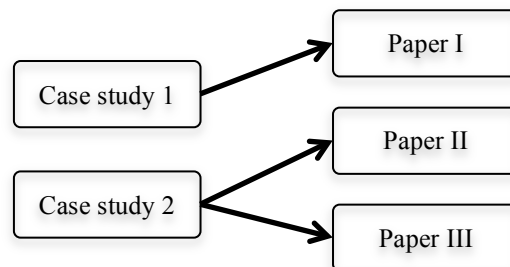


Figure 7 - Relationships between case studies and papers.

5 Summary of appended papers

This chapter summarises the three papers that are appended this licentiate thesis. Two of the papers are co-authored and a description of the authors' contribution to the appended papers is also provided. In the end of the chapter, a description of how the different papers are used to answer the two research questions is presented.

5.1 Paper I: Information quality deficiencies in delivery schedules and their impact on production scheduling

The purpose of the paper is to (1) explore how different delivery schedule characteristics impact the quality of shared delivery schedule information, and (2) how these deficiencies impact a supplier's production scheduling process. The paper is based on case study 1 and its empirical focus is thus a supply network in the automotive industry, including a supplier acting as a first-, second-, and third-tier supplier to an OEM. All delivery schedules the studied supplier receives in the network are examined.

The analysis takes a supplier perspective and identifies IQ deficiencies in the delivery schedules, which are related to activities and resources in the supplier's production scheduling process. The findings show (1) how four delivery schedule characteristics (receiving frequency, planning period, frozen period, and demand variation) cause IQ deficiencies in five IQ dimensions (complete, concise, reliable, timely, and credible), and (2) how the deficiencies impact a supplier's production scheduling process, by increasing the need for additional activities (rescheduling, rework, and follow-up) and resources (capacity problems, safety time, safety stock, and backlogs) in the process.

The paper builds on previous IQ-related research and extends it to include IQ in delivery schedules. It contributes with an understanding of how IQ deficiencies in delivery schedules can relate different delivery schedule characteristics to the need for activities and resources in a supplier's production scheduling process. Practically, this research can help practitioners to improve the IQ of delivery schedules shared in supply chains and thereby also help improve a supplier's production scheduling process. Lastly, this research may serve as a foundation for future research on information sharing and IQ in delivery schedules.

5.2 Paper II: Supply chain information utilisation – conceptualisation and antecedents

The purpose of the paper is to define the concept of supply chain information utilisation and to explore how determinants (in the paper called antecedents) of it impact the utilisation of shared information in an information user's planning processes. The paper is based on case study 2 and its empirical focus is thus an OEM in the automotive industry and three of its first-tier suppliers. The paper focuses on shared demand-related information (forecasts, planned orders, firm orders, inventory levels) utilised in the suppliers' tactical and operational planning processes. The paper adopts a dyadic supply chain approach that allows the study of determinants at the OEM, the suppliers, as well as in their dyadic relationships.

The paper conceptualises supply chain information utilisation by defining different levels of utilisation: (1) utilisation as potential usage, (2) utilisation as intended usage, (3) utilisation as actual usage, and (4) utilisation as efficient and effective usage. Potential usage include perceived usefulness and ease of use and is related to different IQ dimensions. Intended usage includes a supplier's willingness and ability to utilise shared demand-related information in its OPC processes. Actual usage is directly dependent on intended usage and efficient and effective usage requires the utilisation to have positive impact on the OPC performance. The analysis generates twelve propositions relating intended usage (and thereby actual usage) to a set of mutually related information, inter-, and intra-organisational factors in a dyadic relationship. The findings show how the determinants have both direct (e.g. IQ, collaborative relationships) and indirect (e.g. composite information sharing) mediating and moderating effects on information utilisation.

The paper builds on previous information sharing and IQ-related research, and extends it to include information utilisation, which is rather unexplored in previous research. The paper contributes with a conceptualisation of supply chain information utilisation and introduces a five-phase mediation model to explain how information sharing affects performance. The paper also extends previous research to include composite information sharing, social network governance, and informal communication as determinants of information utilisation, which are rather unexplored areas in the literature. It furthermore details previous research by showing how previously examined determinants of information sharing and IQ are determinants also of information utilisation. The findings can be used as basis for future research regarding information utilisation, and practically help practitioners to understand how to improve information utilisation and thereby increase the value of information sharing.

5.3 Paper III: Determinants of information quality in supply chains

The purpose of the paper is to explore how determinants of IQ impact specific IQ dimensions of shared demand-related information. The paper is based on case study 2 and its empirical focus is thus an OEM in the automotive industry and three of its first-tier suppliers. All types of demand-related information (forecasts, planned orders, firm orders, inventory levels) shared in the three dyads are examined and the paper focuses on direct determinants of pragmatic IQ deficiencies identified in the dyads. The paper adopts a dyadic supply chain approach that allows the study of determinants at the OEM, the suppliers, as well as in their dyadic relationships.

The analysis takes a determinant-oriented perspective and generates eight propositions relating pragmatic IQ dimensions (relevance, accessibility, credibility, understandability, ease of operation) to their determinants (e.g. trust, planning system, internal information). The findings identify trade-offs between IQ dimensions, since different dimensions are beneficially (e.g. trust on credibility), detrimentally (e.g. planning system dysfunction on relevance and ease of operation), varyingly (e.g. information analysis on credibility, depending on analytical results), and conflictingly (e.g. composite information sharing benefits accessibility, credibility, and understandability, yet compromises relevance) impacted by the determinants.

The paper builds on previous IQ-related research and extends it to include willingness, composite information sharing, and internal information sharing as determinants of pragmatic IQ dimensions. It furthermore details previous research by showing how previously examined determinants directly impact specific pragmatic IQ dimensions. Since IQ mediates the linkage between information sharing and performance, this research helps to explain conflicting results regarding the value of information sharing. In this sense, the propositions developed can also be used as guidance for future research. Yet, the paper also has practical implications, for it can help practitioners to improve demand-related IQ shared within supply chains. By understanding how different IQ dimensions are impacted, companies can consciously make decisions to increase the IQ of shared information and thus increase the value of information sharing.

5.4 Author’s contribution to appended papers

Paper I: single author. Myrelid has performed all parts of the research process (i.e. research design, literature review, data collection, data analysis, and writing of the paper) herself, with support from her two supervisors.

Paper II: second author, written together with Patrik Jonsson. The research design and literature review was a joint effort between the two authors. The data collection was mainly performed by Myrelid, and Jonsson participated in some extent. The within-case analysis was a joint effort between the two authors, however, the cross-case analysis was mainly performed by Jonsson. The writing of the paper was a joint effort between the two authors, however, Jonsson had the main responsibility of the writing process.

Paper III: first author, written together with Patrik Jonsson. The research design was a joint effort between the two authors. The literature review was mainly performed by Myrelid. The data collection was mainly performed by Myrelid, and Jonsson participated in some extent. The within-case analysis was mainly performed by Myrelid, however the cross-case analysis was a joint effort between the two authors. The writing of the paper was also a joint effort, however, Myrelid had the main responsibility of the writing process.

5.5 Relationships between papers and answers to research questions

Paper I contributes to the answer of both research questions, while paper II contributes to the answer of RQ1 and paper III contributes to the answer of RQ3. How the three papers contribute to the answers of the two research questions are illustrated in Figure 8.

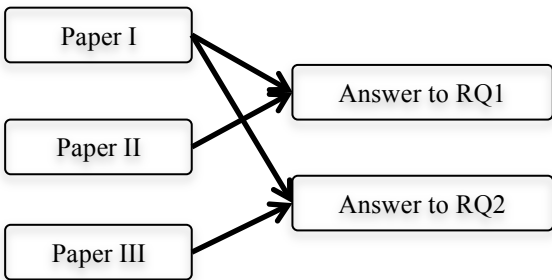


Figure 8 - Relationships between papers and answers to research questions.

6 Results

This chapter presents the results of the research, by answering the two research question separately.

6.1 Direct determinants of information utilisation

RQ1 asked how determinants of information utilisation directly impact the utilisation of shared demand-related information in a supplier's OPC processes. Paper II shows that how determinants of information utilisation directly impact the utilisation depends on how information utilisation is defined. In paper II, it is seen how information utilisation can be divided into four levels of utilisation: utilisation as potential usage, utilisation as intended usage, utilisation as actual usage, and utilisation as efficient and effective usage. Determinants of potential usage is related to IQ, and thus discussed in relation to RQ2 and determinants of efficient and effective usage is related to performance, which is out of scope of this research. Thus, the focus here is on direct determinants of intended and actual usage. Paper II shows how intended usage includes a supplier's willingness and ability to utilise shared demand-related information in its OPC processes, as well as determines if shared information actually is used or not. Further, paper I shows how IQ also directly impact actual usage, by determining how shared information is utilised in the processes.

Paper II shows how a collaborative relationship and dependency of shared demand-related information in an inter-organisational relationship impact actual usage, through a supplier's willingness to use the shared information. Further, it shows how skills and understanding of individual planners, functionality of the planning system, and formality and structure of internal processes at a supplier impact actual usage, through the supplier's ability to use the shared information. Papers I and II together also show how IQ impacts actual usage, through both a supplier's ability and willingness to utilise shared demand-related information, depending on the specific IQ dimension. In paper II, the IQ dimensions are grouped into four categories and the paper shows how the value (relevance and validity) as well as accuracy (reliability and credibility) of shared demand-related information impact a supplier's willingness to utilise the information, and how the format (conciseness, understandability, appropriate amount) as well as availability (accessibility, completeness, timeliness) impact a supplier's ability to utilise the information. In paper I, the IQ dimensions are treated separately and the paper shows how timeliness and completeness deficiencies in shared demand-related information result in an inability at a supplier to utilise the information.

Paper I confirms the findings in paper II about the relationship between dependency of shared demand-related information and a supplier's willingness to use the shared information. Paper I even shows how dependency alone can make a supplier willing to use shared demand-related information, regardless of the perceived IQ. Paper I shows how conciseness, reliability, and credibility deficiencies in shared demand-related information, without impacting a supplier's willingness and ability to utilise the shared information, can cause a need for additional activities (e.g. rework and follow-up of information) in the supplier's OPC process to enable actual usage. How the determinants of information utilisation, identified in this research, directly impact the utilisation

of shared demand-related information in a supplier's OPC processes are summarised in Table 7.

Table 7 – Direct determinants of information utilisation.

| Factor | Type of factor | Impact on utilisation |
|---------------------------------|-----------------------------------|------------------------------------|
| Collaborative relationship | Inter-organisational relationship | Willingness to use |
| Information dependency | Inter-organisational relationship | Willingness to use |
| Human skills and understanding | Intra-organisational at supplier | Ability to use |
| Planning system functionality | Intra-organisational at supplier | Ability to use |
| Process formality and structure | Intra-organisational at supplier | Ability to use |
| Value of information | Information quality | Willingness to use |
| Accuracy of information | Information quality | Willingness to use Actual usage |
| Information format | Information quality | Ability to use Actual usage |
| Information availability | Information quality | Ability to use |

6.2 Direct determinants of information quality

RQ2 asked how determinants of IQ directly impact specific IQ dimensions of shared demand-related information. Paper I shows how certain information sharing factors cause deficiencies in specific IQ dimensions and paper III shows how both certain information as well as inter- and intra-organisational factors impact specific IQ dimensions, either beneficially, detrimentally, varyingly (i.e. sometimes beneficially and sometimes detrimentally), or conflictingly (i.e. beneficially impact one dimension and detrimentally impact another) depending on the factor.

Paper III shows how trust beneficially impact the credibility of shared demand-related information, and how willingness to share and explain information beneficially impact the relevance, accessibility, credibility, understandability, and ease of operation of shared information. Furthermore, the paper shows how skills and understanding of individual planners at a supplier beneficially impact the understandability, while skills and understanding of contact persons at a customer beneficially impacts both the credibility and understandability of shared demand-related information. Also, paper III shows how a dysfunctional planning system at a supplier detrimentally impact the relevance and ease of operation of shared demand-related information, and how information analyses at a supplier impacts the credibility, beneficially or detrimentally depending on the analytical results. Paper III further shows how formality and structure of internal processes at a customer detrimentally impact the accessibility, credibility and understandability of shared demand-related information, when they prevent internal information sharing. Last, paper III shows how composite information sharing impacts the credibility of shared demand-related information, beneficially or detrimentally depending on the coherence of the composite information. The paper also shows how composite information sharing beneficially impact the accessibility and understandability of the information, but at the same time detrimentally impact the relevance of it.

Paper I shows how the frequency of shared demand-related information can cause deficiencies in the complete, concise, and timely IQ dimensions, and how the planning period in the shared information can cause deficiencies in the concise dimension. Furthermore, paper I shows how demand variations in shared demand-related information can cause deficiencies in the concise, reliable, and

credible IQ dimensions, and how the frozen period used in the shared information can cause deficiencies in the timely dimension. How the determinants of IQ, identified in this research, directly impact specific IQ dimensions of shared demand-related information are summarised in Table 8.

Table 8 – Direct determinants of information quality.

| Factor | Type of factor | Impact on IQ |
|---------------------------------|-----------------------------------|---|
| Trust | Inter-organisational relationship | Credibility |
| Willingness | Inter-organisational relationship | Relevance Accessibility Credibility Understandability Ease of operation |
| Human skills and understanding | Intra-organisational at supplier | Understandability |
| Planning system functionality | Intra-organisational at supplier | Relevance Ease of operation |
| Information analysis | Intra-organisational at supplier | Credibility |
| Human skills and understanding | Intra-organisational at customer | Credibility Understandability |
| Process formality and structure | Intra-organisational at customer | Accessibility Credibility Understandability |
| Composite information | Information sharing | Accessibility Credibility Understandability Relevance |
| Frequent communication | Information sharing | Completeness Conciseness Timeliness |
| Planning period | Information sharing | Conciseness |
| Demand variation | Information sharing | Conciseness Reliability Credible |
| Frozen period | Information sharing | Timeliness |

7 Discussion

This chapter discusses the results of the thesis in relation to previous research. Furthermore, it discusses how the results of the thesis are related to the overall research problem, i.e. the complex relationship between information sharing and performance.

7.1 Direct and indirect determinants of information utilisation

This research shows how individual IQ dimensions, as well as groups of dimensions, impact intended and actual information usage. More specifically, the research shows how the IQ dimensions impact both the willingness and ability dimensions of intended usage. This seems reasonable, based on the definitions of the IQ dimensions. For example, relevance refers to how value-adding information is (Wang *et al.*, 1996) and a supplier should be unwilling to use shared demand-related information that are invaluable to its OPC processes. Further, accessibility refers to how quickly shared information is available (Lee *et al.*, 2002; Wang *et al.*, 1996) and a supplier should be unable to utilise unavailable information. The same type of reasoning can be applied for the IQ dimensions' impact on actual usage. Conciseness refers to the amount of rework needed before the shared information can be utilised in a supplier's processes (Gustavsson and Wänström, 2009) and thus determines how shared information is actually used. Previous research points out IQ as important for information utilisation (Bruch and Bellgran, 2013; Lee *et al.*, 2010; Moorman *et al.*, 1992), however, it does not explain how IQ impacts the utilisation of shared demand-related information. The research in this thesis thus extends previous research by including specific IQ dimensions as determinants of information utilisation, and by showing how their impact on actual usage is both direct and mediated by intended usage.

This research shows how complementary information sharing, frequent communication, and information content (i.e. planning period, demand variation, and frozen period) indirectly impact information utilisation, through specific inherent and pragmatic IQ dimensions. However, no information sharing factor with direct impact on information utilisation is identified here. It seems reasonable that the information sharing factors have no direct impact on information utilisation, as it is the perceived quality of the shared information that should have direct impact. Also in previous research, no information sharing factor with direct impact on information utilisation is identified, but several with direct impact on IQ, e.g. information technology, informal communication, and frequent communication (Barratt and Oke, 2007; Jonsson and Gustavsson, 2008; Jäckel *et al.*, 2006). A surprise in the present research is the lack of impact of information technology on IQ, which was expected from previous research (e.g. Auramo *et al.*, 2005; Jonsson and Gustavsson, 2008; Kärkkäinen *et al.*, 2007), but this lack can be explained by the well functioning information technology used for the information sharing studied. Also, even though previous research has studied several information sharing factors as determinants of IQ, it does not fully explain how these factors impact specific IQ dimensions. The research in this thesis thus details previous research in that aspect. Also, as no identified paper in previous research discusses composite information sharing or the information content in relation to IQ, the research in this thesis extends previous research to include these factors. However, even

though not studied here, information sharing factors are likely to also impact several inherent IQ dimensions, e.g. timeliness (system-to-system communication is expected to be quicker and thus more up-to-date than human-to-human communication, see e.g. Jonsson and Gustavsson, 2008), reliability (automatic information is expected to be more reliable than manual information, see e.g. Jonsson and Gustavsson, 2008), and consistency (formal communication is expected to be more consistent than informal information, see e.g. Narasimhan and Nair, 2005). As inherent dimensions should be just as important for information utilisation as pragmatic ones, further attention is needed regarding information sharing factors as determinants of inherent IQ.

This research shows how a collaborative relationship and the dependency of shared demand-related information directly impact information utilisation, through a supplier's willingness to utilise the shared information. Further, the research shows how trust and willingness indirectly impact utilisation, through some pragmatic IQ dimensions. Previous research does not identify any inter-organisational relationship factor with direct impact on information utilisation, but it identifies several factors with indirect impact, through IQ, e.g. trust, commitment, shared vision, and participation (Hung *et al.*, 2011; Li and Lin, 2006; Lu and Yang, 2011). Commitment, shared vision, and participation are not seen here, however, they are likely to indirectly impact IQ, through their impact on experienced trust and willingness (see e.g. Chen *et al.*, 2014; Li and Lin, 2006; Nagati and Rebolledo, 2013; Vijayasathy, 2010), which might explain the different results in this and previous research. Even though previous research study determinants of IQ, it does not fully explain how these factors impact specific IQ dimensions. Jonsson and Gustavsson (2008) is one of few researchers who study determinants of specific IQ dimensions and they show that trust is important for the credibility of shared information. The research in this thesis thus contributes with an extension of previous research to include collaborative relationships and information dependency as direct determinants of information utilisation, as well as details previous research to include determinants of specific pragmatic IQ dimensions. However, Jonsson and Gustavsson (2008) further show that trust is important also for the completeness, conciseness, reliability, and timeliness of shared information, which are inherent IQ dimensions. The definition of willingness (Fawcett *et al.*, 2007) also indicates an impact of willingness on inherent IQ. However, this research does not study the relationships between inter-organisational relationship factors and inherent IQ, which need further attention.

This research shows how human, technological, and organisational factors at a supplier directly impact the utilisation of shared demand-related information, through the supplier's ability to utilise the shared information. No intra-organisational factor at a customer is here seen to directly impact information utilisation, which seems reasonable as a customer is not related to a supplier's OPC processes, only to the information utilised in the processes, and should therefore only have an indirect impact, through IQ. Furthermore, this research shows how all three types of factors at both a supplier and a customer (except for technological factors at a customer) indirectly impact utilisation, through a set of pragmatic IQ dimensions. The lack of impact of information technology at a customer on IQ in this research likely depends on the focus on pragmatic IQ

dimensions. The planning system at a customer is related to the development of the shared information and is thus more likely to impact the reliability (i.e. an inherent dimension) of the information. Previous research does not identify any intra-organisational factors with direct impact on information utilisation, but it identifies several factors with indirect impact on utilisation, through IQ, e.g. human (top management support and individual skills and understanding), technological (information technology), and organisational (information management) factors (Chen *et al.*, 2014; Gustavsson and Jonsson, 2008; Jonsson and Gustavsson, 2008; Jäckel *et al.*, 2006). Still, previous research does not fully describe how these factors impact specific IQ dimensions, and this research thus both extends and details previous research. However, Jonsson and Gustavsson (2008) further show that information life-cycle management is important for completeness, timeliness, and validity of shared information, which explains that also intra-organisational factors impact inherent IQ dimensions. As the intra-organisational factors are not studied in relation to inherent IQ in this research, the inherent dimensions need further attention.

This research shows how a set of information, inter- and intra-organisational factors, both directly and indirectly through IQ, impact the utilisation of shared demand-related information in a supplier's OPC processes. However, as IQ is assessed in relation to stated and implied needs of a supplier (Gustavsson and Wänström, 2009), how determinants of IQ impact specific IQ dimensions thus depends on contextual aspects. The same reasoning applies for information utilisation. The contexts of the case companies included in this research thus impact the findings of the research. For example, this research shows how the use of full truckloads impact the quality of shared demand-related information. Also, the dyadic context prevents this research from identifying the information technology used for information sharing as a determinant of IQ, even though it should be a determinant as described earlier in this section. Thus, in order for the findings in this research to be relevant in other contextual settings, further attention is needed in other types of companies, relationships, and industries, and in different tiers of the supply chains.

7.2 Relationship between information sharing and performance

Previous research indicate the importance of information utilisation when studying the relationship between information sharing/IQ and performance (e.g. Bartlett *et al.*, 2007; Paulraj *et al.*, 2008; Sanders *et al.*, 2012; Wiengarten *et al.*, 2010; Yu *et al.*, 2001), however, they have not shown how information utilisation can be achieved or how it impacts performance. By exploring determinants of information utilisation, this research thus fills an important gap in previous research (namely how information utilisation can be achieved). Furthermore, even though this research has not explicitly studied the relationship between information utilisation and performance, by showing how specific IQ deficiencies cause a need for additional activities in the OPC process, it indicates such relationship.

Even if it becomes accepted that utilisation of shared demand-related information in a supplier's OPC processes can improve OPC performance (such relationship of course needs to be tested and verified before it can be accepted), the relationship is not uncomplicated. This research is not trying to say that

information utilisation always is desirable. There might be several reasons for why shared demand-related information is not actually used in a supplier's OPC processes, and rightfully so. For example, if shared information is irrelevant for a supplier's processes, information utilisation will obviously not improve OPC performance. However, in such situations, the supplier should be unwilling to use the shared information in its processes and actual usage should thus be avoided. Still, it is reasonable to believe that demand-related information shared in supply chains can improve OPC performance, if the shared information is of high quality (i.e. considered value-adding, accurate, available, and in an appropriate format), and efficiently and effectively utilised in a supplier's OPC processes, but this relationship needs further attention.

8 Concluding remarks

This chapter concludes the research presented in this thesis and highlights the academic and managerial contributions of the research. In the end of the chapter, the limitations of the research and directions for future research are also presented.

8.1 Conclusions

This thesis identifies a set of determinants of information utilisation and explores how these determinants impact the utilisation of shared demand-related information in a supplier's OPC processes. By executing two case studies in the European automotive industry, the research presented in the thesis shows how the utilisation of shared demand-related information is impacted by certain information as well as inter- and intra-organisational factors, both directly and indirectly through specific IQ dimensions. The research shows how inter-organisational relationship factors as well as intra-organisational factors at a supplier impact information utilisation both directly and indirectly, and how information factors and intra-organisational factors at a customer only have indirect impact.

This research shows how information utilisation can be divided into four levels of utilisation: utilisation as potential usage, utilisation as intended usage, utilisation as actual usage, and utilisation as efficient and effective usage. This research shows how inter- and intra-organisational determinants of information utilisation impact actual usage through the intended usage, which can be divided into a supplier's willingness and ability to utilise shared demand-related information in its OPC processes. The research also shows how IQ, except for having direct impact on intended usage, also has direct impact in the actual usage. Furthermore, the research in this thesis also shows how the indirect determinants of information utilisation impact the intended usage by a beneficial, detrimental, varying, or conflicting impact on specific IQ dimensions. By these findings, the initial model in Figure 1 has been developed into Figure 9, where the levels of information utilisation and their determinants are included. There, potential usage is included in the IQ and efficient and effective usage is included in the OPC performance.

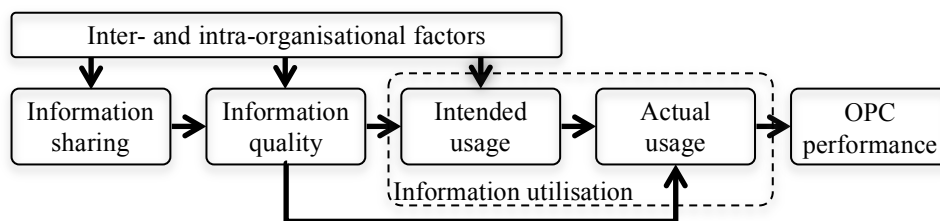


Figure 9 – Information sharing-OPC performance model.

8.2 Contributions

The results of this research have both academic and managerial contributions. Theoretically, the results of the research fills some parts of the gap related to the relationship between information sharing and OPC performance (see Figure 2). First, it clarifies the relationship between IQ and information utilisation, by showing how specific (and groups of) IQ dimensions impact intended and actual information usage. Second, it clarifies the relationship between information

sharing and IQ, by showing how different information sharing factors impact specific IQ dimensions. Third, it identifies a set of inter- and intra-organisational factors of information utilisation and show how these factors, both directly and indirectly through specific IQ dimensions, impact the different levels of information utilisation. Further, as the relationship between information sharing and performance still is far from completely understood, the findings of this research can also be used as guidance of future studies regarding the relationship.

Practically, the results of this research can help customers to design their information sharing processes in order to improve the quality of shared demand-related information. By understanding how intra-organisational factors at a customer indirectly impact information utilisation in a supplier's OPC processes, through IQ, customers can impact the intended and actual usage of shared information at a supplier. Further, the research can help suppliers to design their OPC processes to improve IQ and assure their ability to use shared demand-related information. By understanding how different intra-organisational factors at a supplier directly and indirectly impact information utilisation, suppliers can impact its own intended and actual usage of shared information. Also, the results of the research can help customers and suppliers to develop their dyadic relationships to improve the quality of shared demand-related information and improve the willingness to both share and use the information. By understanding how inter-organisational factors in a dyadic relationship directly and indirectly impact information utilisation in a supplier's OPC processes, dyads can impact the intended and actual usage of shared information at a supplier. Consequently, by being aware of how they impact information utilisation, customers and suppliers can both individually and together impact a supplier's intended and actual usage of shared demand-related information and ultimately impact the supplier's OPC performance.

8.3 Limitations and future research

This research addresses some of the missing gaps identified in previous research regarding the relationship between information sharing and performance, however, the research does not cover the last linkage, between information utilisation and performance. An alternative for future research is thus obviously to extend this research and explore this linkage, and thereby take an additional step towards an understanding of the complex relationship between information sharing and performance. To address this linkage, an empirical survey could be used to test the relationship. Previous research has tested the relationships between information sharing and performance, as well as between IQ and performance, however, no identified study has previously included all linkages in this relationship (i.e. information sharing, IQ, intended usage, actual usage, and performance).

This research is limited to two case studies, with limited amount of case companies. As the context of the case studies highly influence the findings of the research, all potential determinants of information utilisation are not explored in this research. Thus, an alternative for future research is to include more case companies in the same type of case research that is used here, but with other contextual settings. For example, in the case studies included in this

research, no long distance supplier is included, which likely would provide other determinants of information utilisation than the ones presented here. Also, this research is performed within the automotive industry, and an other industry context would also likely provide other determinants of information utilisation. In other industries, e.g. for fast moving consumer goods, point-of-sales data would be more relevant to study, which also are likely to be impacted by other determinants.

This research takes a dyadic supply chain approach, however, demand-related information is shared between more actors in a supply chain than just adjacent ones, especially when point-of-sales data are relevant. An alternative for future research is thus to extend this research to include demand-related information sharing between more than two tiers. Even though case study 1 includes a supply network, the study only focuses on the respective dyads in the network. To address this alternative, further case companies could be included in the research, for example the intermediate customers between the supplier and the OEM in case study 1.

Case study 2 is limited to pragmatic IQ dimensions and the information, as well as inter- and intra-organisational determinants of IQ identified in case study 2 is thus only related to pragmatic IQ. However, in the same way as previous research has not extensively studied determinants of pragmatic IQ dimensions, it has neither studied determinants of inherent IQ dimensions. Still, inherent dimensions should also be relevant for how shared demand-related information is utilised in a supplier's OPC processes. Therefore, an alternative for future research is to extend this research to include also determinants of inherent IQ dimensions. This could be done within the case companies already included in case study 2, but could be even more interesting if it was combined with the inclusion of second and third tier suppliers, as e.g. reliability tends to increase upstream in supply chains.

The research presented in this licentiate thesis is based on theory-building case studies and the concluding model (Figure 9) is thus a result of such research. To be able to generalise the findings from this research, an alternative for future research is to continue with more theory-testing research, for example a survey, to test the different linkages in the model (i.e. the different levels of information utilisation and the relationships between determinants of information utilisation and the different levels). A survey could be used both to generally understand what type of determinants of information utilisation there are for different types of suppliers, but also for customers to be able to understand how different information sharing strategies can be used for different types of suppliers, depending on the supplier's willingness and ability to use shared demand-related information in their OPC processes. This alternative for future research can preferably also be combined with the missing linkage between information utilisation and performance.

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Appendix A – Interview guides

The interviews were performed in Swedish, which explains why the interview guides presented here are in Swedish. All interview questions were not asked in detail during all interviews, and the interview guides presented here is a summary of all interview guides used during the study. Further, the sub-questions related to the presented interview questions are not included here.

Interview guide for case study 1

1. Relationen mellan leverantör och kund

- Hur länge har ni levererat produkter till kunden?
- Hur många olika artiklar levererar ni till kunden?
- Hur levereras produkterna?
- Hur är kunden som kund?
- Hur ser ert avtal ut?
- Är det skillnad på relationen till de olika fabrikerna?
- Hur många av er har direkt kontakt med kunden?
- Vilka kontaktpersoner har ni hos kunden?

2. Delad planeringsinformation

- Vilka typer av information får ni från kunden?
- Genom vilka kanaler skickas informationen?
- Hur ser informationen ut?
- Hur ofta tar ni emot informationen?
- Hur lång planeringsperiod innehåller informationen?
- Frångår ni någonsin det ”normala” informationsutbytet?
- Finns det någon information som ni skulle vilja ha som ni inte har tillgång till?

3. Leveransplaner

- Får ni mer än en leveransplan från respektive kund?
- Anser ni att det finns några brister i leveransplanerna eller sättet de delas på?
- Hur delas leveransplanerna?
- Hur ofta kommer leveransplanerna?
- På vilken nivå får ni informationen (artikel, artikelgrupp mm)?
- Hur lång planeringshorisont innehåller informationen?
- Vilken planeringsperiod innehåller informationen?
- Vilken frystid har informationen?
- Hur mycket litar ni på informationen?
- Hur pålitlig är informationen (mäts den)?

4. Planeringsprocesser

- På vilka olika nivåer har ni planeringsprocesser?
- Hur ser planeringsprocesserna ut?
- Vilka personer är involverade i de olika planeringsprocesserna?
- Hur ser kommunikationen ut mellan de olika planeringsnivåerna?
- Planerar man för mer än den specifika fabriken?
- Finns det några beslutspunkter i de olika processerna?

5. Informationsanvändning

- Vilka personer tar emot information från kunden?
- Vad händer med informationen när den tagits emot?
- Hur tolkas informationen?
- Använder ni all information?
- Vad använder ni informationen till?
- Hur används informationen?
- Görs det några ändringar i informationen innan den används?
- Vilken information används/används inte?
- Varför/varför inte används informationen?

6. Variationer i informationen

- Hur upplevs efterfrågan variera?
- Hur lätt är det att förutspå efterfrågan?
- Hur ofta sker det stora ändringar i efterfrågan?
- Vet ni vad det är som gör att stora variationer i efterfrågan uppstår?
- Vad får variationen i efterfrågan för konsekvenser för er?
- Hur gör ni för att hantera variationerna i efterfrågan?
- Sker informationsdelningsprocessen annorlunda ut när det sker stora variationer i efterfrågan jämfört med normala situationer?

Interview guide for case study 2

Different interview guides were used for the OEM and the suppliers.

Interview guide for the OEM

1. Relationen till leverantörerna

- Hur länge har ni haft dem som leverantörer?
- Vad är skillnaderna mellan de olika leverantörerna?
- Har det skett någon förändring i relationerna?
- Köper ni många olika typer av artiklar från leverantörerna?
- Vilka är kontaktpersoner hos leverantörerna och hos er?
- Har ni någon intern kommunikation kring leverantörerna?
- Vad ställer ni för krav på leverantörerna?
- Ställer de några krav på er?

2. Informationsdelning

- Vad för typer av information skickar ni till leverantörerna?
- Får leverantörerna olika typer av information från er?
- Vilka avdelningar/personer skickar information till leverantörerna?
- Har leverantörerna någon möjlighet att kommentera informationen?

3. Webcast

- Varför började ni använda webcasten?
- Hur tas materialet till webcasten fram?
- Hur förhåller sig webcasten till produktionsprogrammen?
- Vad är det meningen att webcasten ska bidra med?

4. Produktionsprogram

- Vad innehåller produktionsprogrammen?
- Hur förmedlas produktionsprogrammen?
- Hur tas produktionsprogrammen fram?
- Vad är det för skillnad på de fasta och preliminära programmen?
- Hur förhåller sig programinformationen till leveransplanerna?
- Vilken information kring produktionsprogrammen ger ni leverantörerna?
- Har alla era leverantörer tillgång till produktionsprogrammen?
- Skiljer sig produktionsprogrammen något för olika leverantörer?
- Varför började ni dela med er av produktionsprogrammen?
- Vet ni hur leverantörerna använder produktionsprogrammen?
- Hur anser ni att leverantörerna bör använda produktionsprogrammen?
- Följer ni upp produktionsprogram-användningen hos leverantörerna?
- Hur mäts kvaliteten i produktionsprogrammen?
- Finns det någonting som ni ser som skulle kunna göras annorlunda?
- Får ni någon feedback från leverantörerna?

5. Programmöten

- Vilka leverantörer har ni programmöten med?
- Vilka är delaktiga på programmötena?
- Vad tas upp på programmötena?
- När har ni dessa möten?
- Vad blir skillnaden för de leverantörer som har programmöten jämfört med de som inte har?
- Vad händer om en leverantör inte kan klara av produktionsprogrammet?

6. Leveransplaner

- Vad innehåller leveransplanerna?
- Hur förmedlas leveransplanerna till leverantörerna?
- Hur tas leveransplanerna fram?
- Hur förhåller sig leveransplanerna till produktionsprogrammen?
- Vilken information kring leveransplanerna ger ni leverantörerna?
- Har alla era leverantörer tillgång till leveransplanerna?
- Skiljer sig leveransplanerna något för olika leverantörer?
- Varför delar ni med er av leveransplaner till era leverantörer?
- Vet ni hur leverantörerna använder leveransplanerna?
- Hur anser ni att leverantörerna bör använda leveransplanerna?
- Följer ni upp leveransplans-användningen hos leverantörerna?
- Hur mäts kvaliteten i leveransplanerna?
- Finns det någonting som ni ser som skulle kunna göras annorlunda?
- Får ni någon feedback från leverantörerna kring leveransplanerna?

7. Onlinesystemet

- Vad innehåller onlinesystemet?
- Vilken information kring onlinesystemet ger ni leverantörerna?
- Hur förhåller sig onlinesystemet till leveransplanerna?
- Vilka leverantörer har tillgång till onlinesystemet?
- Varför började ni använda er av onlinesystemet?

- Vet ni hur leverantörerna använder onlinesystemet?
- Hur anser ni att leverantörerna bör använda onlinesystemet?
- Följer ni upp onlinesystem-användningen hos leverantören?
- Finns det någonting som ni ser som skulle kunna göras annorlunda?
- Får ni någon feedback från leverantörerna kring onlinesystemet?

Interview guide for the suppliers

1. Företagsinformation

- Historik och nuvarande situation?
- Översiktlig organisationsbeskrivning?

2. Relation till kunden

- Hur länge har kunden varit kund?
- Vad karakteriserar relationen med kunden?
- Hur många och vilka kontaktytor finns mot kunden?
- Vilka produkter levereras till kunden?
- Hur levereras produkterna?
- Vilka krav ställer kunden på leveransservice?

3. Planering

- Vad har man för olika planeringsprocesser?
- Vem utför de olika processerna?
- KPIer och mål för de olika processerna?
- Vad används de olika processerna till?
- Vad använder man för IT support i de olika processerna?
- Hur 'bra' fungerar processerna?

4. Prognosprocessen

- Hur varierar produkternas efterfrågan?
- Hur ser prognosprocessen ut?
- Mäter ni prognosfelet?
- Vilken data används i prognosprocessen?

5. Produktionsplanering

- Hur planeras produktionen?
- Hur ser försörjningskedjan ut?
- Vilka är de kritiska produktions-/försörjningsresurserna?
- Om man producerar mot lager, hur planeras lagren?
- Hur tar man hem material till produktionen?
- Vilken data används i produktionsplaneringen?

6. Operativ styrning

- Vad är syftet med den operativa styrningen?
- Vilka aktörer är involverade?
- Hur ser kontaktytan ut mot kunden?
- Vilken data används för styrningen?

7. Informationsdelning

- Vilken efterfrågerelaterad information erhålls från kunden?
- Hur överförs informationen?
- Vilket format har respektive överförd information?
- Mellan vilka överförs respektive information?
- När och hur frekvent överförs respektive information?
- Upplever ni några problem med datan?

8. Informationsanvändning

- Vilken delad information används i vilken process?
- Vilken delad information används inte?
- Varifrån kommer informationen som man använder?
- Vilket är 'värdet' av att ha tillgång till respektive informationstyp?
- Vilken ytterligare information hade varit bra att ha tillgång till?

9. Hinder/möjliggörare för informationsanvändning

- Vilka hinder/möjliggörare ser ni för informationsanvändningen?
- Vad fungerar bra?
- Vad fungerar mindre bra?

10. Webcast

- Hur får ni tillgång till webcasten?
- Vad gör ni med informationen i webcasten före användning?
- Hur används informationen i webcasten i er organisation/processer?
- Vilka hos er har tillgång till webcasten?
- Upplever ni några problem med webcasten?
- Vad hindrar/möjliggör användningen av datan?

11. Produktionsprogram

- Hur får ni tillgång till det preliminära/fasta produktionsprogrammet?
- Vad skiljer de preliminära produktionsprogrammen från de fasta?
- Vad gör ni med informationen före användning?
- Hur används informationen i produktionsprogrammet?
- Vilka hos er har tillgång till programinformationen?
- Upplever ni några problem med programdatan?
- Vad hindrar/möjliggör användningen av datan?

12. Leveransplaner

- Hur får ni tillgång till leveransplanerna?
- Vilken data innehåller planerna?
- Vad gör ni med datan före användning?
- Hur används datan i er organisation/processer?
- Hur registreras datan i egna system?
- Vilka hos er har tillgång till leveransplanerna?
- Upplever ni några problem med datan?
- Vad hindrar/möjliggör användningen av datan?

13. Onlinesystemet

- Hur ser gränssnittet i onlinesystemet ut?
- Hur ofta uppdateras onlinesystemet?
- Vilka hos er har tillgång till onlinesystemet?
- Vilken data i onlinesystemet används?
- Vad hindrar/möjliggör användning av datan?

14. Telefon/email

- Vem kan ringa/maila?
- Vilka ärenden kan samtalen/mailen handla om?
- Vilken information kan förmedlas via telefon/email?
- Hur används denna information?
- Vad hindrar/möjliggör användning av datan?

15. Informationskvalitet

- Upplever ni några problem med informationen ni får?
- Kan ni uppskatta informationens kvalitet för varje informationstyp?

Appendix B – Survey design

The survey was performed in Swedish, which explains why the survey questions presented here are also in Swedish. The survey design below shows the survey questions used for delivery schedule information. Similar survey questions were used for the other types of information objects as well.

1. Informationen innehåller all nödvändig data

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

2. Alla nödvändiga förklaringar av data finns tillgängliga

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

3. Informationen kan användas direkt, utan omarbetning

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

4. Informationen innehåller få fel, dvs informationen speglar verkligheten väl, på kort sikt (ca 2 veckor)

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

5. Informationen innehåller få fel, dvs informationen speglar verkligheten väl, på medellång sikt (ca 3 månader)

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

6. Informationen innehåller få fel, dvs informationen speglar verkligheten väl, på lång sikt (längre än 6 månader)

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

7. Informationen mottas alltid före den behövs

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

8. Informationen mottas med korrekta intervall, dvs inte för ofta eller för sällan

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

9. Kunden använder samma mått (t.ex. tidsenhet, planeringsobjekt, aggregeringsnivå) som vi använder internt

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

10. Informationen om leveransplanen är enkelt tillgänglig hos kunden när vi behöver den

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

11. Informationen är enkelt tillgänglig internt om den behöver återskapas

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

12. Informationen är trovärdig

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

13. Informationen är alltid relevant för vårt arbete

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

14. Informationen är enkel att förstå

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl

15. Informationen är enkel att omarbete så att den passar våra ändamål

Stämmer inte alls 1 2 3 4 5 6 7 Stämmer väl