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Motivators and barriers for SME suppliers in demand information sharing for forecasting

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1 Abstract

This research seeks to identify motivators and barriers that SME suppliers encounter for demand information sharing. Motivators and barriers in academic literature are only known for NGOs and large multinationals, therefore, this research aims to investigate the motivators and barriers in an SME context.

The methodology consists of a literature review and a case study that includes 16 semi-structured interviews with representatives from suppliers in SMEs in various industries.

The main motivators for demand information sharing identified in this research are disruptions in the supply chain and commodity market, industry-specific motivators, and believed increase in productivity. The main barriers to demand information sharing identified are barriers resulting from the covid pandemic, wait-and-see attitude from suppliers towards customers, and small customer size. Recommendations for future research include a study on the motivators and barriers on demand information sharing that customers of SME supplier's encounter.

A practical recommendation to SME suppliers and buyers includes the need to take initiative in process innovation, since SME suppliers in this research have a wait-and-see attitude towards process innovation. Following, companies that pursue information sharing should aim for low set-up cost and clear outcomes for the information sharing initiative.

2 Acknowledgements

In the autumn of 2021, I began to see the final horizon of my master's. This horizon did not only mark the end of an intensive study at the University of Twente but concluded an era that I look back to with great pleasure and modest pride.

To reach this final horizon, I had the opportunity to conduct my graduation research at Company X. This report is a representation of the results of my research but also breathes the joy and spirit which I felt throughout my entire internship in Aalten.

This leap to the final horizon was not possible without the people in my environment who provided me with the opportunity to perform. First, I want to thank my colleagues from the at Company X. The open culture, guidance, and no-nonsense culture created an atmosphere where I could work and learn with a big smile. Secondly, I want to express my gratitude to Stef, Mike, and Peter for their time and guidance during my internship. Next to the colleagues of Company X, I'm very grateful for the support of my family. Lastly, I would like to thank the supervisors, Frederik, and Carolina from the University of Twente for their effort.

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3.1 Index of abbreviations

ARP	Automatic replenishment program
CPFR	Collaborative forecasting planning and replenishment
CR	Continuous replenishment
MPS	Master production schedule
SKU	Stock keeping unit
S&OP	Sales and operations planning
SME `	Small and medium-sized enterprises

3.2 List of figures

4 Introduction

In the past decades, the rise of globalization, historical events, and disruptive technologies resulted in an increase in the complexity of supply chains (Dolgui & Ivanov, 2020; Peterson et al., 2003). A supply chain consists of all the decision-making units involved, directly or indirectly in fulfilling a customer request or demand (Anupindi et al., 2012, p. 143; Chopra & Meindl, 2007). The key to successful supply chain management is attaining effective integration of the business functions and members of the supply chain in a way that all processes are strategically aligned to achieve fluency in the overall system (Sahin & Robinson, 2002, p. 505).

To keep the supply chain fluent, demand will have to be quantified to support the forecast of future demand. Demand for products is partly based on sales and marketing cycles, therefore consumer demand for product lines must be predicted and identified early and planned into supply and manufacturing. The process of forecasting these predictions and identification of consumer needs is called demand planning (Silvente et al., 2015, p. 487). The goal within demand planning is to strive for a balance between having sufficient inventory needs to meet demand without having too much inventory resulting in a surplus.

"A good demand management process enables a company to be more proactive to anticipated demand, and more reactive to unanticipated demand" (Croxton, Lambert, García-Dastugue, & Rogers, 2002, P.51). Various instruments can be used to plan demand including product portfolio management, trade promotion management, and forecasting. Forecasting is not a planning or decision instrument since its core function is to predict the future as accurately as possible. This prediction does not influence the actual demand and therefore forecast is not considered as a direct demand planning instrument (Wagner, 2002, pp. 125–126). However, since forecasting enables managers to use demand planning instruments, forecasting goes hand in hand with demand planning.

"Forecasting is a common data science that helps organizations with capacity planning, goal setting, and anomaly detection" (Taylor & Letham, 2018, P.37). Different organizations across all sectors of industry must engage in forecasting to effectively allocate resources and goal setting to measure performance. (Aviv, 2001, p. 1332; Taylor & Letham, 2018, p. 41). Different organizations, products, patterns, and time spans require different forecasting methods.

Forecasting is used in various fields within organizations. As it is commonly used in a variety of functions such as supply chain management, customer demand planning, economics, earthquake forecasting, financial forecasting, sales forecasting, product forecasting, technology

forecasting, transport planning, and many others. Especially financial- and operational forecasting are broadly used within organizations and therefore intensively researched by academic researchers. Most of the studies regarding forecasting share a common feature: they all propose a non-existing technique or evaluate the performance of existing ones (Zotteri et al., 2005, p. 481; Zotteri & Kalchschmidt, 2007, p. 77). With hundreds of papers published over the last 50 years, forecasting has received a lot of attention from scientists due to its potential added value in demand planning. (Makridakis, 1996, p. 6). However, to make an actual forecast, it is necessary for supply chain partners to share demand information (Zhao et al., 2002, p. 322).

Sharing demand information for forecasting ultimately leads to delivery performance (Zhou & Benton, 2007, p. 1352). Most of the research in the relation between information sharing, forecasting, and improvements in delivery performance is based on research in the public domain and large fortune 500 companies as Dell and Cisco Systems and does therefore not cover Small and medium-sized enterprises (SMEs) (Willem & Buelens, 2006, pp. 581–584; Zhou & Benton, 2007, p. 1354).

SMEs are particularly interesting since they have a different way of operating, and therefore encounter different challenges than public domains and fortune 500 companies. Daud, (2012, p. 4230) states that SMEs generally need to focus more on knowledge acquisition than larger firms to improve their performance. Next, SMEs, faces more deficiencies in resources and capabilities than large companies (Lu & Beamish, 2001, p. 566). SMEs are characterized by limited customer base, operating in competitive and turbulent markets and have less influence over the markets (Garengo et al., 2005, p. 26).

These fundamental differences could lead to other factors that influence the willingness and capabilities for information sharing than NGOs and large multinationals. Therefore, this research focuses on the motives which suppliers that are qualified as SME might have with demand information sharing for forecasting purposes. Insights in the underlying motives will contribute to the forecasting accuracy, delivery performance and ultimately lead to an improvement in inventory management (A. A. Syntetos et al., 2016, p. 3; Zhou & Benton, 2007, p. 1352). This study, therefore, aims to investigate the characteristics of underlying motives of suppliers for information sharing between SMEs.

There are relevant motives for information sharing identified in the existing literature. These motives are mentioned as motivators and barriers and are presented for NGOs and large multinationals. These motives and are categorized into four categories; organizational motives, technological motives, managerial motives, and financial motives (Bureš, 2003, pp. 58–59; Clark & Hammond, 1997, p. 263; Curry & Moore, 2003, p. 101; Ramon Gil-Garcia et al., 2007a, p. 124;

Tsai, 2002, p. 180; Zhou & Benton, 2007, p. 1354). This research aims to investigate the underexposed and unexplored part of underlying motives in information-sharing in a SME setting, where previous research only included fortune 500 companies and NGOs. The following research questions emerges from this goal.

RQ 1: What are the main motivators for demand information sharing for forecasting purposes in an SME supplier?
RQ2: What are the main barriers for demand information sharing for forecasting purposes in an SME supplier?

This research aims to fill a part of the gap in the literature on information-sharing in a SME context. The perspective of this research is focused on the motivators and barriers of demand information-sharing for supplies. The focus will then lie on demand information-sharing for forecasting purposes in SMEs, which is an up to this point unexplored field of study. Where (Tsai, 2002) researched multiunit organizations, (Zhou & Benton, 2007) researched American manufacturing firms and (Curry & Moore, 2003) focused on healthcare firms, this research focuses on SMEs.

Since demand information sharing for forecasting in SMEs is an unexplored field, this research will contribute to the theoretical knowledge academics and others pursue on the backbone of the European economy. Additionally, this research could help other researchers who study information sharing with the mapped-out motivators and barriers.

The practical implications will help buyers and suppliers in information sharing programs, improving forecast accuracy and therefore a is a contribution to the general efficiency of supply chain members. Suppliers' underlying motives for demand information-sharing influence the willingness of a supplier to cooperate in information exchange. When underlying motives and barriers are understandable for supply chain members, they could contribute to the construction and improvement of forecasts, which lead ultimately to an increase in delivery performance (Zhou & Benton, 2007, p. 1352).

To provide substantiate answers to the research questions, the study has the following structure: first, the physiology of supply chains will be discussed, next different forecasting methods, forecasting performance, and barriers to demand information-sharing. Then the framework of the research will be depicted after which the methodology will be sustained. Within the methodology, a case company will be introduced. After the methodology, the results of the research will be outlined and discussed. This research concludes with the limitations of this study.

5 Theoretical framework

This research focuses on factors that influence demand information sharing. To get a better understanding of demand information sharing for forecasting in supply chains, this research introduces the characteristics of supply chains, forecasting methods and demand-information sharing. In this chapter, an overview of the literature will be given to outline the key concepts such as the physiology of supply chains, forecasting, different forecasting methods, forecast performance and demand information sharing. This results in the creation of a prototype model for motivators and barriers on demand information sharing.

5.1 Physiology of supply chains

Before looking at the forecasting methods, it is important to understand what the goal of the forecast is. When customer demand must be forecasted, the part of the supply chain where the demand forecast is implemented, must be identified, and analyzed. Supply chains could be decomposed into different variables, common variables are identified by Syntetos et al., (2016, p. 2) as length, depth, and time and are referred to as the physiology of supply chains. When the length, depth, and time of the supply chain are identified, they could serve as a model on which forecasts can be built when selecting the right forecasting technique.

5.1.1 Supply chain length

The final customer's demand triggers motion in the entire supply chain. This generates movement throughout the chain, as organizations must respond to the demand. This will cause an upstream generation of request in the chain where every participant responds by placing requests at suppliers. This flow of request constitutes the transmission of information from one participant to another and therefore requires a complimentary information flow throughout the chain. As the length of a supply chain increases, the number of stake-holding organizations in the supply chain increases accordingly. Given this fact, the complexity and therefore the coordination of the entire supply chain increase both as well. The amount of collaboration between stakeholders in the supply chain differs per chain. According to Syntetos et al., (2016, p. 3), there are three given key features that are derived from the supply chain length which have implications on forecasting.

At first, under certain conditions, the variance of demand is amplified as the number of levels of the supply chain increases; increasing demand variability in the supply chain from downstream echelons to upstream echelons (Cachon et al., 2007, p. 463). Some other sources of

demand fluctuation mentioned in the literature are competition, price elasticity, historical events, and disruptive technologies (Aday & Aday, 2020, p. 3; Desmet & Parente, 2010, p. 324; Hobbs, 2020, p. 173; Labandeira et al., 2017, p. 553). The increase in amplification of demand makes it more difficult to forecast accurately as it progresses upstream. This distorted information from one end of the supply chain to the other end can lead to inefficiencies such as excessive inventory investment, lost revenues, ineffective transportation, and missed production schedules (H. L. Lee et al., 1997). This effect is referred to as the bullwhip effect in the literature (Braz et al., 2018, p. 1; Dejonckheere et al., 2003, p. 568; Fransoo & Wouters, 2000, p. 78; Wang & Disney, 2016, p. 691).

Lee referred to the bullwhip effect as the representation of ignorance of the information flow which has contributed to a significant problem where orders to suppliers tend to have a larger variance than sales to the buyer (H. Lee et al., 1997, p. 93; H. L. Lee et al., 1997, p. 546). Furthermore, order batching, promotions, shortage gaming, high inventory levels, and poor customer service rates are typical symptoms of the bullwhip effect (Chopra & Meindl, 2001; Dolgui et al., 2020, p. 1287; Metters, 1997, p. 92). Researchers today indicate that the elimination of this phenomenon plays a vital role for organizations to gain a competitive advantage (Costas et al., 2015, p. 2058). To cope with the bullwhip effect, better information sharing initiatives are broadly mentioned in the literature such as the production-inventory control policy proposed (Dolgui et al., 2020, p. 1286). This policy provides results in favor of information coordination in supply chain management which mitigates the bullwhip effect.

Secondly, demand sharing information between different levels in the supply chain may lead to more accurate forecasting. Ha et al., (2011, p. 568) propose that information sharing benefits a supply chain when the production diseconomy is large, and competition is less intense or at least one retailer's information is less accurate.

Lastly, the practice of collaboration has resulted in some major automatic replenishment programs (ARPs) like Collaborative Planning, Collaborative forecasting planning, and replenishment (CPFR), continuous replenishment (CR) Forecasting and Replenishment, and Vendor Managed Inventory (VMI) systems. These initiatives have led to a change in the way of organizing the supply chain and had important implications over the years for the practice of supply chain forecasting. These systems enable cost-savings due to inventory cost reductions which are generated through these collaborative initiatives (Yao et al., 2007, p. 667). Especially VMI always leads to a higher buyer's profit, wherein in the long run, it is more likely to increase suppliers' profit than in the short-term (Dong & Xu, 2002, pp. 80–82). Following the financial benefits, customer service levels are likely to increase with the implementation of ARPs (Avlijas

et al., 2021, p. 1392). The improvement in customer service levels is often coupled with significant improvements in inventory turnover (Achabal et al., 2000, p. 430). These systems could realize many benefits when they are fully integrated with the supply chain.

Concluding that as the length of the chain increases, the amplifier increases as well, which is well known in the literature as the bullwhip effect. Forecasting could be improved if information sharing between different levels in the supply chain is increased. Automatic replenishment programs improved efficiency, customer service, and therefore profitability. Next to the length of supply chains, the depth of supply chains has an impact on forecasting.

5.1.2 Supply chain depth

Supply chain forecasting involves decision-making at different levels in the supply chain. The depth span reaches from the lowest level; inventory control at individual stock keeping units (SKU) levels to strategic planning at the top aggregate level. Forecasting at different levels requires information at various levels in the supply chain. According to Syntetos et al., (2016, p. 4), a common assumption in most of the operational research and operations management literature is that the information at different levels in the supply chain is available at the required level of decision making. However, such information is in practice accumulated from other data or may be aggregated from other levels in the supply chain. Data collection methods that rely on aggregation and accumulation of data have significant implications for many decision-makers, ranging from operational to strategic. The reconciliation of those forecasts is of great importance and an integral part of Sales and Operations Planning (S&OP) processes, which provides focus, alignment, and synchronization towards the organization. S&OP practices are directly linked to improved forecast accuracy (Kristensen & Jonsson, 2018; Wagner, 2002). According to Syntetos et al., (2016, p. 4), four given key features are derived from the supply chain depth, that have implications on forecasting.

First, supply chains contain thousands of individual SKUs on which decisions are made on various levels. E.g., at the lowest level of inventory control for individual SKUs, at a product family in Master Production Scheduling (MPS), or across all SKUs in aggregate capacity planning. Decisions on different product levels require information originating from different levels within the product hierarchy.

Following, a range of suppliers are involved in each supply chain. Those suppliers may be located geographically near to their clients or as far away as the other side of the world. A similar geographical dispersion applies to the distribution network. Extensive collaboration with specific

suppliers may lead to the development of collaboration strategies, demand information sharing, or the creation of partnerships (Angulo et al., 2004, p. 104). Companies may for example be interested in a group forming with suppliers that are geographically close to each other as a part of a lead time reduction strategy for specific parts of the world.

Next, supply chains typically serve many industrial customers or final consumers that are usually geographically dispersed. Customers and consumers with overlapping specific needs are usually formed into segments (Khajvand & Tarokh, 2011, p. 1328). Segmentation is done to simplify the supply chain, enable more efficient marketing, understand the needs of customers, and ability forecast on an aggregate level (Christy et al., 2018, p. 2). Typically, companies will be interested in the needs of specific customer segments in terms of prioritization of activities.

Lastly, suppliers and customers have in common that they may be geographically dispersed. Even companies themselves may be dispersed over several locations which have multiple implications for forecasting demand and information sharing within the own organization.

Concluding that decisions on different product levels require information originating from different levels within the product hierarchy. Next, geographical location has a big impact on the chain, the same could be said from information orientating from different locations. Companies are interested in segmentation to prioritize activities. Geographical dispersion, even dispersion within the company leads to forecasting implications.

5.1.3 Supply chain time

In addition to the length and depth effects previously discussed, time itself may also lead to hierarchical structures. Syntetos et al., (2016, p. 5) identified five features that are a result of time and have implications on forecasting.

First, the time buckets in which demand data is collected are rarely consistent across the companies in the supply chain. This does not only affect forecasting but is also a reflection of operational differences between the various stakeholders within the supply chain. Some stakeholders schedule per day, while others may schedule per week or even per month. The time buckets reflect the difference in operationalization between organizations and make it difficult to implement a general bucket length for everyone in the supply chain.

Following this, the forecast horizons in a supply chain are even more deviating. Different SKUs have different lead times and therefore different forecast horizons. Following, complex ordering cost structures may need horizons longer than the lead times and financial planning necessitates forecasts for a full financial year.

Next, despite the availability of IT systems and big data companies do not necessarily store long demand histories. Even when there is sufficient data available, it may consist of data that became obsolete due to various reasons. Accruement of data of individual SKUs may help to identify seasonal trends across product ranges, which could otherwise not be identified due to the shortness of data (Thomopoulos, 2015, p. 4).

Following, the frequency of demand; “intermittence is a fundamental concept in supply chain forecasting” (A. A. Syntetos et al., 2016, p. 5). Strongly deviating demand and sporadic demand characteristics are common in many supply chains and many scholars have proposed methods to deal with intermittent supply (Dolgui et al., 2008, p. 2).

Lastly, for intermittent demand forecasting, not all-time buckets are equally vital for exploration purposes. Since restocking is most of the time reactive, i.e., triggered by demand occurrence, the forecasts that are created at the end of the demand occurrence period are the forecasts that determine inventory implications.

5.2 Forecasting

"Forecasting is about predicting future events based on a foreknowledge acquired through a systematic process or intuition" (Soyiri & Reidpath, 2013, P.1).

Stakeholders in the supply chain make decisions on operational, managerial, and strategic levels based on demand forecasts. Forecast of demand plays a vital role in shaping decisions that are made by purchasing, marketing, manufacturing, staffing, financial planning, and logistics (Fildes et al., 2006). Forecasting is vital for decision-making at all levels, all departments, and therefore important for all the stakeholders from the organization. These stakeholders do all have different interests and goals for their forecast. As a result, there exist no identical forecasts, even the methods for developing these forecasts are different. Also, there is not a perfect forecast available in the academic literature that can be implemented in all situations since different situations require custom solutions.

Next to the effects of the physiology of the supply chain on a forecast, the methodology on forecasting also creates an effect on the forecast. Within the literature there are three main constructs of forecasting; judgmental forecasting, statistical forecasting, and integrated statistical forecasting (Figure 1) (Lawrence & O'Connor, 1992, p. 19; A. A. Syntetos et al., 2016, p. 29). Where statistical forecasting is used in short-term forecasting, judgmental forecasting is used in forecasting with a large timespan.

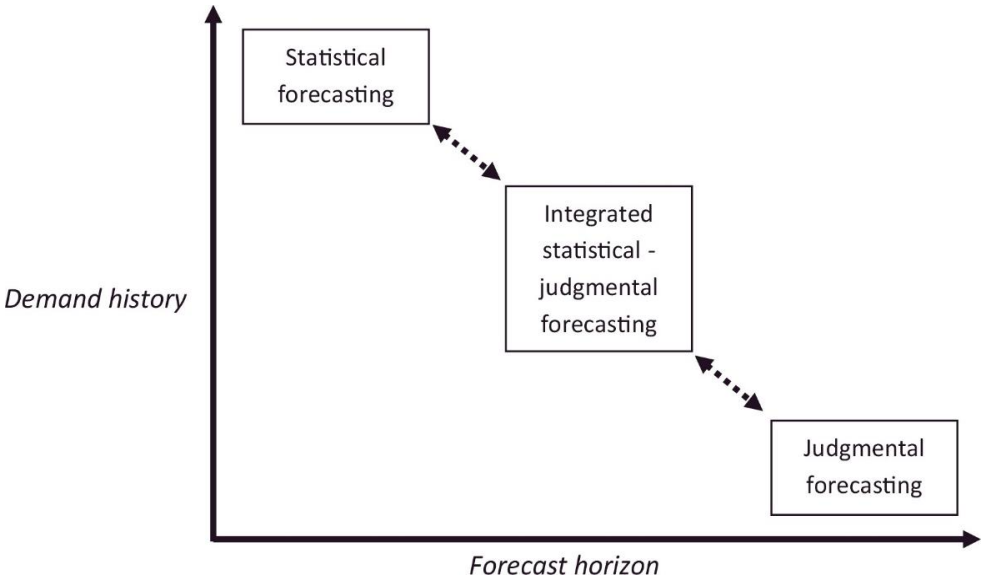

Figure 1; Statistical, integrated statistical and judgmental forecasting. (Syntetos et al., 2016, p.29

5.2.1 Forecasting horizons; short, middle, and long term

Back in the 90s, Judgmental forecasting was the most used forecasting technique (Harvey & Bolger, 1996, p. 122; O'Connor et al., 1993, pp. 164–166). This forecasting technique creates forecasts with the input of "experts" within the organization suitable for long-term timespan with low demand history (A. A. Syntetos et al., 2016, p. 28) A long period includes forecasts which cover a period extending 2 years. Long-term forecasting is used in strategic planning. Strategic planning should include market opportunities, environmental factors, and internal resources (Hyndman & Athanasopoulos, 2014).

Judgmental forecasting showed significant improvement in forecast accuracy back in the 1990s. Judgmental forecasting is used in three general settings: first, if there is no available data with a result that statistical methods are not applicable and therefore judgmental forecasting is the only feasible method. Following that there is data available from which statistical forecasts are generated and these forecasts are then adjusted using judgment. Lastly when there is data available and both statistical and judgmental forecasts are generated separately and, in the end, combined. The combination of statistical and judgmental forecasting is referred to as integrated statistical forecasting (Fildes & Goodwin, 2007, p. 582).

Next to judgmental forecasting, integrated statistical forecasting is suitable for medium timespan with medium demand history. A medium period in operational forecasting includes forecasts which cover a period ranging from three months to two years. Forecasts with a medium period are needed for determining future resource requirements such as purchasing commodities, recruiting staff, and assets investments (Hyndman & Athanasopoulos, 2014). Forecasting as well as the likely change in demand dynamics over the forecasting horizon that calls for human input rather than reliance on a statistical model (A. A. Syntetos et al., 2016, p. 29). Furthermore, it makes sense that an integrated approach would be more useful for medium forecast horizons where useful information which originates from outside the statistical model may be brought in by managers into the forecasting by adjusting the statistical forecasts.

Statistical forecasting should usually be the preferred approach for very short time horizons (A. A. Syntetos et al., 2016, p. 28). A short period in operational forecasting includes forecasts which cover a period up to three months from the present. Short-term forecasts could be useful for applications such as scheduling personnel, production, and transportation. As part of the scheduling process, demand forecasting is often required (Hyndman & Athanasopoulos, 2014). Statistical forecasting could for example be used in a supermarket that requires forecasts for every 12 hours to keep all the different SKUs replenished, where the forecast could not solely

be built on judgmental approaches due to the enormous product diversity. If the timespan of the forecast increases, the unexpected changes (e.g., demand-, product changes) will also increase. "In contrast to short term forecasting, it is in the nature of the decisions involved in long term forecasting as the likely change in demand dynamics over the forecasting horizons that calls for human input rather than reliance on a statistical model" (A. A. Syntetos et al., 2016, p. 29)

5.2.2 Forecasting with data from different levels: Hierarchical forecasting

Generate forecasts from information gathered in different levels is called hierarchical forecasting. To forecast at different levels in production or even at different levels in supply chains, hierarchical forecasting is commonly used. There are several applications of hierarchical forecasting distinguished in the literature. At first, temporal aggregation is the process of aggregating demands from higher frequency to lower-frequency time-buckets (A. Syntetos, 2014, pp. 8–9). For example, aggregate hourly data to daily data and weekly to monthly data. Temporal aggregation is known to reduce demand volatility and could be seen as one of the most important areas in forecasting (Rossana & Seater, 1995, p. 451; Rostami-Tabar et al., 2013, p. 480, 2014, p. 489, 2015, p. 297).

Hierarchical aggregation of products occurs when the aggregation of SKUs takes place across different SKUs in a given period (Silvestrini & Veredas, 2008, p. 464). SKUs natural group in hierarchies with individual products at the bottom line, followed by several intermediary levels which consist of product groups, categories, and modular products. The top level of the hierarchy consists of total sales. To provide demand forecasts at various levels and for functional disciplines within organizations, family-based forecasting is increasingly used. Within the literature, family-based product forecasting is referred to as hierarchical forecasting. Hierarchical forecasting is based on a strategy of aggregating items into families. Hierarchical forecasting can provide accurate forecasts for specific items and their respective families (G. Fliedner, 2001, p. 6). Muir, (1979) identified that hierarchical forecasting leads to improvement in forecast accuracy. Muir, (1979) argues that there is a stabilizing effect from combining data from two or more homogenous items, this was later confirmed by Villegas & Pedregal, (2018, p. 32).

Within the literature, there are two main strategies for determining aggregate forecasts: the direct strategy and a derived strategy (Theil, 1954). After 1954 these strategies were further researched and developed to "bottom-up" and "top-down" hierarchical forecasting (Kohn, 1982, p. 340; Lütkepohl, 1984, p. 201; Shlifer & Wolff, 1979, pp. 508–510; Tiao & Guttman, 1980, p. 219; Weatherby, 1984; Wei & Abraham, 1981).

5.2.3 Bottom-up and top-down forecasting

In the bottom-up approach, forecasts for the most disaggregated level are first generated. Next, they are aggregated to obtain forecasts for higher levels in the hierarchy (Dunn, Williams & Dechaine, 1976) (Appendix A). This has the advantage that no information is being lost due to aggregation (Gordon, Morris & Dangerfield, 1997; Widiarta, Viswanathan & Piplani, 2009). On the other hand, data at the bottom level can potentially be turbulent or very noisy and therefore challenging to forecast (Athanasopoulos, Gamakumara, Panagiotelis, Hyndman & Affan, 2019). When bottom-level data is identified and formed into an aggregate group, it is relatively less volatile than its components.

In contrast to the bottom-up approach, the top-down approach generates the forecast for the most aggregate level and then disaggregates this down the hierarchy (Appendix B). Within this strategy, the forecast is based on the history of the demand at the aggregate family level. In general, the top-down approach seems to produce reliable forecasts for the aggregate levels. A drawback of this approach is the loss of information due to aggregation since the characteristics of lower-level series cannot be captured. To deal with this a new top-down approach was tested which is based on proportions of forecast rather than historical data. The study showed that this method outperformed the traditional top-down approach (Athanasopoulos et al., 2009). One limitation that still exists overall top-down approaches is the bias that is implemented in all top-down forecasts, even when top-level is not biased. This is due to the domination of the information on the top level, which influences all forecasts which are aggregated from this top level.

The middle-out approach is a compromise between the bottom-up and top-down approaches. It entails generating forecasts at a selected middle-level. For series above the middle-level, the forecasts are generated using the bottom-up approach by aggregating the middle-level forecast. Following, for the series below the middle-level, forecasts are generated using a top-down approach by disaggregating the middle-level forecast (Athanasopoulos et al., 2009)(Appendix C). A schematic overview of aggregated forecasting methods is presented in Figure 2.

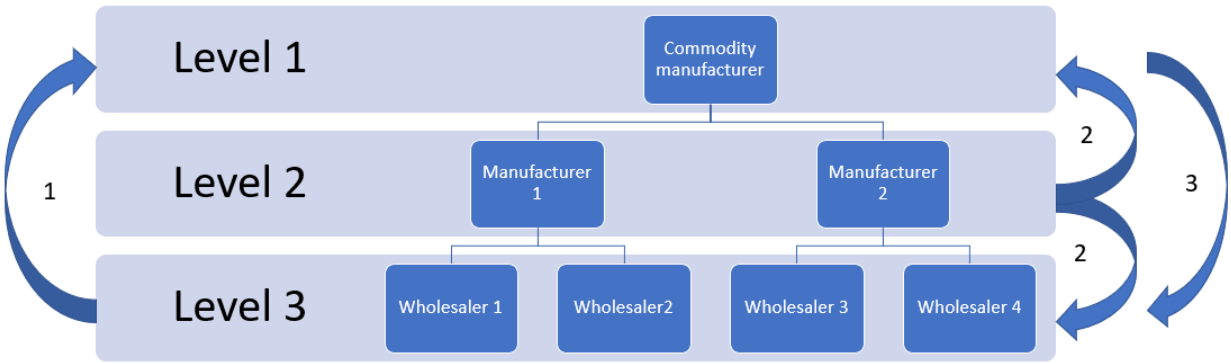

Figure 2: Bottom up (1), middle out (2) and top down (3) forecasting

5.3 Forecast performance

Lots of researchers in the past focused on comparing the performance of bottom-up and top-down approaches, with some preferring top-down (G. Fliedner, 1999, p. 8; Grunfeld & Griliches, 1960, p. 1), while others favor bottom-up (Dangerfield & Morris, 1992, p. 2; Pesaran et al., 1989, p. 861). A third group found neither method to be superior (E. B. Fliedner & Mabert, 1992; Weatherby, 1984, p. 1143). Later, researchers studied the relative effectiveness of top-down and bottom-up strategies for forecasting the aggregate demand in a production planning framework (Widiarta et al., 2009). Their simulation study found that the difference in performance between the two strategies is relatively insignificant when the correlation between the components is small.

A drawback of all hierarchical forecasting models is the dominance of the level at which the initial forecast is generated, since it will ignore information that is gathered at other levels in the hierarchy (Athanasopoulos et al., 2017, pp. 3–4). To counter this significant limitation, it is vital to gain and process information at different aggregation levels (Athanasopoulos et al., 2009). In a supply chain, this means that data must be collected at different levels in the chain, which explicitly means that demand-information must be exchanged between different stakeholders in the chain. Therefore, Fliedner, (1999) introduced a regression-based approach that combines forecasts from all levels of the chain and transforms them into reconciled forecasts. Wickramasuriya, Athanasopoulos, & Hyndman, (2015) further developed this approach resulting in significant forecast improvements over the traditional approaches in the cross-sectional setting.

Pennings & van Dalen, (2017) introduced an integrated hierarchical forecasting approach to forecasting the demand at different hierarchical levels. Their approach succeeded the traditional bottom-up and top-down approaches from Fliedner, (1999) by generating forecasts at all of the levels in the hierarchy, which in a practical setting would mean that forecast need to be generated at all levels in the supply chain. Following, their approach includes all available information, in comparison with Fliedner, who used selected parts of data. The integrated approach extends beyond the application of forecasting for manufacturers. The advantages of this approach are that outliers, missing values, and extra information such as promotions can be easily and flexibly included in the forecast (Durbin & Koopman, 2012). Riedel & Gabrys, (2009) considered the concept of hierarchical forecasting by hierarchically considering grouping time series. They combined the forecast obtained at different hierarchical levels. By performing different aggregations across the supply chain and combining the forecast, they obtained an improvement in forecasting performance.

A conclusion drawn by many researchers who studied hierarchical forecasting over the years is that the structural difference in the performance of top-down and bottom-up strategies is not significant. A common problem is the dominance of the level used to forecast other levels. This can partly be solved by including information from multiple layers and combining them in the forecast.

5.4 Demand Information sharing

To create an actual forecast, supply chain members have to exchange information about the demand at some point. Information regarding the future demand is called demand information. Demand information sharing between supply chain partners is one of the major means to improve the performance of the supply chain (Chen & Lee, 2009, p. 781). By revealing sensitive demand information to upstream supply chain partners, a retailer may lose some advantage in the future. Therefore, whether information will be shared depends on the potential value for the supply chain (Ha et al., 2011, p. 566).

Information sharing in general can be a barrier for some companies since companies are reluctant to share information with supply chain partners due to the sensitivity of data. To deal with resistance, companies need to be made aware of the benefits that information sharing systems can add to a partnership (Matos Marques Simoes & Esposito, 2014, pp. 6–8; Waddell & Sohal, 1998; Zhao et al., 2002).

5.4.1 Factors for demand information sharing

There are two types of factors distinguished in the current literature: motivators and barriers. Additionally, some factors could serve as both a motivator and barrier. Typical barriers to demand information sharing include confidentiality of the information, incentive issues, reliability and cost of information technology, anti-trust regulations, timelessness and accuracy of the shared information, and the development of capabilities, which allows companies to utilize the information (Lotfi, Mukhtar, Sahran, & Zadeh, 2013, P.302).

Within the literature, Bureš, (2003) & Tsai, (2002) describe factors directly related to organizational characteristics, these factors include centralization, hierarchy, bureaucracy, and formalization. Bureš, (2003) relates these factors to culture, where Tsai, (2002) and Willem & Buelens, (2006) define these factors as organizational factors. Next, Bureš, (2003) & Tsai, (2002) describe barriers directly related to firms' technological capabilities as an inconsistency in the technological capabilities between buyer and seller, which are supported by other researchers (Caudle et al., 1991a; Hoffman & Mehra, 2000; Stewart et al., 2004).

To identify possible underlying motives for information sharing, this research takes the following categories of factors related to information sharing in the literature into consideration; managerial-, financial-, technological- and organizational arguments. All factors known in current information sharing literature fit into one of these categories (Bureš, 2003, pp. 58–59; Clark & Hammond, 1997, p. 263; Curry & Moore, 2003, p. 101; Ramon Gil-Garcia et al., 2007a, p. 124; Tsai, 2002, p. 180; Zhou & Benton, 2007, p. 1254).

5.4.2 Organizational factors

Organizational factors represent factors that are categorized as those that originated from attitudes within organizations towards information sharing. These factors are due to the organizational structure and the groups involved in information sharing. Information sharing initiatives require drastic changes in processes and behavior of individuals as well as organizations. Tsai, (2002, p. 181) mentions that centralized and hierarchical structures within organizations have significant negative impact on information sharing. Willem & Buelens, (2006, p. 583) mentioned that horizontal departmentalization in bureaucracy could imply barriers to information sharing. Ramon Gil-Garcia, Chengalur-Smith, & Duchessi, (2007, p. 124) found that the complexity of information sharing gradually increases from the organizational level to the inter-organizational level. Khurana, Mishra, & Singh, (2010) found that small to medium organizations feel that information sharing is suited only to big companies Bureš, (2003, pp.58-59) found that organizations with high levels of bureaucracy and strict administrative control lack information sharing spirit in supply chains. Several researchers found that formal rules, guidelines, procedures, and regulations could be barriers to information sharing (Milward, 1982; Tsai, 2002, p. 180; Willem & Buelens, 2006, p. 584).

These studies also concluded that less formalized organization structures and voluntary information-sharing arrangements can lead to flexible and open interaction among employees which promotes an information-sharing environment. Caudle, Gorr, & Newcomer, (1991, p. 174) concluded that without top management approval and support, an innovation in information-sharing is less likely to be successfully implemented. Top management support has been consistently found to be a factor with high importance in the adaptation and implementation of information systems. Organizational factors studied in this research are stated in table 1.

Table 1: Organizational factors for information sharing

Organizational factor	**Relationship between the organizational factor and information sharing**	**Source**
Centralization	"Centralization has a significant negative effect on information sharing"	(Tsai, 2002)
Hierarchy	"Reducing hierarchical constraints is a direction that managers may pursue to encourage knowledge flows and enhance capabilities of their organizations"	(Tsai, 2002; Willem & Buelens, 2006)
Bureaucracy	"Departmentalization in bureaucracy could imply barriers to information sharing"	(Bureš, 2003; Willem & Buelens, 2006)
Organization size	"Small to medium organizations feel that information sharing is only suited for big companies"	(Khurana et al., 2010)
Formalization	"Formalized organization structures and voluntary information sharing arrangements can lead to flexible and open interaction among employees which promotes an information-sharing environment"	(Milward, 1982; Tsai, 2002; Willem & Buelens, 2006)
Management support	"Without top management approval and support, an innovation in information-sharing is less likely to be successfully implemented"	(Caudle et al., 1991b)

5.4.3 Technological factors

The development of information technology over the last decades increased the ease of information sharing and provided methods to share and integrate information. Furthermore, information technologies started to play a central role in supply chain management in the 1970s; they enable organizations to collect, analyze and disseminate information among stakeholders in the supply chains (Sprague & Watson, 1979, p. 60). When there is a lack of consistent systems used by various stakeholders in the supply chain, there could be challenges in integrating standards, definitions as well as programming languages (Hoffman & Mehra, 2000, p. 368).

Next to inconsistency in the systems used, inconsistencies in the level of technological capabilities of supply chain stakeholders may be an important barrier to implementing inter-organizational information systems. The lack of competent professionals to maintain levels of knowledge and expertise due to the fast pace of rapidly and radically changing technologies, as well as disruptive technological developments in information sharing systems are major barriers in information sharing technologies (Holden et al., 2003, p. 8).

The complexity of technology is a major factor that affects the adoption of information charging systems (Caudle et al., 1991b, p. 173). Following, learning to use those IT systems in a supply chain is proven to take both time and energy according to Goodman & Darr, (1998, p. 423). If the technology is simple to use, it is easier to adopt. Next to an easy adoption, simple to use technology influences the functionality, reliability, and accessibility of users who use the technology for information sharing (Monczka & Morgan, 1997, p. 70). An inefficient and non-user-friendly system would harm information sharing causing less information and knowledge to be shared.

Misinterpretation or misuse of shared information is regarded as a barrier of information sharing by Kamal & Themistocleous, (2006, pp. 5-6). The information shared with stakeholders in the supply chain may be intentionally or unintentionally shared with competitors. Furthermore, a low level of technical knowledge among stakeholders is treated as a barrier to information sharing (Stewart et al., 2004). Organizations with internal information sharing technologies are more likely to participate in information sharing initiatives in the supply chain. Following, lack of commitment to the organization and a lack of employee involvement is considered as a major social barrier for information sharing in the supply chain (Songer et al., 2001, p. 11). Technological factors included in this research are stated in table 2.

Table 2: Technological factors for information sharing

Technological factor	Relationship between Technological factor and information sharing	Source
System inconsistency	"A lack in system consistency over supply chain members could lead to challenges in information sharing"	(Hoffman & Mehra, 2000; Sprague & Watson, 1979)
Technological capabilities	"The lack of competent professionals to maintain levels of knowledge and expertise due to changing technologies is a major barrier"	(Caudle et al., 1991b; Hoffman & Mehra, 2000; Holden et al., 2003; Kamal & Themistocleous, 2006; Stewart et al., 2004)
Technological capabilities inconsistency	"Inconsistencies in the level of technological capabilities of supply chain stakeholders is a barrier to implement information systems"	(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Disruptive technologies	"Disruptive technological developments in information sharing systems are major barriers in information sharing technologies"	(Bureš, 2003; Willem & Buelens, 2006)
Technological complexity	"The complexity of a technology is a major factor that affects the adoption of information charging systems"	(Khurana et al., 2010; Monczka & Morgan, 1997)
IT training	"Learning to use those IT systems in a supply chain is proven to take both time and energy"	(Milward, 1982; Tsai, 2002; Willem & Buelens, 2006)
User-friendliness	"Non-user-friendly system would harm information sharing causing less information and knowledge to be shared"	(Caudle et al., 1991b; Monczka & Morgan, 1997)
Misinterpretation of information	"Misinterpretation of shared information is regarded as a barrier of information sharing"	(Kamal & Themistocleous, 2006)

Internal information sharing systems	"Organizations with internal information sharing technologies are more likely to participate in information sharing initiatives in the supply chain"	(Bureš, 2003; Stewart et al., 2004)

5.4.4 Managerial factors

When managers dealing with supply chains do not recognize the potential of information sharing or do not have confidence in information sharing systems managerial barriers occur (Marsh & Flanagan, 2000, p. 426). Customs, working methods, and organizations may encounter large differences between stakeholders in the supply chain, which may become barriers in information sharing in the supply chain (Curry & Moore, 2003, p. 101). A lack of leadership and managerial direction for information sharing initiatives complicates the implementation of information sharing (Zipf, 2000, p. 35).

To achieve an information-sharing culture, the support of senior management is required (Curry & Moore, 2003, p. 98). The emphasis of top management should hereby be on guiding in contrast to imposing hierarchical top-down leadership. Another managerial barrier to information sharing is a lack of training, experience, and low literacy at the management (Weippert et al., 2002, p. 105). Next to lacking knowledge, Fawcett, Magnan, & McCarter, (2008) found that lack of trust makes it difficult to share sensitive information since managers feel that their information may be misused by other stakeholders in the supply chain.

Furthermore, past experiences of opportunistic behaviors of supply chain stakeholders create hesitation to share information (Fawcett et al., 2008; McCarter & Northcraft, 2007). An overview of managerial factors included in this research can be found in table 3.

Table 3: Managerial factors for information sharing

Managerial factor	Relationship between the managerial factor and information sharing	Source
Management recognition	"Managers dealing with supply chains do not recognize the potential of information sharing or do not have confidence in information sharing systems managerial barriers occur"	(Marsh & Flanagan, 2000)
Managerial direction	"A lack of leadership and managerial direction for information sharing initiatives complicate the implementation of information sharing"	(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Managerial support	"The support of top management is needed to achieve an information-sharing culture"	(Curry & Moore, 2003; Zipf, 2000)
Cultural inconsistency	"Customs, working methods and organization may encounter large differences between stakeholders in the supply chain, which may become barriers in information sharing in the supply chain"	(Curry & Moore, 2003)
Managerial competence	"A lack of training, experience and low literacy at the management is a barrier on information sharing"	(Weippert et al., 2002)
Managerial trust	"A lack of trust makes it difficult to share sensitive information since managers feel that their information may be misused by other stakeholders in the supply chain."	(Fawcett et al., 2008)
Opportunistic behavior	"Experiences of opportunistic behaviors of supply chain stakeholders create hesitation to share information"	(Fawcett et al., 2008; Kamal & Themistocleous, 2006; McCarter & Northcraft, 2007)

5.4.5 Financial factors

Financial constraints are considered a key barrier to information sharing in supply chains. The cost associated with the implementation and maintenance of an information system is considered a prime challenge for information sharing initiatives. The redesigning of internal organizational and technical processes requires large amounts of financial resources. Furthermore, the change in traditional and fundamental product distribution channels, customer service procedures, and education, which are needed to achieve efficient information sharing in the supply chain leads to additional costs (Motwani et al., 2000, p. 322).

Lee & Whang, (2000, p. 14) report that the lack of resources limits organizations to adopt information sharing systems. Not only the lack of resources but also the unwillingness to invest in sophisticated infrastructure is a barrier, Clark and Hammond, (1997, p. 263) concluded that especially retailers show unwillingness to invest in infrastructure for information sharing for ordering and business processing. Financial factors included in this research are stated in table 4.

Table 4: Financial factors for information sharing

Financial factor	**Relationship between the financial factor and information sharing**	**Source**
Cost of change	"Change in product distribution channels, customer service procedures and education, which are needed to achieve efficient information sharing in the supply chain leads to additional costs"	(Motwani et al., 2000)
Lack of resources	"The lack of resources limit organizations to adopt information sharing systems"	(Clark & Hammond, 1997; H. L. Lee & Whang, 2000)
Unwillingness to invest	"The unwillingness to invest in sophisticated infrastructure is a barrier for information sharing"	(Clark & Hammond, 1997)
Company size	"Small to medium organizations feel that information sharing is a financial burden that will not bring returns on their investment"	(Khurana et al., 2010)

5.5 Synthesis

In the theoretical review, several factors that could influence demand-information sharing for forecasting were identified and discussed. Based on the review, these factors will be used as variables to construct a research model, and to propose hypothesis that examines the underlying relationships between these variables and organizational intention for demand-information sharing for forecasting purposes. Within this section, the key elements of the model will be briefly discussed, as the variables included in the model are already discussed in depth in the previous sections. Following the key elements, the derived research model will be shown to get a clear overview.

The first group of factors consists of four factors that influence the demand-information sharing for forecasting are the organizational factors. From the literature, it became evident that organizational factors affect information sharing initiatives. Small-sized (Khurana et al., 2010)), centralized (Tsai, 2002) organizations that have a strong hierarchy (Tsai, 2002; Willem & Buelens, 2006) without organizational support (Caudle et al., 1991) are less likely to participate in information-sharing initiatives. Thus, diminishing their potential demand-information exchange chances to develop accurate forecasts.

The second group that influences the demand-information sharing for forecasting are the technological factors. Research has identified several technological factors for demand-information sharing as system inconsistency within the supply chain (Hoffman & Mehra, 2000; Sprague & Watson, 1979), which will not support fluent information sharing between companies. Following technical capabilities (Caudle et al., 1991; Hoffman & Mehra, 2000; Holden et al., 2003; Kamal & Themistocleous, 2006; Stewart et al., 2004), complexity (Khurana et al., 2010; Monczka & Morgan, 1997), and misinterpretation of information (Kamal & Themistocleous, 2006).

Thirdly, the following group that affects the demand-information sharing for forecasting are identified by the literature as managerial factors. Managerial factors include recognizing the need by management (Marsh & Flanagan, 2000), cultural differences between companies (Curry & Moore, 2003; Zipf, 2000), trust (Fawcett et al., 2008), and a lack of competence by the management (Weippert et al., 2002).

The last group consists of financial factors that affect the demand-information sharing for forecasting. Potential financial factors to demand-information sharing include the cost related to the change of systems and training (Motwani et al., 2000). Following a lack of available resources in the organization (Clark & Hammond, 1997; Lee & Whang, 2000) and unwillingness to invest

(Clark & Hammond, 1997). Lastly, a limited company size with therefore limited funds is identified as a barrier to information sharing (Khurana et al., 2010).

Zhou & Benton, (2007) state that demand-information sharing has a strong influence on delivery performance. Bourland et al., (1996) demonstrate that sharing timely demand information may result in delivery performance. Gurin, (2000) states that big firms like Ford and UPS leverage information sharing to improve Ford's delivery performance.

This model gives the expectation of the working of several factors on information sharing for forecasting purposes. Lotfi et al., (2013) call for empirical studies of exploring what underlying principles of information sharing for forecasting purposes are. The goal of this research is to address this gap and explore applicability in SMEs. Since current literature about demand information sharing for forecasting does not include factors for demand information sharing for forecasting purposes of SMEs in one research, this model will answer the research questions:

What are the main motivators for demand information sharing for forecasting purposes in a SME supplier? And RQ2: What are the main barriers for demand information sharing for forecasting purposes in a SME supplier? The model consists of factors that are mentioned most in the literature. The factors categorized into organizational-, technical- managerial- and financial factors. Factors affecting suppliers are indicated with (S), factors affecting buyers are indicated with (B), factors affecting the relationship between buyers and suppliers are indicated with (BS). The model is visualized in Figure 3.

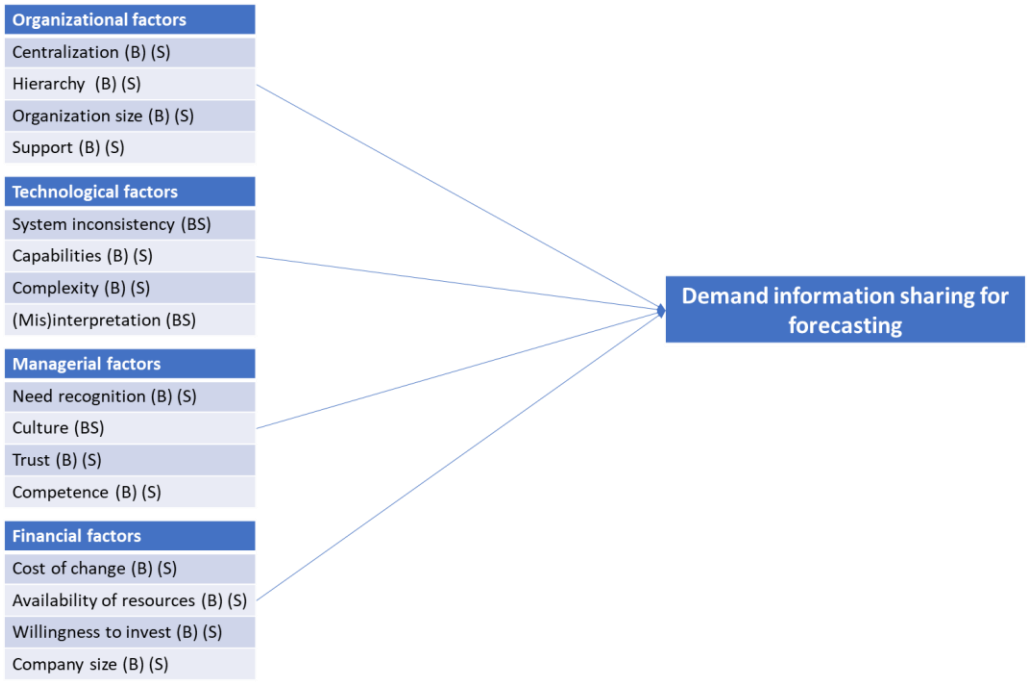

Figure 3 Research Model: Factors that influence the willingness and capability of SMEs in demand information sharing for forecasting.

6 Methodology

This chapter describes the setup of the research process. This section includes an explanation of the selected method, data collection, and analysis. Furthermore, it introduces the case company where the data collection took place to answer the central research question.

6.1 Design of the study

The literature review on information sharing, forecasting, and hierarchical forecasting formed the basis of this research. To investigate the possible factors on suppliers' willingness and capabilities to participate in information sharing initiatives, data has to be collected from a practical setting, since there is no valid and reliable existing data available.

Therefore, this research aims to identify suppliers' barriers in demand information sharing for forecasting in a practical context. To be able to test this in a practical setting, a case study will be used. This is because a case study enables an in-depth analysis of complex, real-life phenomena which could result in new insights (Eisenhardt & Graebner, 2007, p. 28). Since the article of Eisenhardt, (1989), the development and interest in case-based studies increased over the years.

Furthermore, this research aims to get insights into underlying motives for demand information sharing for forecasting, which requires insight in levels of understandings', perceptions, and feelings of participants which cannot simply be acquired by taking snapshots of a phenomenon. Taking simple snapshots does not include in-depth testing and could overlook test-takers' and testers' experiences, attitudes, and feelings, as well as understanding and misinterpreting test-takers' answers. Rahman, (2016, p. 108) describes the ability to catch the aforementioned principles as one of the key strengths of qualitative research methods.

Disadvantages of a case study include those qualitative studies could lack trustworthiness due to small sample sizes. Due to small sample sizes and the absence of variables with statistical testing, the relations found may not be generalizable over the population (Rahman, 2016, p. 108).

To ensure the quality of a case study, Da Mota Pedrosa, Näslund, & Jasmand, (2012, p. 290-292) suggested that case research should not only be evaluated on validity and reliability but include transparency for the audience in the entire process. When conducting a case study, three criteria must be fulfilled in general; transferability, truth-value, and traceability (da Mota Pedrosa et al., 2012). At first, Transferability refers to the generalizability of the study; the study's result should be able to be analytically generalized (Ketokivi & Choi, 2014, pp. 233–234; Yin, 2013). Information about units of analysis, case selection, and the number of cases also belong to the

transferability. Next, truth values are established by information about the coding process, comparisons, iteration, and refutation. Lastly, traceability includes openness about research protocols, data collection guidelines, participant selection, and the number of participants within case studies.

6.1.1 Introduction case company

Not available in this version

6.2 Sampling strategy

To explore the underlying motives for information sharing, an adequate number of interviews need to be investigated. Galvin (2015, p. 5) states that data saturation in qualitative studies is achieved after 12 interviews. For achieving data saturation, 20 suppliers were initially selected in collaboration with Company x's purchasing department. The specific suppliers were selected to participate in this to get a good representation of the supply base. The representatives from the suppliers were selected on availability and are ranked by industry segment in Table 5.

Table 5: Respondent's profile

Respondent	***Job title***	***Years of job experience***	***Segment***	***Company size (employees)***
R1	Sales engineer	16-20	Drives & Controls	1000-3000
R2	Manager	6-10	Drives & Controls	5000+
R3	Customer service manager	1-5	Drives & Controls	251-500
R4	Hub Manager	6-10	Drives & Controls	101-150
R5	Key account manager	6-10	Plastics	101-150
R6	Supply chain Planner	1-6	Plastics	101-150
R7	Sales manager	1-5	Plastics	25-50
R8	Sales engineer	6-10	Plastics	<25
R9	Sales manager	6-10	Metal	25-50
R10	Operational director	11-15	Metal	25-50
R11	Key account manager	1-5	Metal	25-50
R12	Sales manager	6-10	Metal	51-100
R13	Key account manager	6-10	Metal	1000-3000
R14	Senior account manager	11-15	Metal	25-50
R15	Key account manager	1-5	Metal	51-100
R16	Operational director	1-5	Systems	101-150

6.3 Interview procedure and protocol

To get insights in the underlying motives and barriers for demand information sharing for forecasting, which require insight in levels of understandings', perceptions, and feelings of participants semi-structured interviews will be conducted. The interviews will be semi-structured, since that allows in-depth interviewing with a small number of respondents. Furthermore, semi-structured interviews allow flexibility for clarification of interesting and relevant issues raised by the respondents. It can also help respondents recall information for questions involving memory (Louise Barriball & While, 1994).

A downside of semi-structured interviews is the potential of each step in the research process has the potential to influence research output. Therefore, it is important to avoid as much error as possible during all phases of the research to increase the credibility of the results (Brink, 1989). To reduce the error as much as possible, the interview guide was only used as a guideline. This guideline was solely used keep the interviewee on topic and allow more in-depth information exchange. It also provides a certain room for the interviewee to answer on matters which might be sensitive to the company instead of ignoring the questions asked (Louise Barriball & While, 1994).

The interview guide consists of three parts: the opening, the middle, and the conclusion. Within the opening, the goal of the research is explained, as well as the ethical considerations. The questions in the middle part are directly linked to the factors in the research model above, e.g. the technological section in the interview guide (Appendix D) refers to technological factors in Table 2.

In the conclusion, interviewees will be asked if they have any remarks about the interview, the research, or the procedures regarding the outcomes. Furthermore, interviewees are asked if they would like to receive updates about the research, the interview guide can be found in Appendix D. The guide was verified by the purchasing department of the Company X on completeness, suitability, and duration in a trial interview. The interviews were all conducted via Microsoft Teams.

6.4 Analysis of data

The interviews are at the request of the interviewees conducted in Dutch, as the interviewees will be able to express themselves better in their native language. The interviews are interpreted by the researcher in Dutch and direct quotes in the research are translated into English. A separate researcher translated these specific quotes back to Dutch and compares the outcomes to the original quotes. This was done to eliminate errors in the translation process. The length of the interviews was approximately 30 to 45 minutes per interview.

After the data was collected, it had to be transcribed and analysed. The input derived from the interviews is transcribed with Amberscript software, which enables fast transformation from audio to text. The transcript is checked manually afterward to ensure accurate transcription. After transcription, the transcript is coded using the ATLAS.ti9 software, which supports qualitative research analysis by generating overviews of codes.

Since the interviews followed a semi-structured approach with unknown outcomes, an inductive, 'data-driven' coding was used (Crabtree & Miller, 1992, pp. 94–95). Data-driven coding refers to an approach where the concepts, codes, and sub-codes are determined while the coder analyses the transcript. To provide the codebook with structure, the stages of Burnard (1991, pp. 462-464) were used (Appendix E). The codebook can be found in Appendix F. This research will use Krippendorff's Alpha instead of the well-known Cohen's Kappa, due to the controversy with Cohens Kappa. Researchers are raising issues with Cohens Kappa for years (Brennan & Prediger, 1981; Byrt et al., 1993; Cicchetti & Feinstein, 1990; Feinstein & Cicchetti, 1990; Kraemer, 1979; Maclure & Willett W. C., 1987; Zwick, 1988). Furthermore, researchers stated two paradoxes with Cohen's Kappa; at first, A low kappa can occur at a high agreement and secondly, unbalanced marginal distributions produce higher values of kappa than balanced marginal distributions (Cicchetti & Feinstein, 1990, p. 556; Feinstein & Cicchetti, 1990, pp. 543–545).

Following the two paradoxes, Zhao, (2011) mentioned twelve additional paradoxes with Cohen's Kappa. He furthermore states that Cohen's Kappa is not a qualified reliability measurement. Zhao claims that Cohen's Kappa is not generalizable as a measurement, but only a measure of reliability under certain conditions which are rarely found. Next, Cohen's Kappa assumes an infinite sample size, in qualitative research, the infinite sample size is a requirement that can never be fulfilled (Banerjee et al., 1999, p. 4). The mentioned limitations of Cohens Kappa led to the use of Krippendorff's Alpha in this research instead of the well-known Cohen's Kappa.

6.5 Reliability and validity

To ensure reliability and validity, four key criteria are considered in this research: credibility, transferability, dependability, and confirmability (Shenton, 2004). Guba, (1981) referred to these concepts as internal validity, external validity, reliability, and objectivity. Several strategies were used in this study to ensure the fulfillment of criteria in this research.

To achieve credibility, the researcher developed an early familiarity with the culture. This has been done to get a prolonged engagement between the participants and the researcher to gain understanding of the organization and its supply base. Furthermore, it established a relationship of trust and increased the willingness of participants to be interviewed. Every company that was approached agreed voluntary on collaborating in this research. Furthermore, the researcher included an intro in every interview which ensured participants that there are no right answers to the question that will be asked (Appendix D). Furthermore, the introduction included the message that participants have the right to withdraw from the research at any point, without the requirement to disclose an explanation. Member checks were also included in this study. After an interview, every participant was asked if he/she would like to check the transcript of the interview. Concluding credibility with a thick description of the phenomenon under scrutiny. A detailed and clear description of concepts was provided to participants in order to help convey the actual situations. A more in-depth version of credibility can be found in Appendix G.

Next, transferability, qualitative studies are typically not as generalizable as quantitative studies, because qualitative research findings often relate to a small number of environments or individuals (Flyvbjerg, 2006; Maxwell, 1992). It is therefore important to clearly define qualitative studies and its limitations. To increase the transferability, this study intends to provide a clear and thick description. This thick description will be focused on the research context and the assumptions that were central in this research. This enables future researchers who desire to transfer this study with making the judgement of how sensible this transfer is. More information about the transferability of this research can be found in Appendix H9Appendix H.

This research intends to provide a detailed coverage of the methodology and data collection, which allows the reader to determine if the appropriate practices have been used. Furthermore, dependability was ensured using an interview guide, which was checked by other researchers. Following the open coding process enables structure for future researchers to gain knowledge systematically and prevent misinterpretations. The dependability will be further increased by the usage of the inter-coder reliability measurement by Krippendorff's alpha (Krippendorff, 2011, 2018). More details about dependability can be found in Appendix I.

Confirmation is achieved in this research by recognizing shortcomings, describing possible effects, and the usage of bias reduction techniques. When conducting interviews, the researcher always has a certain influence on the interviewees. Since the researcher is aware of this bias beforehand and during the interview, measures can be taken to reduce the bias to a minimum. The interview guide in this research strives to reduce bias by defining the questions broadly. As a result of this, interviewees are not pushed in a certain direction. To tackle the limited number of interviews, the researcher interviewed a reflection of the supply base of the case company, meaning that interviewees work in different industries covered in the supply base. More details on confirmability can be found in Appendix J.

This research is assessed by the ethics committee for Behavioral, Management and Social sciences (BMS) of the University of Twente. In addition, several other ethical considerations are considered, which can be found in Appendix K. The sharing of ethical guidelines was done to ensure the ethical responsibility of this research.

6.6 Inter coder reliability results

The inter-coder agreement scores are shown in table 6. The scores are calculated based on three randomly selected interviews, which were also coded by a second researcher. The inter-coder agreement was then calculated using Krippendorff's alpha.

Table 6: Inter coder reliability by Krippendorff's alpha

Code group	***Krippendorff's alpha***
Organizational	0.926
Technological	0.896
Managerial	0.865
Financial	0.798
Market specific	0.822
Commodity market	0.877
Buyer-seller relationship	0.913

7 Results

In this chapter the results are presented including a revised researched model. Next to the factors from the theory, the results include new factors that came up during the interviews. New factors are grouped in three groups: market specific factors, commodity market factors and buyer-seller relationship factors.

The model is generated from the suppliers' perspective and reflects the outcomes of the interviews. Factors that are identified as motivator are marked green in the model; factors identified as barriers are marked red. Following, factors that could be both motivator and barrier are marked blue and factors that were present in the theory, but not found in the interviews are marked white. Factors affecting suppliers are indicated with (S), factors affecting buyers are indicated with (B), factors affecting the relationship between buyers and suppliers are indicated with (BS). The model is visualized in Figure . After the model is presented, the result section continues with an explanation of the results in each section presented in the model. Due to semi-structured interviews, not every respondent answered for every factor, therefore not every respondent is present in every table.

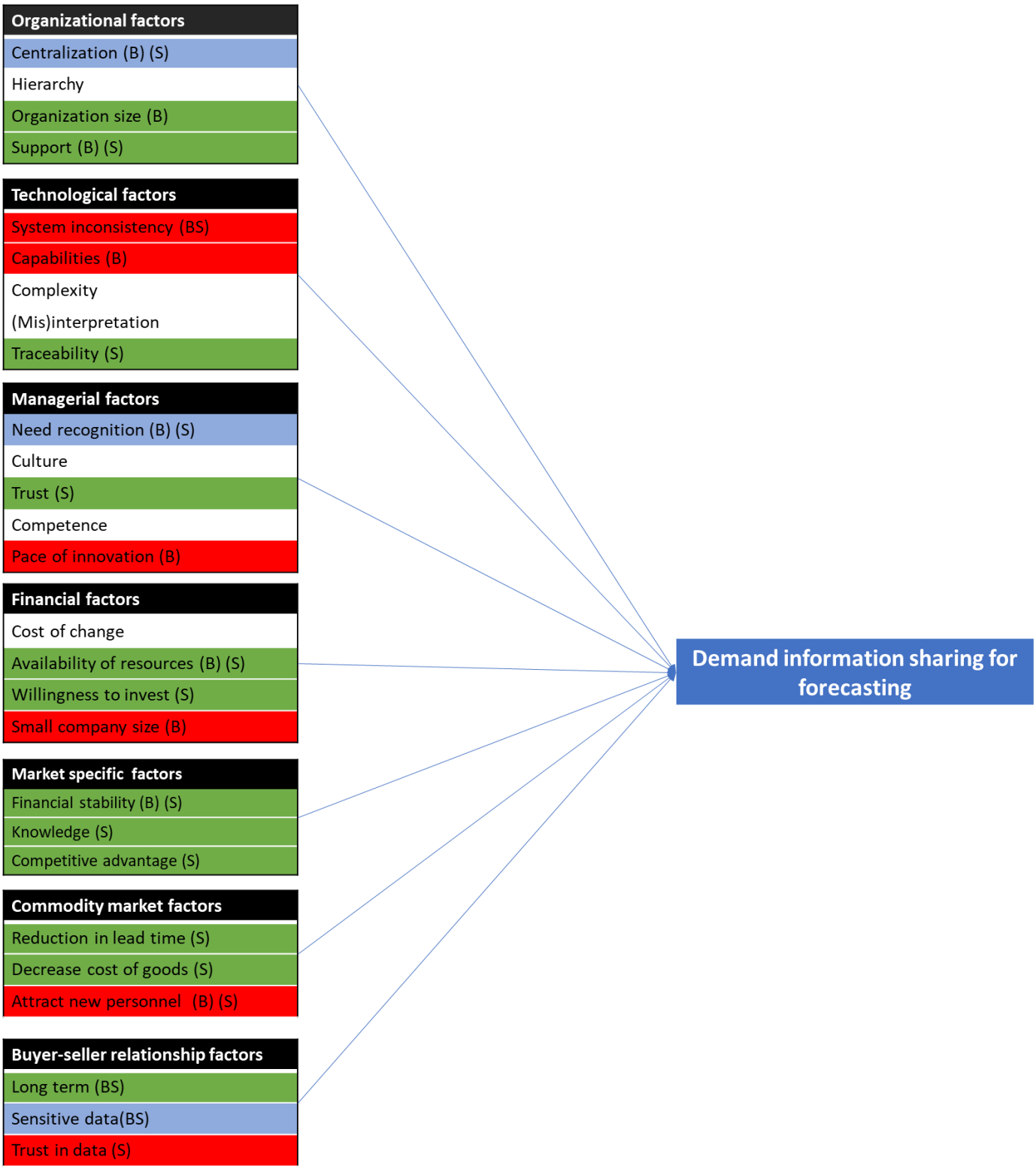

Figure 4: Revised research Model: Factors that influence the willingness and capability of SMEs in demand information sharing from a supplier's perspective.

7.1 Organizational factors

This section includes all organizational factors, which consist of centralization, hierarchy, organization size and organizational support. Appendix L consists of outcomes of the interviews, further explanation is stated below.

Respondents 2,5,6,7,11,15 & 16 mention that most of the decisions are made by the management team, which implies a centralized organisation. These respondents mention that the management team therefore has a vital role in the willingness of the company to invest in information sharing technology. A centralized organization could be both a facilitator as a barrier to information sharing due to the dominance of a small number of employees. Respondents 1, 3, 9, 10 & 12 mention that decisions are made decentralized. They mention that different management layers have different authority levels to make decisions. They argue that this makes it more likely that their company will support information sharing, since their decisions are not made by one dominant leader.

Most of the SMEs participating in this research consist of 3 hierarchical layers. One consists of 2 layers and one company consist of 4 layers. Since there is little variation over the hierarchical layers in the sample and the respondents did not mention hierarchy as a factor, there is no clear outcome for hierarchy as a factor in willingness and capability in demand information sharing.

Organization size on its own does not affect the willingness to share information in the supply chain according to the respondents; the participants mention that their capabilities and willingness to share information is not influenced by the size of their own organization.

However, the organization size of their customers does affect the willingness and capabilities of the customer to share information. Respondents 1 & 13, which are representatives of large companies in this sample state that small customers focus on daily business and continuation rather than innovation. Respondent 13: “The priority of small customers is limited to the daily operations, the focus of especially our small customers to continue the operations without any delays. They simply do not have the capacity to employ additional employees with focus on the innovation process. These customers typically employ 10 to 15 people.” Respondent 5: “Our typical customers are not multinationals. There is no development in information sharing at those companies.” Respondent 16: “The current business requires so much time and attention that our customers do not have the capacity to innovate their processes.”

7.2 Technological factors

This section includes all technological factors, which consist of system inconsistency, capabilities, complexity, (mis)interpretation and traceability. Appendix M consists of outcomes of the interviews, further explanation is stated below.

Some respondents experienced barriers originating at the systems used by some of their customers. Respondents mentioned that there were customers who developed their own software based on Excel over the years. The self-development of these tools has one mayor drawback; its output can only be used internally, due to a lack of standardised output. According to the respondents, the customers who used these types of tools were typically very hesitant to change their systems.

Own technological capabilities are not considered as a barrier for all respondents. Some respondents claim that their company has the technical knowledge for setting up information sharing initiatives and EDI in house. Others mention that when they don't have the technical knowledge in house, they will simply buy the knowledge on consulting basis.

While their own technological capabilities are not considered as a barrier by the respondents, the technological capabilities of their customers are a barrier. Respondents 5&6 claim that there is a lack of knowledge within their customers, especially with small customers. Respondent 5: "Some of my smaller customers do not have the technological knowledge to share information. Within those companies, which have less than 20 employees, it is no exception that the founder works on the floor. These founders simply want to see their employees performing manual labour, rather than sitting behind a computer screen".

The respondents did not mention the complexity and (mis)interpretation of information as a factor.

Following traceability, which is a factor that is not presented in the theory but is considered as a technological motivator by several respondents. Respondents 1, 2, 5, 6, 12 and 13 indicate that they want to be able to track their products after they sell them, to deal with warranty and defects. They claim that many of their customers are not able to track their products at this point, which bring difficulties if the machines show downtime. Therefore respondents 1 and 13 indicate that they are willing invest in information sharing systems that could contribute to the traceability of components.

7.3 Managerial factors

This section includes all managerial factors including need recognition, culture, trust, competence, and pace of innovation. Appendix N consists of outcomes of the interviews, further explanation is stated below.

Companies with management which pursue process innovation strive for better information sharing. Respondent 13: “For the past years our senior management started attracting different people with different skill sets to or company. We for example hired supply chain managers and data analysts to work with internal data and data from customers. Whereas in the past, we used to hire planners and purchasers”. On the other end, respondent 4 mentioned that the focus of their management was not on innovating the business processes but het continuation of the company; ‘We neglected innovations as information sharing, due to other priorities’. Concluding that managerial influence can be both a facilitator as a barrier.

The sample consisted of companies located throughout the Benelux. The respondents did not include cultural differences as a factor in their willingness and capabilities to share information.

A theoretical barrier to information sharing is the sensitivity of data. The respondents did not recognize the sensitivity of data as a valid barrier due to two major reasons. First, all the respondents claim that data is only distributed to customers which are trusted. This trust is gained in a relationship which last for several years. Secondly, the participants mention that when there is no long-lasting relationship or trust, an NDA can be an outcome.

Most of the respondents believe that their consumers should decide the pace of process innovation. Respondent 4: “We monitor the progress of our customers and try to keep up with their needs”. Respondent 13: “The customer actually determines the pace of innovation, where we just try to stimulate innovation and show the possibilities to our customers”. This policy often leads to a reactive position for the suppliers in the sample. According to the respondents, small customers typically do not have the managerial urge to innovate on the process. They mention that their customers rather innovate on the product.

7.4 Financial factors

This section includes all financial factors including cost of change, availability of resources, willingness to invest and financial factors related to company size. Appendix O consists of outcomes of the interviews, further explanation is stated below.

Respondents 4 and 8 mention the cost saving ability of information sharing systems in the supply chain as a main facilitator. The respondents' arguments for cost savings are the time saving and less space for errors. Respondent 8: "We see the handling cost rising over time, especially if our customers create new products. Up to this point, we put a lot of time in the handling of new products. If that could be atomized, we will save a lot of financial resources" Respondents 5,6 and 16 mention that a ROI is always a decision-making instrument for any (process or product) investment. When an ROI cannot be calculated or estimated, the management will consider other decision-making instruments to make the decision. The respondents flag a low ROI as a barrier, but a low ROI on its own is never decisive since it is hard to quantify every aspect of an investment.

Different respondents claim that their organizations strive to reinvest the profits in product and process innovations. They emphasise that their reinvestment programme substantiates the willingness to invest. Respondent 2: "Our company strives to reinvest most of the profit in the company, we heavily reinvest in the software tools to make our work easier. This is in line with the core philosophy of our owner."

Respondents 2, 4, 5, 9, 12 and 13 claim that small customers do not always have the financial resources to invest in innovations. Respondent 13: "I'm sure that some of our customers do want to take part in the supply chain integration, but do not have the financial resources to attract qualified personnel".

7.5 Market specific factors

This section includes all market specific factors for different industries. Different industries have specific factors that influence their willingness to share information, this section includes the market specific factors for plastic, metal, and wholesalers. Appendix P consists of outcomes of the interviews, further explanation is stated below.

Respondents 5 and 6 mention that the most important financial barrier is the financial health of the customer. Both companies operate in the plastics industry and emphasize the importance of financial health. Respondent 6: “Because financial stability is very important in the relationship between a plastic manufacturer and its customers. Because relationships in our market usually exceeds over 20 years. Within the relationship, stability of the both the plastic manufacturer as the customer is very important, because we ultimately manage a very large capital of our clients in the form of injection moulds”. The respondents active in the plastics industry mention that there must be financial stability to be interested in sharing information with customers. Due to high start-up costs which are common in the plastics industry, the plastic manufacturers strive for financial stable customers. The respondents claim that insights in financial stability of customers is their biggest motivator, which could result from demand information sharing.

Gaining knowledge through collaboration and information exchange is the biggest motivator for the respondents in the metal industry. Within the steel industry, there are a few big steel producers with a lot of power. The biggest motivator for the metal suppliers is getting more knowledge of the market. These respondents are both trying to get more leverage at the large steel producers. Respondent 13: “knowledge is key in this industry”.

Having a competitive advantage though the creation of unique value propositioning is the goal of the wholesalers in the sample. Respondent 4: “We are in essence a company which moves boxes. But we need to create some unique value to be able to move the actual box. We therefore try to do more things than just move the box. And would willingly collaborate with our customers if they approach us”. Taking part in information sharing is a motivator for wholesales since it enables them to differentiate from competitors and gain competitive advantage.

7.6 Commodity market factors

This section includes factors resulting from developments in the commodity market including changes in lead time, fluctuations in the cost of goods and attraction of new personnel. Appendix Q consists of outcomes of the interviews, further explanation is stated below.

All the respondents indicated that there are currently challenges within the commodity market. Especially in the raw metals and electronic markets, lead times and prices increased. According to the respondents, these challenges are a direct result the corona pandemic. Respondents 2,5,6, 7 and 13 indicated that prices had risen sharply due to this pandemic. Respondent 6: “The reason that information sharing, and forecasting is extremely important is huge shortages at the raw material market. This resulted in extreme high prices. So, for us it is vital to get insights in customers demand predictions, especially with bulk volumes.”
Respondent 7: “The lead time of technical raw materials increased from 3-4 weeks to three to five months at this point”. Respondent 2: “Currently, we are having problems to catch demand, which results in a 3-to-4-month delay of the projects our customers deliver to their customers”. Respondent 13 claims that the disrupted commodity market in the 2008 financial crisis functioned as a wakeup call for intensified information sharing within their supply chain: “We were heavily affected by the 2008 crisis, the company was on the edge of bankruptcy. After the crisis we got a new CEO, who changed the entire process at the company. The crisis was a wakeup call for our survivability and urged intensified connectivity with our supply chain. We do now benefit from the changes we made after the 2008 crisis; our factories continued producing where our competitors faced of stock situations.”

Respondents 3,4 and 13 and 14 indicate that this crisis not only affected the raw materials market, but that there were currently also challenges in finding suitable personnel. Respondent 4: “There is scarcity in the labour market. Especially in the logistics management we and our customers face difficulties in attracting skilled employees. This prevents us from introducing demand sharing systems, since we simply cannot attract the desired employees.”

7.7 Buyer-seller relationship factors

This section includes factors resulting from the relationship between buyers and sellers. Factors that influence the willingness and to share information are the length of the relationship, sensitivity of data and trust in the data provided by the buyers. Appendix R consists of outcomes of the interviews, further explanation is stated below.

13 out of 16 respondents claim that the relationship between buyer and suppliers are very important when it comes to sharing information. Respondent 4 claims that it is vital to have a close relationship with their customers, since it enables them to share demand information on a frequent basis, which in the end helps to capture supply. Respondent 4: “I want to pursue long-term relationships with my customers, it prevents me from reinventing the wheel every time.” Therefore, a long-term relationship is a motivator for the willingness to share information.

Especially trust is important to the respondents if they share sensitive information to customers. Trust is achieved throughout a long-lasting relationship which is built over the years. If there is a lack of trust, this would mean a barrier for the respondents. Some respondents tell that in some situations, where there is not enough trust, signing an NDA could provide outcomes. Concluding that the sensitivity if data is not a barrier, nor a motivator.

Trust in the data which originates from the customers is a barrier to some respondents. Respondent 7: “In the past, we received data, but if we compared that data to our own data, it showed clear discrepancies. We therefore are very hesitant with data from our customers”. Therefore, a lack of trust in data provided by the buyers is a barrier on the willingness to share information.

8 Discussion and conclusion

In this chapter, theoretical- and practical relevance are stated, following by a discussion of the results. The chapter concludes with the limitations of this research and recommendations for future research.

8.1 Theoretical relevance

This study makes a theoretical contribution towards the understanding of motivators and barriers for demand information sharing within SME suppliers. The findings are consistent with the theories mentioned in chapter 2 and therefore contribute to the existing literature on information sharing in supply chains.

Following, this research could help other researchers who study information sharing with the mapped-out motivators and barriers. The three most important motivators are the current developments and disruptions in the raw materials market, market specific motivators and a believed increase in productivity. Whereas the three top barriers are the current developments and disruptions in the raw materials market, the adaptive attitude towards customers and barriers originating from the size of the customers.

The barriers and motivators mentioned in the theory were only tested on NGO's and large corporate firms, this research focused on an up to this point under researched topic in supply chain literature; the motivators and barriers of information sharing for SMEs. Therefore, this research contributes to the theoretical understanding of SMEs.

8.2 Practical relevance

Next to the theoretical contributions of this research, this research comes up with the following practical contributions. The practical contributions consist of two parts. At first the contributions for the case company towards the motives and barriers on information sharing of their supplier portfolio. Following with the practical contributions for companies working with SME suppliers in general, as well as contributions for SME suppliers.

In general, the case company benefits from the outcomes of the interviews in this research. The outcomes provide insights in the motives and barriers of their supplier portfolio towards information sharing. Since the data is anonymized, the case company is not able to trace individual outcomes to suppliers. However, the general outcomes of this study can be used to get a deeper understanding of motivators and barriers within the supplier portfolio of the case

company. If the case company wants to introduce information sharing within their supply base, it is useful to know that most of their suppliers have a wait-and-see attitude towards process innovation. In order to trigger them, the case company should aim for low costs in the first phase of a new process innovation. Furthermore the implications of the change should be specifically defined in order to get a clear expected outcome for both the buyer and supplier (Gupta & Maranas, 2003).

Next to the practical relevance for the case company, this research also imposes practical outcomes for SMEs and SME suppliers in general. In practice, the case company should take initiative if they pursue information sharing with their suppliers, since the results show that the suppliers have a wait-and-see attitude towards process innovation. Most of the participants stated that they follow their customers' pace of innovation, and the customers should keep the cost low and define the outcomes as clear as possible.

Following the initiative, SMEs should be aware that companies in different industries have different motives. A metal supplier for example will strive for knowledge of the market, where a wholesaler will strive for competitive advantage though the creation of added value by information sharing.

8.3 Key findings of this research

At the end of each interview the respondents were asked to their top three motivators and barriers for information sharing within the supply chain. Most of the respondents repeated the same arguments in their conclusion which are stated below. Additionally, two discrepancies were found between the theory and interviews.

8.3.1 Discrepancies

The researcher found two discrepancies between the theoretical framework and the interviews. First centralization, the theory states that centralization has a negative effect on information sharing (Tsai, 2002). The respondents did not completely substantiate this theory, as 7 respondents mentioned centralization as a motivator and 5 respondents mentioned centralization as a barrier Appendix L. This may be due to the fact that the theory is based on large multinationals and the outcomes of the interviews are from SMEs, which implies that there could be a difference between the relationship of centralization and willingness to share information in large multinationals and SMEs. This is substantiated by the respondents who claim that small companies who consist of ten employees have only one director, if this dominant director has a

positive attitude towards information sharing, centralization is a motivator for information sharing.

The second discrepancy is managerial need recognition, where theory states that when managers dealing with supply chains do not recognize the potential of information sharing or do not have confidence in information sharing systems managerial barriers occur (Marsh & Flanagan, 2000). Four respondents claimed that need recognition was a motivator and four respondents claimed need recognition as a barrier. Appendix N shows that need recognition at the suppliers is considered as a motivator, and a lack of need recognition at the buyer is a barrier. If the difference between need recognition at the supplier and buyer is taken into account, this factor is consistent with the theory.

8.3.2 Main motivators and barriers

The first main motivator which is identified are the developments in the commodity market. Literature states that suppliers underestimate disruptions in the supply chain if proper assessment tools are not available (Tang, 2006). The respondents classify the need to share information within the supply chain as a main motivator for information sharing. Without the proper tools to get insights in the future demand of customers, there arise challenges for the capture of supply given the current disruptions in the commodity market. One respondent experiences similarity between the current conditions on the market and the conditions during the financial crisis of 2008. The respondent referred to the 2008 crisis as a wake-up call to take action in terms of intensify the collaboration and information sharing within their supply chain. According to the respondent, the investments which are made after the financial crisis in 2008 resulted directly in less difficulties capturing supply in the current disturbed market.

The second motivators are identified as market specific motivators. The first market specific motivator covers the metal industry. This industry is dominated by a few large multinationals which have power dominance over the SMEs. This results in SME suppliers requesting information about the market from their customers, in order to get more leverage in the negotiations with the industries' giants. Knowledge is key in this industry according to the interviewees. This claim can be verified in literature which states that knowledge of the market may help guide firms and provides leveraging power (Cha et al., 2008; Paton & McLaughlin, 2008). Following the metal industry, the plastics industries' main motivator for information sharing is financial stability. Since this industry typically consist of high set-up cost, the plastic SME suppliers would like to receive financial information from their customers in order to manage financial risks. Concluding market specific motivators with wholesalers, who want to

create value by sharing information with customers. Sharing information with customers leads to competitive advantage over competitors who do not want to participate in information sharing in the supply chain. This claim is suspended by theory, which suggest that most enterprises created significant competitive advantage through the use of information technology in order to increase competitiveness (Berisha-Shaqiri, 2015).

The third main motivator for SME suppliers to participate in information sharing are motives related to productivity. Most of the respondents believe that information sharing in the end will lead to lower ordering costs, more accurate forecasts and more flexibility and therefore increase productivity. Accurate forecasts reduce the up-stream amplification of demand, which increases the inventory management performance. This is in line with the theory which suggests that information sharing improves efficiency and reduces the bullwhip effect (Lee et al., 1997).

The first main barrier identified are barriers resulting from developments in the commodity market resulting from the corona crisis. The crisis limited the suppliers in their contacts with their customers. Next to the limited contact moments, the corona crisis caused heavy disruptions in the raw materials market, which resulting in both suppliers and customers preferring to focus on the continuity of the business rather than innovation. This is in line with the theory, which states that COVID-19 has an impact on the whole supply chain. Research states that COVID-19 will affect the entire manufacturing industry due to he demonstrated closed connectivity of business all over the world (Aday & Aday, 2020). Proper information sharing in the beginning of a crisis combined with ramping up production allows to reduce shortfalls and out of stock situations (Aday & Aday, 2020; Mehrotra et al., 2020). Concluding that corona could be a wake-up call for intensified collaboration and information sharing, where the 2008 financial crisis was a wake-up call for respondent 13.

The second main barrier is the fact that the interviewees believe that their customers need to determine the pace of innovation. There is no process innovation if the customer does not initiate improvements or innovations. SME suppliers in the sample are self-aware that they do not push process innovation to their customers, which is defined as a lack of managerial direction which results in difficulties in implementing information sharing. Similar lacks of managerial direction are found in the theory (Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000). The suppliers in this sample rather take a wait-and-see attitude. This wait-and-see attitude results from a high presence of uncertainty and is reflected by both the uncertainty for the outcomes and uncertainty in future costs. In order to change the attitude towards an initiative taking attitude it

is important to reduce the first-stage cost of the process innovation, as well as get a clear expected value of the outcome for the innovation (Gupta & Maranas, 2003).

Following with the last barrier; the size of the customer. Most of the SME suppliers have customers which are also considered as SME. According to the respondents, their smaller customers do not have as much focus in innovation as their bigger customers. According to the suppliers, their smaller customers are not interested in innovating processes, they rather focus on product innovation and daily business. Theory states that SMEs typically have more difficulties in attracting knowledge and resources (Garengo et al., 2005). Where SMEs face difficulties in capturing assets, the difficulties for small SMEs are even greater according to the respondents.

Concluding, this research leads to an answer to the following research questions: "What are the main motives for SME suppliers in demand information-sharing?" and "What are the main barriers for SME suppliers in demand information-sharing?". The main motivators according to the sample in this research are current commodity market developments, market specific motivators, increased productivity. Whereas the main barriers include barriers resulting from the corona crisis, barriers resulting from a wait-and-see approach towards customers and barriers resulting from a small customer size. An overview of the top motivators and barriers can be found in Figure .

Motivator	Barrier
1. Developments in commodity market	1. Developments in commodity market
2. Market specific motivators	2. Wait-and-see approach
3. Productivity	3. Customer size

Figure 5: Top three motivators and barriers for SME suppliers in information sharing

8.4 Limitations

This research consists of different limitations that offer opportunities for future research. This research investigated motivators and barriers which occur at SME suppliers when sharing information. In this chapter, the limitations of this research are described combined with suggestions for future research.

The first limitation of this research is the origin of the data. All data is collected qualitative by interviews of SME suppliers. With only qualitative data, it would be inappropriate to suggest that the findings are based on triangulated data.

A second limitation in this research is the focus on SME suppliers four industries. This research is based on the outcomes from interviews with sixteen representatives from four different industries, which constitutes a small sample. Since this research only consist of four different industries, it would be inappropriate to suggest that the findings are representative for the average SME supplier in the Benelux. Although this research provides insights in SME suppliers in the Benelux, it is not generalizable for all industries. Future research should contain a more diverse and wider population to make such generalizable conclusions.

This research is conducted by one researcher only. The researcher tried to be objective as possible, but the researcher has to acknowledge that the respondents can be biased by the researcher. Next to the interviews, the bias could apply to the coding and the interpretation of the coding, since only three out of sixteen interviews are coded by a second researcher. The inter-coder agreement scores suggest good reliability but could always be improved if more respondents and coders are included. Therefore, the results of this research could be biased by the researcher's subjectivity. Future research could include more interviews and coders to in the end exclude the subjectivity.

When conducting the interviews, the respondents presented themselves and their organizations as collaborative with their customers. This self-evaluation could be overestimated by the respondents. Further research should include interviews with their customers to measure if there are discrepancies between the expression of participants in the interviews and the true behavior of the interviewee. This research could consist of a combination of qualitative and quantitative methods, such as the combination of a survey and interviews in order to triangulate the data.

Despite these limitations, the researcher is confident that this research provides useful insights in the facilitators and barriers for information sharing of SME suppliers.

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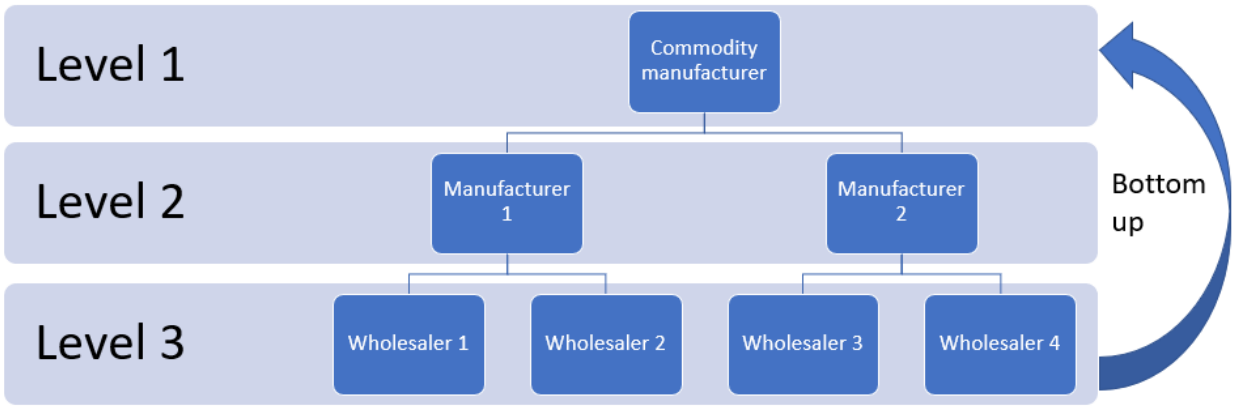
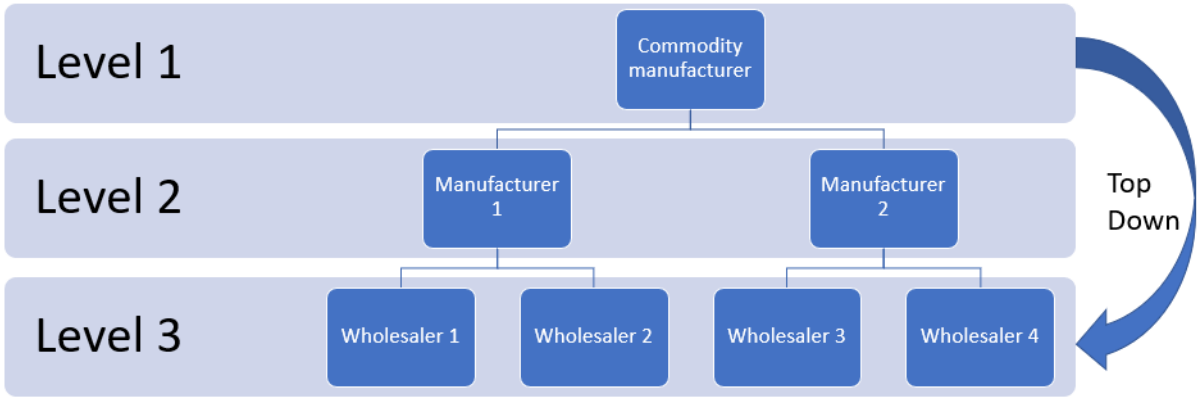
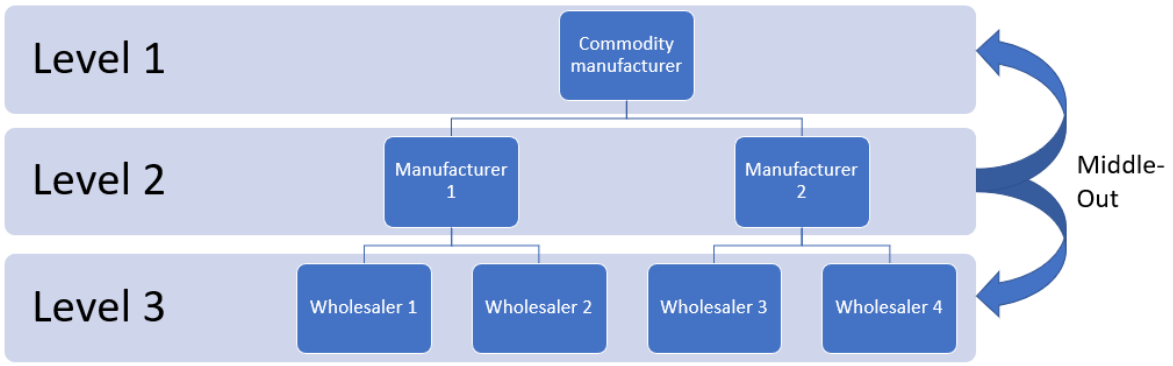
Appendix A. Bottom-up hierarchical forecasting



Appendix B. Top-Down hierarchical forecasting



Appendix C. Middle-out hierarchical forecasting



Appendix D. Interview plan

Opening

- This research is about demand-information sharing, the goal is to identify factors which could influence demand information sharing for forecasting purposes, as well as the opinion about demand information sharing from firms in Company X's supply base.
- This interview will take 30-45 minutes approximately
- All answers given will be completely anonymized, resulting that they never could be traced to a specific company or participant
- An interviewee may leave the interview at any point in time without owning the researcher any explanation
- The interviewee will not be compensated by the researcher in any way
- The interview will be recorded for transcription purposes if the interviewee agrees on the recording. The recording will be deleted after the transcription.

Middle

General

- Could you explain the core activities of company X?
- What is your position in the company?
- How many years are you working at this position, or equal positions?
- What is your definition of forecasting?
- Could you walk me through your current forecasts?
- What are factors that could influence firm X's collaboration in demand-information sharing for forecasting?
- What influences your willingness to share demand information with your customers?
- When are you willing to share demand information with your customers?
- Do your customers share demand information with you?

Factor specific questions which can be used when general questions about demand information sharing do not have clear outcomes. These questions will also be asked when certain factors are mentioned in the general questions and need more depth.

Organizational

- How does your organogram look like?
    - Company size
    - Hierarchical
    - Centralization
    - Bureaucratic
- How interprets company X external data?

Technological

- Which (IT) systems does company X currently use?
- Do your systems align with the systems in supply network?
    - How do you align your systems with your supply network?
- Does company x have technical capabilities which might be needed for demand-information sharing?

Managerial

- How does the management stimulate innovation initiatives?
- Does the top management/you recognize the potential of demand information-sharing?
- What is your opinion about demand information sharing, which may be sensitive to competitors?
- How do you make the trade-off between the benefits of information sharing and the vulnerability of the information you provide?
- Do you trust your customers with the information?
    - If not. What is needed for you in order to trust them?

Financial

- Are you aware of the cost of the implementation of demand information sharing systems?
- Are you aware of the maintenance costs of demand information sharing systems?
- What is your investment policy?

Conclusion

- What are the top 3 factors/barriers for company x to share demand-information for forecasting with customers?
- What are the top 3 factors/barriers for company x to receive demand-information from customers?
- Do you have any other questions/remarks regarding this interview?

- Do you have any other questions/remarks regarding this research?
- Do you want to be informed about the results?
- Thank you for your time and cooperation

Appendix E. Steps of (Burnard, 1991)

Stage number	Description
Stage one	Researchers notes serve as memory joggers
Stage two	Transcripts are read and notes are made on general themes
Stage three	Transcripts are red again and headings are written down
Stage four	List of headings are surveyed and are categorized
Stage five	List of categories is worked through, and similarities are removed
Stage six	Independent researcher generates own categories of same data, then compare them to original list to enhance validity
Stage seven	Transcript are re-read alongside the list of categories, to check if every aspect is covered
Stage eight	Transcript is worked through with list if categories and sub-headings are coded
Stage nine	Each coded section of transcript is cut out of the transcript and all items of each code are collected together and context is checked
Stage ten	The cut-out sections are pasted into sheets, headed up with appropriate headings and sub-headings
Stage eleven	Respondents check if their answers match categories
Stage twelve	All of the sections are filed together for direct reference
Stage thirteen	Write up process
Stage fourteen	Link data examples and refer to literature, define “dross”

Appendix F.Codebook

Code name	Code group 1	Code group 2	Source
Access to data customers	Buyer-seller relationship	Technological	
Align processes	Buyer-seller relationship		
Become trustworthy partner	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
Commitment	Buyer-seller relationship		
Conversating	Buyer-seller relationship		
Customer determines pace of innovation	Buyer-seller relationship	Managerial	(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Customer has to ask for information	Buyer-seller relationship		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Customer specific items	Buyer-seller relationship		
Customers should know when orders are made	Buyer-seller relationship	Technological	(Caudle et al., 1991)
EDI with some customers	Buyer-seller relationship	Technological	(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Ethics	Buyer-seller relationship		(Fawcett et al., 2008)
Every collaboration is welcome	Buyer-seller relationship		
Forecast does not capture required time bucket	Buyer-seller relationship	Technological	(Kamal & Themistocleous, 2006)
Forecast provided by customers	Buyer-seller relationship		
Important to capture supply	Buyer-seller relationship	Commodity market developments	
Integrity	Buyer-seller relationship		
No trust in data from customer	Buyer-seller relationship	Technological	(Kamal & Themistocleous, 2006; Stewart et al., 2004)
Only some customers provide forecasts	Buyer-seller relationship		(Stewart et al., 2004)
Preferable information sharing with every customer	Buyer-seller relationship		

Protect IP	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
Provide space to each partner	Buyer-seller relationship		
Relation with customer is most important	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
sensitive information	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
Trust	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
Trust based on personal judgement	Buyer-seller relationship	Managerial	(Fawcett et al., 2008)
Vital to share information to capture supply	Buyer-seller relationship	Commodity market developments	
VMI	Buyer-seller relationship		
We don't engage in forecasting, only blanket orders	Buyer-seller relationship		
We help customers with data	Buyer-seller relationship	Technological	(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
We use system customer want us to use	Buyer-seller relationship		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
2008 crisis, start with information sharing	Commodity market developments		
Be able to fulfill customer needs	Commodity market developments		
Business continuity	Commodity market developments		
Corona	Commodity market developments		
Decrease the lead time	Commodity market developments		
Hard to capture supply	Commodity market developments		
Increase in lead times	Commodity market developments		
Manage supply	Commodity market developments		

Out of stock situations	Commodity market developments		
Political developments	Commodity market developments		
Price increase	Commodity market developments		
Staff shortage	Commodity market developments	Managerial	
Supply customers	Commodity market developments	Buyer-seller relationship	
200 offices	Demographics		
Belgium	Demographics		
Company activity 80 countries	Demographics		
Employees: <25	Demographics	Organizational	(Khurana et al., 2010)
Employees: 1000-3000	Demographics	Organizational	(Khurana et al., 2010)
Employees: 101-150	Demographics	Organizational	(Khurana et al., 2010)
Employees: 251-500	Demographics	Organizational	(Khurana et al., 2010)
Employees: 25-50	Demographics	Organizational	(Khurana et al., 2010)
Employees: 5000+	Demographics	Organizational	(Khurana et al., 2010)
Employees: 51-100	Demographics	Organizational	(Khurana et al., 2010)
Experience in company 23 years	Demographics		
Experience in company: 1 year	Demographics		
German company	Demographics		
Injection molding	Demographics	Market specific	
Job experience 16-20 years	Demographics		
Job experience: 11-15 years	Demographics		
Job experience: 1-5 years	Demographics		
Job experience: 6-10 years	Demographics		
Job: customer service manager	Demographics		
Job: Hub manager	Demographics		
Job: key account manager	Demographics		
Job: sales engineer	Demographics		
Job: Sales manager	Demographics		
Job: senior account manager	Demographics		
Machines	Demographics	Market specific	
Producer	Demographics	Market specific	

Revenue: 50 million	Demographics	Organizational	(Khurana et al., 2010)
Wholesale	Demographics	Market specific	
Years at company: 16-20	Demographics		
Years at company: 44	Demographics		
Add value	Financial		
Cost higher than returns	Financial		
Cost saver	Financial		
Financial growth	Financial		(Clark & Hammond, 1997)
Financial health	Financial		(Clark & Hammond, 1997)
Hire supply chain managers	Financial	Managerial	
Importance of financial health	Financial	Buyer-seller relationship	
Reinvest profit in innovation	Financial		(Clark & Hammond, 1997)
ROI	Financial		
Small customers do not have financial resources	Financial		(Khurana et al., 2010; Lee & Whang, 2000)
Willingness to invest	Financial		(Clark & Hammond, 1997)
Blanket order	Managerial		
Chain integration with key customers	Managerial		(Curry & Moore, 2003; Fawcett et al., 2008)
Consideration per relationship	Managerial	Buyer-seller relationship	(Fawcett et al., 2008)
Create own planning, not with customers	Managerial		
Customers are short-sighted	Managerial		(Curry & Moore, 2003)
Customers focus on daily business, not on innovation	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Customers have no priorities	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Customers' internal communication does not work	Managerial		(Bureš, 2003; Stewart et al., 2004)
Customers' management focus op product development rather than process, development	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Customers prefer old fashioned	Managerial	Technological	(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Data becomes important	Managerial		(Marsh & Flanagan, 2000)

EDI only at customer request	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Efficiency	Managerial		
Flexibility	Managerial		
Impossible to do with all customers	Managerial		
Information only shared with large customers	Managerial		(Khurana et al., 2010)
Information sharing enables efficiency	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Information sharing is the future	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Make entire chain efficient	Managerial		
Management initiates changes	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
NDA	Managerial	Buyer-seller relationship	(Fawcett et al., 2008)
No data is received from other companies	Managerial	Buyer-seller relationship	
No investment means no future	Managerial	Financial	(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
No priority	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
No risk with sensitive information	Managerial		(Fawcett et al., 2008)
Not share any information	Managerial		(Fawcett et al., 2008)
Not tangible	Managerial		
Only suitable for multinationals	Managerial		(Khurana et al., 2010)
Planning isn't shared with customers	Managerial	Buyer-seller relationship	(Fawcett et al., 2008)
Prevent mistakes	Managerial		
Quick decisionmakers	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Reduce Co2	Managerial		
	Managerial	Buyer-seller relationship	Fawcett et al., 2008)
Servitization	Managerial		
Small customers focus on daily business, not on innovation	Managerial		

Small customers lack fucus on information sharing	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Strategic repositioning	Managerial		
Supplier wants to implement EDI	Managerial		
Time saving	Managerial		
Vital for success	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
We neglected information sharing	Managerial		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Able to read the market	Market specific		
Accurate per SKU	Market specific		
Agriculture	Market specific		
Assemblage	Market specific		
Cost leadership	Market specific		
Drive systems	Market specific		
Explore stainless steel market	Market specific		
For changing safety norms	Market specific		
Forecast is vital for manufacturers	Market specific		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Longer horizon than OEM	Market specific		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Metal	Market specific		
Only for non-standardized items	Market specific		
Only large companies in this market are able to share information	Market specific		(Curry & Moore, 2003; Marsh & Flanagan, 2000; Zipf, 2000)
Sensitive information	Market specific		(Fawcett et al., 2008)
Steel factories are too powerful and reject information sharing	Market specific	Buyer-seller relationship	
Transparency	Market specific		
Transparent pricing	Market specific	Buyer-seller relationship	
2 layers	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
3 layers	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
4 layers	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
All decisions by MT	Organizational		(Tsai, 2002)(Caudle et al., 1991)

Decision-making based on function	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
Hierarchical	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
Non-Hierarchical	Organizational		(Tsai, 2002; Willem & Buelens, 2006)
Quick communication	Organizational		(Khurana et al., 2010)(Bureš, 2003; Stewart et al., 2004)
Revenue: 1 billion	Organizational	Demographics	(Khurana et al., 2010)
Self-managing teams	Organizational	Managerial	(Khurana et al., 2010)
Small customers need to hire additional personnel	Organizational		(Khurana et al., 2010)
Better predict demand	Technological		(Caudle et al., 1991; Hoffman & Mehra, 2000; Holden et al., 2003; Kamal & Themistocleous, 2006; Khurana et al., 2010; Monczka & Morgan, 1997; Stewart et al., 2004)
Created by supplier on historical data	Technological		
Customers are the bottleneck	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Customers can't trace orders	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Email and Excel	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
ERP implementation	Technological		(Khurana et al., 2010; Monczka & Morgan, 1997)
Every customer has different system, inconsistent	Technological		(Hoffman & Mehra, 2000; Sprague & Watson, 1979)
Expand logistics	Technological		
Get insight in projects	Technological	Buyer-seller relationship	
Industrial automation	Technological		
Industry 4.0	Technological		
Inhouse knowledge	Technological		(Caudle et al., 1991)
Inventory improvement	Technological		
IT knowledge not present	Technological		(Caudle et al., 1991)
IT knowledge will be bought	Technological	Financial	(Hoffman & Mehra, 2000)

Manual check always required	Technological		
Many customers are not ready for chain integration	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Operational forecast	Technological		
Optimizing systems internally	Technological		
Our software can't be copied	Technological		(Stewart et al., 2004)
Outdated systems	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Required for purchasing department	Technological		
SAP supports information sharing	Technological		(Hoffman & Mehra, 2000; Sprague & Watson, 1979)
Small customers do not have process knowledge, only product knowledge	Technological	Organizational	(Khurana et al., 2010; Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Small customers lack IT development	Technological	Organizational	(Khurana et al., 2010; Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)
Some systems cannot be connected	Technological		(Hoffman & Mehra, 2000)
Standard components	Technological		
Standardized items	Technological		
Traceability	Technological		
We create better forecast than customers	Technological		(Stewart et al., 2004; Willem & Buelens, 2006)
IT knowledge	Technological		(Caudle et al., 1991; Hoffman & Mehra, 2000; Holden et al., 2003)
Better knowledge of market than consumer	Technological		(Stewart et al., 2004; Tsai, 2002; Willem & Buelens, 2006)

Appendix G. Credibility

"How can one establish confidence in the "truth" of the findings of a particular inquiry for the subjects (respondents) with which and the context in which the inquiry was carried out?" (Guba, 1981, p. 80)

The concept of credibility deals with the question; How congruent are the findings with reality? (Merriam, 1998). Credibility is also referred to as internal validity in the literature (Godwin et al., 2003; Meijer et al., 2002; Slack & Draugalis, 2001). Lincoln & Guba Egon, (1985) argue that ensuring credibility is vital for establishing trustworthiness.

To achieve credibility, the researcher developed an early familiarity with the culture of the participating organizations by fulfilling an internship, consultation of appropriate documents and preliminary visits to companies in the supply base of the case company. This has been done to get a prolonged engagement between the participants and the researcher to gain an understanding of the organization and its supply base. Furthermore, it established a relationship of trust and increased the willingness of participants to be interviewed. The preliminary visits were finished in the first weeks of the research, which ensures that the participants were not biased by the researcher.

All of the approached companies agreed voluntarily on collaborating in this research. This has been done to ensure honesty with informants. All informants got the opportunity to refuse the participation multiple times, which ensured that the data collection involved only participants who are genuinely willing to take part in the research and are prepared to give data freely. Furthermore, the researcher included an intro in every interview which ensured participants that there are no right answers to the question that will be asked. Furthermore, the introduction included the message that participants have the right to withdraw from the research at any point, without the requirement to disclose an explanation.

Following, member checks were included in this study. After an interview, every participant was asked if he/she would like to check the transcript of the interview. This has been done to check if the participant considers his/her words to match their intention.

Concluding credibility with a thick description of the phenomenon under scrutiny. A detailed and clear description of concepts was provided to participants to help convey the actual situations.

Appendix H. Transferability

"How can one determine the degree to which the findings of a particular inquiry may have applicability in other contexts or with other subjects (respondents)?" (Guba, 1981, pp. 79–80)

The concept of transferability is concerned with the extent to which the phenomenon or findings described in one study are applicable or useful in other situations, theory, practice, 2 and future research (Merriam, 1998). Transferability is also referred to as external validity in the literature (Chiswick & Miller, 2009; Finfgeld-Connett, 2010; Takahashi, 1996). It should be questioned if it is realistic to produce truly transferable results from a single study. Qualitative studies are typically not as generalizable as quantitative studies because qualitative research findings often relate to a small number of environments or individuals (Flyvbjerg, 2006; Maxwell, 1992). It is therefore important to clearly define qualitative studies and their limitations.

To increase the transferability, this study intends to provide a clear and thick description. This thick description will be focused on the research context and the assumptions that were central in this research. This enables future researchers who desire to transfer this study with making the judgment of how sensible this transfer is.

Appendix I. Dependability

"How can one determine whether the findings of an inquiry would be consistently repeated if the inquiry were replicated with the same (or similar) subjects (respondents) in the same (or similar) context?" (Guba, 1981, p. 80)

Dependability refers to the consistency and reliability of the research findings (Moon et al., 2016) Dependability refers as well to the degree to which procedures are documented which allows future research to follow the procedures, audit, and critique the research process (Sandelowski, 1986).

This research intends to provide detailed coverage of the methodology and data collection, which allows the reader to determine if the appropriate practices have been used. Furthermore, dependability was ensured using an interview guide, which was checked by other researchers. Following the open coding process enables structure for future researchers to gain knowledge systematically and prevent misinterpretations. The dependability will be further increased by the usage of the inter-coder reliability measurement by Krippendorff's alpha (Krippendorff, 2011, 2018).

Appendix J. Confirmability

"How can one establish the degree to which the findings of an inquiry are a function solely of the subjects (respondents) and conditions of the inquiry and not of the biases, motivations, interests, perspectives and so on of the inquirer?" (Guba, 1981, p. 80)

"The concept of confirmability is the qualitative investor's comparable concern to objectivity" (Shenton, 2004, P.72). Confirmability is also referred to as objectivity in the literature (Drisko, 1997; Guba, 1981; Hamberg et al., 1994; Lincoln & Guba Egon G, 1985). To achieve confirmability, researchers have to prove that results are linked to conclusions. The link between results and conclusions should be clear to readers in a way that they can be followed and replicated (Moon et al., 2016). Confirmation is achieved in this research by recognizing shortcomings, describing possible effects, and the usage of bias reduction techniques. When conducting interviews, the researcher always has a certain influence on the interviewees. Since the researcher is aware of this bias beforehand and during the interview, measures can be taken to reduce the bias to a minimum. The interview guide in this research strives to reduce bias by defining the questions broadly. As a result of this, interviewees are not pushed in a certain direction. Before the interviews, the researcher explained to the interviewees that the data gathered will be anonymized and that outcomes of the interview will not be shared with their employers nor other parties involved.

Limitations of this research are the limited number of interviews due to time limitations. To tackle the limited number of interviews, the researcher interviewed a reflection of the supply base of the case company, meaning that interviewees work in different industries covered in the supply base.

Appendix K. Ethical considerations

This section includes the ethical considerations made in this research. The following aspects affected the ethical considerations in this research, anonymity, confidentiality, consent, and voluntary participation.

Respondents were informed before they provided consent to participate in the study. Every interview started with informing the participant. The information given at the start of the interview was consistent over all the interviews and is covered in the first part of the interview guide (Appendix D). Part one of the interview guide consists of the following elements.

At first, the goal of the research was explained; to gain insights into underlying motives of information sharing for forecasting purposes. The goal was explained clearly without giving any underlying motives from the literature nor hypothesis. This was done to allow the respondents to participate in the interview as objectively as possible.

Secondly, participants were informed that all data will be anonymized after transcription. After the coding process, the recordings of the interviews will be deleted. This excludes the possibility that the data in this research could be either traced or linked in any possible way to the respondents. Company names will not be mentioned nor published, concluding that these measures ensure the anonymity of the respondents, participating companies, and confidentiality of the data.

Thirdly, participants were told that they would not receive any compensation for participating in the interviews and that the participation is voluntary. Furthermore, participants were told that they could withdraw from the study at any point in time, without owing any explanation to the researcher. These measures taken ensure voluntary participation.

The first part of the interview guide concludes with the question if the participants give the researcher permission to record the interview. The goal of recording the interviews was explained; this will enable the researcher to transcribe the data as accurately as possible.

After the interview, the respondents were asked if they had any questions about the interview or research. Following with the question if participants would like to be updated about this research. If the respondents agreed, they would receive a summary of the research results once the research was completed. In addition, the research proposal is assessed by the ethics committee for Behavioral, Management, and Social sciences (BMS) of the University of Twente. The measures explained in this section were taken to confirm that the research is executed in an ethically responsible way.

Appendix L.Outcomes organizational factors per respondent

Organizational factors	Respondents
Centralization (B) (S)	2,5,6,7,11,15,16
	1,3,9,10,12
Hierarchy	
Organization size (B)	1,2,5,13
Support (B) (S)	4, 5, 15, 16

Appendix M. Outcomes technological factors per respondent

Technological factors	Respondents
System inconsistency (BS)	3,4,6,12
Capabilities (B)	2,4,5,6,12,13,16
Complexity	
(Mis)interpretation	
Traceability (S)	1,2,5,12,13

Appendix N. Outcomes managerial factors per respondent

Managerial factors	Respondents
Need recognition (B) (S)	9, 10, 13, 15 (S)
	4,8,13,16 (B)
Culture	
Trust (S)	4, 13
Competence (B) (S)	
Pace of innovation (B)	1,4,8,9,10,11,13,16

Appendix O. Outcomes financial factors per respondent

Financial factors	Respondents
Cost of change	
Availability of resources (B) (S)	2,5,6,11,16
Willingness to invest (S)	2,5,6,16
Small company size (B)	2,4,5,12,13

Appendix P.Outcomes market specific factors per respondent

Market specific factors	
Financial stability (S) (B)	5,6
Knowledge (S)	1,9,12,13
Competitive advantage (S)	4,10,13

Appendix Q. Outcomes commodity market factors per respondent

Commodity market factors	Respondents
Reduction in lead time (S)	2,3,5,6,7,9,11,16,
Decrease cost of goods (S)	2,5,6,7,13,14,
Attract new personnel (B) (S)	3,4,13,14

Appendix R. Outcomes buyer seller relationship factors per respondent

Buyer-seller relationship factors	Respondents
Long term (BS)	1,2,3,4,5,8,10,11,12
Sensitive data(BS)	3,5,14
	2,7,9,10
Trust in data (S)	2,7,8,11