Supply Chain Planning in Automotive Sector: Swedish Case Study

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ABSTRACT

This research aims to enhance current knowledge of supply chain planning (SCP) by analyzing the importance of collaboration, information exchange and a supporting information system in its successful execution. The issues are examined through a case study from international manufacturing company, Volvo Powertrain, which operates in automotive industry through its worldwide manufacturing network. This research reveals that collaboration is a complex and important issue of SCP, and occurs simultaneously in vertical and horizontal dimensions. It is important to select strategic partners and to develop a structured work processes and routines. The main objective of collaboration is to determine common goals and objectives and to facilitate the exchange of information and these together drives the performance of a supply chain. A sufficient information system supporting the SCP is vital to facilitate collaboration, and information exchange between the different supply chain participants. However, currently in Volvo Powertrain quite many phases of SCP are completed without appropriate and integrated information systems and the process itself contains several manual phases. This study is explorative in nature and more empirical data, from similar and other research settings, is needed to further validate the findings. However, its empirical findings strengthen research discipline knowhow of SCP in global manufacturing companies. This research provides insights to managers and practitioners on how to coordinate operations planning and control (OPC) across organizations within the supply chain to enhance efficiency and effectiveness. The SCP procedures described in this research work also are valuable for Volvo Powertrain and other industrial actors to further develop processes to respond on competitive pressure. This research work empirically demonstrates, as very few before have done so, how OPC can be coordinated across the supply chain. It is also based on the most recent observations from the automotive industry sector, where structural renewal has been ongoing in the recent decade due to global production overcapacity.

1. INTRODUCTION

The planning and control of operations within a manufacturing company has the objective of optimizing the performance of the internal supply chain (Jonsson and Mattsson, 2009; Olhager, 2007; Ptak, 1997). It is about creating a situation image of what the company is supposed to do in the future, which can be tomorrow, next week, next month, or next year (Vollmann, 2004). To make these decisions and to generate the required plans in a qualified way, information is needed as well as estimations of how the business is expected to be affected externally. It means that judging the future (forecasts), together with other knowledge and information are important inputs in the planning and control process (Jonson and Mattson, 2009). This is particularly the case in automotive industry, where suppliers often have dedicated assets for brand manufacturers, and they are hard to be replaced (Wei and Chen, 2008). In a manufacturing company this planning is often referred to as manufacturing planning and control (MPC), however, a more general term, also suitable for non-manufacturers, is operations planning and control (OPC).

Many aspects on several levels in the organization have to be planned, which means that the OPC normally is carried out on different levels in a company. The planning is distinct on different levels and it it has different time dimensions from short term to long term and aims at different things (Jonsson and Mattsson, 2009). Still, the overall objective is to improve the performance of the internal supply chain (Vollmann, 2004). In OPC usually four levels of planning are considered: Sales and operations planning (SOP) which deals with the long term planning of production, materials, and resources to balance the most long term resources with future demand; Master planning, which deals with the creation and planning of production plans to meet demand of customer orders, forecasts and stock level objectives; Order planning, which deals with the planning of materials supply orchestrated by master planning; and Operations activity control, which deals with the planning of manufacturing, when production orders should be carried out taking capacity into consideration (Olhager, 2007).

A major paradigm shift of modern business management is that individual organizations no longer compete as independent entities, but rather as supply chains (Christopher, 1998). What this is about is that how well a company manage to deliver the right products, in the right quantity, at the right time, to the right location, and in a cost-efficient way is not only decided internally, but is also affected by the suppliers' and distributors' performance. This has led to the growth and success of concepts such as supply chain management (Cooper et al., 1997; Hilletofth et al., 2009; Lummus and Vokurka, 1999). A supply chain can be defined as a network of autonomous organizations through which raw-materials and components are acquired, transformed and delivered to the end-user (e.g., Gibson et al., 2005; Hilletofth, 2009; Mentzer et al., 2001).

This development naturally has an effect on OPC and requires that an additional level of planning is implemented to plan the operations efficiently. When all companies in a supply chain are going to work jointly to satisfy the end-customers at the market, all actors' planning should be synchronized with the others' (Jonsson, 2008). As a logical consequence, the fifth level is about coordinating OPC across the supply chain and is entitled supply chain planning (SCP). It aims to coordinate companies' internal OPC with the overall strategic planning and control of the whole supply chain (Figure 1) and thereby decrease conflicts of

goals and sub-optimization and to get the involved actors to focus on a common goal, the end-customer (Jonsson and Mattsson, 2009; Olhager, 2007).

The objective is to develop common view of planning and control by collaborating and sharing information in the upstream and downstream of the supply chain. Information flows most often do not have a predestined route and may therefore change and develop, in contrast to material flow, and may in that way streamline a supply chain, where several actors cooperate. It requires that the use flexible and adaptable information systems to connect several organizations to a more powerful planning tool in order to exchange information for new and efficient decisions and plans (Kjellsdotter and Jonsson, 2010; Monge and Contractor, 2001). When planning the supply chain, the focus should be on certain actors to decrease the complexity with fewer links to less important actors. For many links between different actors this means that there is a large risk of losing the internal and external coordination, and for many actors it may simply lead to the exchange of unreasonable large amounts of data and information. Two fundamental parts of SCP is first that collaboration is seen as an opportunity to reduce risks and secondly that efficiency can be achieved through the exchange of strategic information (Vollmann, 2004).

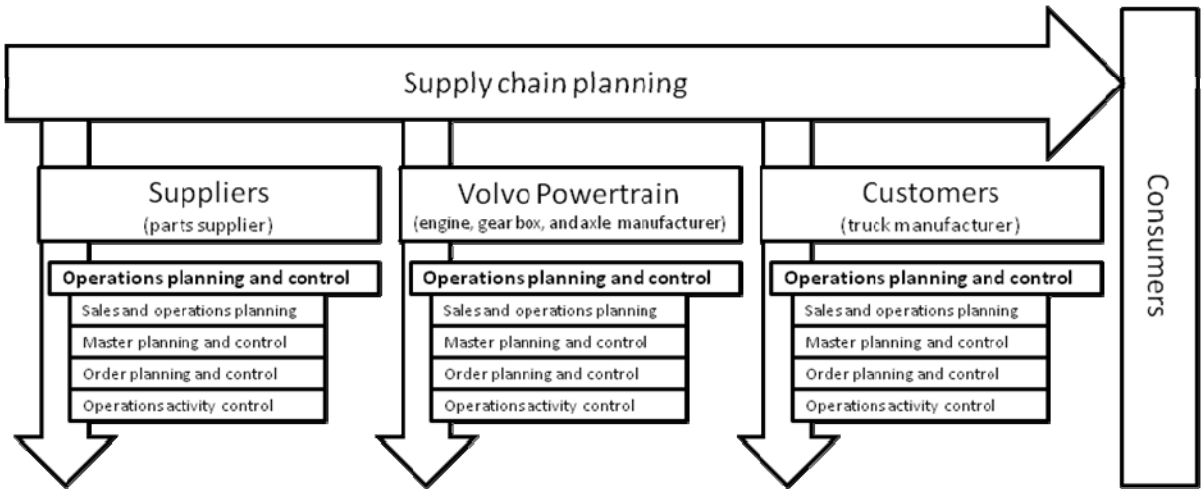

Figure 1 Supply chain planning from the perspective of Volvo Powertrain

In this research work a holistic single case study approach is used to illustrate how SCP is structured and executed in one international manufacturing company. The purpose is to create an increased understanding of SCP by analyzing the importance of collaboration, information exchange, and a supporting information system. The research questions are as follows: 'What is the importance of collaboration in supply chain planning?', 'What is the importance of information exchange in supply chain planning?', and 'What is the importance of information systems in supply chain planning?'. These questions have been studied before with respect to other issues than SCP, primarily to clarify them and to understand how they contribute in various situations. However, less research has been made in the area of how these areas contribute to facilitation and streamlining of the SCP process. The Volvo Powertrain (VPT) is a Swedish manufacturing company operating on an international basis in the automotive industry. Empirical data has been collected during year 2009 – this makes our research contemporary and also provides insights, how manufacturing networks are managed in an environment of global downturn. Automotive industry is particularly interesting, with its structural problems related to global overcapacity in production (Alpern,

2010), and emphasis on end-item inventory based production control (Koskinen and Hilmola, 2008).

2. LITERATURE REVIEW

2.1. Role of collaboration in supply chain planning

The purpose of collaboration in SCP (external) is to create a strategic weapon to maintain and/or increase competitive advantage through common planning and decision making, both internal and external (Thron et al. 2006). Internal collaboration may be about standardizing work routines in order to more easily exchange information when making decisions, internally and externally.

Collaboration is a complex and important issue of SCP as it is depending of improvements of the whole supply chain's performance and is carrying out common processes between several actors. The supply chain perspective includes a number of levels of collaboration with, for example, suppliers' suppliers and customers' customers. Collaboration is the key to create a more efficient SCP, which means teamwork when making plans and decisions in order to reach mutual goals (Jonsson and Mattsson, 2009), and thereby enhance the supply chain's overall performance.

Increasing number of companies are using collaboration as a tool for improving their supply chain performance (Barratt and Oliveira, 2001), which can increase the integration in a supply chain with several partners or actors. Collaboration can take on different shapes and varying forms within different supply chains such as: vertical collaboration, which is collaboration with external customers and suppliers as well as internal collaboration. It is of vital importance to create collaboration and relations with strategic partners, suppliers, and customers. Horizontal collaboration includes collaboration with external competitors and organizations as well as internal collaboration. Vertical collaboration can also occur between diverse supply chains (Sandberg, 2005).

Collaboration is one key element for supply chains that are seeking a more efficient and robust planning. The use of collaboration in a manufacturing company can be divided into two parts: Part one is a process that improve the visibility and trust between partners within the supply chain, and part two is a process that supports the integration of coordinated relations (Cassivi, 2006). The visibility of information and trust in a supply chain is achieved by the use and exchange of as precise information as possible. Information exchange is an important building block of SCP since supply chains are depending on the management of operations planning across the supply chain in order to enhance overall performance.

2.2. Role of information exchange in supply chain planning

Exchanging information gives the opportunity to improve and develop SCP. It is important to understand the difference between, when the exchange of information should be made, and to whom the information should be sent to. The visibility of information and trust in a supply chain is accomplished by treating and exchanging as precise information as possible (Cassivi, 2006). Data, information, and knowledge is the foundation for planning logistics activities, organizing logistics and supply chain processes, coordinating and communicating with business partners, controlling functional logistics activities, controlling the physical flow of

material and information exchange, and the sharing of information between partners within and outside of a supply chain (Waters, 2007). Information quality is a collection of ideas regarding the quality of the information and can be distinguished from several dimensions, which are further discussed in the following.

When information is valid, the information gives out what it is supposed to give out. This could be that a supplier and a customer mean the same thing when planning for example capacity. The information's reliability is about to what extent the information can be expected to be true. Reliability in SCP may be about how different actors define information in the same way. If information is delayed, that is to say not up-to-date, it does not represent the correct state at the time of usage in for example an analysis or for decision making. Complete information indicates that all specifications and data needed really have been exchanged. Valid, reliable, and complete information needs to be available at the correct time. It also needs to be easy to understand and to use. Up-to-date and complete information leads to that the information is creating value for the user. If data is structured it will become information, which can be used when exchanged as communication or analyses, interpreted or changeable (Lumsden and Mirzabeiki, 2008).

Information exchange in SCP can be done in an efficient and robust way with the help of a supporting information system (Helo and Szekely 2005), which also can reduce the risk of information not fulfilling its purpose of quality dimensions (e.g., reliability). Information systems can be viewed as a revolutionary possibility to register, handle, store, and exchange data. Information technology (IT) improves the possibilities to communicate, organize, and analyze data and with this increase the potential for efficient planning and information exchange in supply chains.

2.3. Role of information system in supply chain planning

Information systems consist of telecommunications, networks, and data process techniques and are used as a tool to gathering data, create breakdown reports, and exchange and share that information with partners in a supply chain (Waters, 2007). The key to future success is in companies spelled information systems (Lerouge and McDonald, 2008), since they allow companies and organizations to exchange information through several communication channels and thus create stronger coordinated and synchronized relations both internal and external.

A supporting information system might be the most important driving force regarding the development of SCP, since it improves the possibilities to integrate different systems and applications and to communicate. Databases make it possible to store, update, handle, and organize a very large amount of data. In databases data can be received and presented in the shape of for example pictures, graphic, numbers, or sounds. Data from databases can also be analyzed with the help of statistics and mathematical models and thereafter be used as a support tool when making future plans or forecasts in SCP. This increases the possibility to common planning and information exchange between involved actors. However, database structures are still under development due to increasing complexity and efficiency improvement need of supply chains (Ardalan and Ardalan, 2009).

Different IT tools are contributing to that more actors in a supply chain can make use of data and information. The integration of information systems and other applications in the supply

chain gives the possibility to more automated solutions, which can make the decision making more efficient in SCP. It is not an information system it itself that controls the success but the integration and creative usage of different information system functions in SCP. Different presentation tools make it possible for all actors in a supply chain to visually see compiled information. Decisions can therefore be made on the basis of homogeneous information.

The integration of systems and applications in an existing organization is mostly a long-term process and has to be combined with short-term solutions to secure that different standards and guidelines are maintained for the long-term agenda. What determines the competitive opportunities in SCP is the possibility to be able to achieve improvements, by integrating internal systems and the integration between actors. To effectively use all advantages of an information system it takes that it is user-friendly, has a simple interface and an elementary structure.

3. RESEARCH METHODOLOGY

In this research the applied research strategy has been a holistic single case study where the supply chain planning processes represent the unit of analysis. This strategy was considered appropriate since the research aimed to analyze contemporary events, capture a wider problem area, and because the researcher had no control over the events (Yin, 2008). Although, the case study strategy can be used for many purposes it has been used for exploration and theory building in this research. The main strength of the case study strategy is that it is not constrained by rigid limits of questionnaire and models, and thus can have a very high impact and lead to creative insight and development of theory. Volvo Powertrain is a Swedish manufacturer operating on international basis in the automotive industry. They were chosen on the basis of it being a Swedish automotive manufacturer and one of the largest players on the international market. It is important to note that the case study concerns OPC across a manufacturing network and that this planning is a large challenge since the automotive industry is facing global overcapacity and high costs, especially in advanced economic countries such as Europe and North America, and since the planning of such manufacturing networks is much more complex than for example planning wood pulp production.

A case study does not imply the use of a particular data collection method, as it represents a research strategy with multiple data collection methods. The possibility to combine several data collection methods is one of the major advantages of case study research (Yin, 2008), since it allow the researcher to study the research problem from several perspectives. In this research empirical data has been collected from multiple sources to enhance understanding by examining the research object from several perspectives. To be begin with, this study is based on data gained from several interviews with persons representing senior management at VPT; logistics manager, supply chain planning manager, global logistics manager, and global manufacturing manager. The interviews were conducted during 2009, and the lengths of interviews were between 60-90 minutes. The study is also based on secondary data retrieved from strategic and financial reports produced by the VPT.

Several tactics have been used to increase the validity of the case study. Firstly, several data sources (interviews and company reports) have been used to answer the same questions (triangulation). Moreover, the respondents have been asked to review the case study report

to confirm that they were understood correctly (respondent validation) and colleagues have been asked to continuously comment on the findings as they have emerged (peer examination). Assumptions and theoretical orientation have also been clarified to respondents prior to interviewing them (bias reduction). The reliability of the case study has also been improved through multiple tactics. The use of triangulation not only increases the validity of the case study but also the reliability since several data sources improve the measure and makes it more reliable. Moreover, a semi-structured interview framework has been used (case study protocol) and assumptions and theoretical orientation have been presented to the respondents prior to interviewing to make sure that appropriate respondents were selected (investigator's position). The data collection has also been documented and sometimes digitally recorded (documentation).

4. CASE STUDY FINDINGS

Volvo Powertrain (VPT) is a multinational automotive manufacturing company which uses SCP. Included in this supply chain are VPT, their partners, customers, and suppliers. The suppliers can be divided into two categories; internal suppliers which are included in the parent company and external suppliers that are freestanding. The customers and partners are global automotive manufacturers and VPT has factories in different locations of Europe, North America, South America, and Asia. Between VPT's customers and the consumers there are also different retailers.

The customers are continuously delivering program suggestions, also called volume programs, consisting of forecasted monthly sales volumes, to process step one in SCP. The collaboration in SCP is on a strategic level with several actors from several different supply chains forming a kind of an extended supply chain and has the goal of synchronize and coordinate common plans to meet the customers' demand. Another important goal is to detect capacity restriction in the industrial frame at an early stage. The SCP process can be described by 12 different steps divided in three different periods (Figure 2). Step one to three are in period one, step four to eight in period two and step nine to 12 in period three.

The first period is built upon forecasts from the customers. VPT uses an information system called *Program Capacity Check* (PCC) for SCP which all VPT's factories have access to as well as most of the internal and external key suppliers. In the second week of every month the SCP starts with the customers sending in volume plans for the next 12 months (step one). The information is based on market analyses such as new legislation, trade fairs, new products, and market conditions. The customers send their predefined plans to a general Outlook mailbox at VPT. The reliability of the information is low, since this information is not completely trustworthy and could change within time. VPT controls that all customers have delivered their information in time. In step two all customers' volume plans are consolidated. Before the consolidation step can be made some data has to be updated manually for some customers. Thereafter PCC will execute the consolidation of all data and divide all volumes between the producing plants according to registered parameters. PCC performs a material break down for each factory and key supplier. The reliability of the information has increased, but not to its full extent, since some of the input work is done manually. At this time (third week in every month/period) the volumes are seen for all users of PCC. Every factory prepares the volumes and presents the information internal. A capacity control is made by PCC for each production department (internal suppliers), external key

suppliers and partners. The purpose of this information is to pass it along to the correct persons that need it in step seven. In this first period, the collaboration is both horizontal and vertical, which suggests that it is a complex collaboration. Consideration must be made to both competitors and other organizations through market analyses as well as parallel indications from both suppliers and customers.

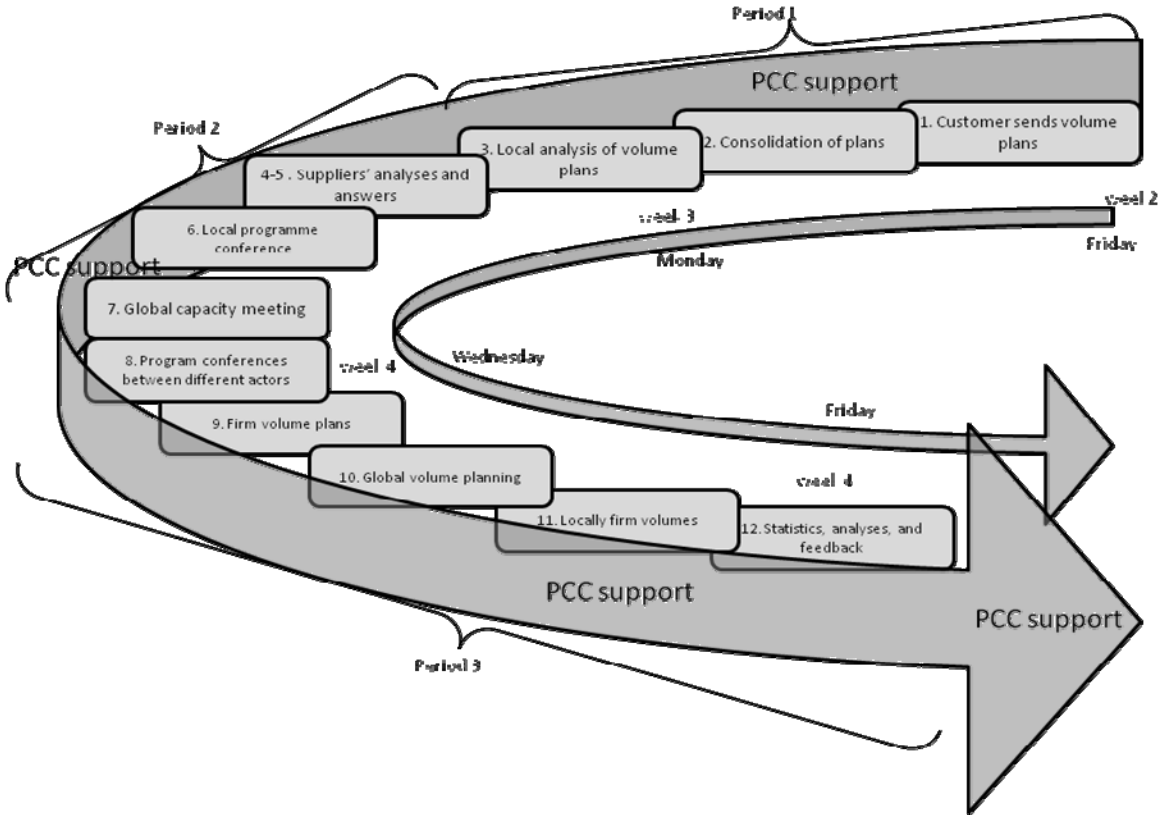

Figure 2 Illustration of VPT's supply chain planning

In the second period the preliminary plans are calculated, based on forecasted volumes. The period starts with a capacity check of each factory's available capacity of machines and personnel. At the same time as all volume plans are visible for the factories the key suppliers can see and analyze which article quantities they have to produce. The capacity is discussed between purchasing and suppliers if needed. The external suppliers are sending their responses to the suggested volume plans to VPT's global logistic department. These answers are sent to VPT via e-mail or PCC. Since the answers are preliminary, no increase or decrease of capacity is made. Each factory has its own local program conference, where they discuss, what kind of consequence the demanded volume will have, and what has to be done. Every factory sends its answer in the form of a PowerPoint presentation to the management and give the answer "Yes" or "No" to the preliminary volume plans with a motivation, if they say no. Next, the global capacity meeting is held and all customers are invited to present and explain the current market situation and the demanded volumes of products. All local factories, partners and key suppliers (through purchasing representatives) give their answers to the demanded volumes. For those actors not participating live a web-based conference system is used. After the capacity meeting the customers discuss if the volume plans should be frozen in their own brand program conference. VPT takes part in some of these meetings when discussing freezing the preliminary volume plans to firm plans. Collaboration in this

second period can be seen as vertical since external suppliers, partners, and customer interact with local factories. The capacity check is used to see, if each factory has the needed capacity to meet demand. Each month, before the process starts, PCC is updated with the correct capacity from the different factories. The information that is the result of the local program conference is used as a base for decision making at the global capacity meeting. In this period the reliability of the information has increased due to further treatment and corrections at capacity checks and discussions. Since PCC, physical conferences, a web based conference system, and PowerPoint presentations are used all data and information can be analyzed and spread further in the supply chain.

In the third and final period the preliminary volumes are confirmed, consolidated and sent out to each factory. All customers send their firm volume quantities in the shape of Excel files or system files to VPT's general Outlook mailbox. The updated volume plans are put into PCC after adjustments. The reliability of the information from customers is high at this point. The volumes are put together to be consolidated and prepared in PCC and a notification to local factories is sent through e-mail, while the information is made available for all actors involved in the system. Each factory prepares the volumes and presents the information to their own production. Customer orders are sent to VPT based on the firm volumes. PCC can be used to analyze the exactness of the volume plans and to determine level of control. Analyses and statistics are used for giving feedback to customers. The information can also be used in order to categorize the customers, but this is hardly ever done. This analysis is also done before the global capacity meeting in step seven, which is an important input to meetings with each customer. An e-mail request is sent out to each factory for feedback of the real outcome of for example budget and volume program for the further use to statistics and new analyses. In this third period collaboration can be seen as vertical, since the external actors are not involved in this period. The information exchange is the customers' firm volume plan which is spread out to the factories in a consolidated shape via PCC or e-mail. The reliability is now seen as high given that the information has been treated closely through the whole process of the SCP.

5. DISCUSSION

5.1. Collaboration

Collaboration is in VPT's case conducted on a strategic level concerning SCP with several actors from different supply chains. It means that they have a kind of an extended supply chain that has the goal to synchronize and coordinate common plans to meet customer demand. The collaboration is both horizontal and vertical, which means that it is a complex work since consideration has to be taken towards competitors, other organizations, suppliers, and customer at the same time. The main differences between literature and VPT concerning collaboration are:

1) According to literature trust is a supporting pillar to exchange reliable information. In VPT this supporting pillar yield since correction of customers volume orders are made continuously.
2) Literature describes that identifying and categorizing customers is an essential part of collaboration. VPT does analyze and identify customer on the basis of the difference between forecasted volume programs and actual outcome. This is used for

questioning the reliability at the global capacity meetings, but not used to any lager extent after that. Further follow-up could be used for segmentation of customers and the collaboration may be worked out in accordance.

3) Horizontal and vertical collaboration is described as very complex, when several actors both internally and externally, should cooperate. VPT has both horizontal and vertical collaboration in SCP and has a thoroughly process, which includes all actors to reach common plans and decisions.
4) Literature describes SCP as a way of interconnect several supply chains with the intention of making common plans in order to make the whole supply chain more efficient. VPT uses this kind of collaboration and can therefore generate more credible common plans.
5) Both literature and VPT states to use a smaller group of decision makers, key actors, which cooperate to reach common goals and decisions.
6) Sometimes it might not be the information exchange itself that should change, but how the information is exchanged. VPT's SCP has not changed over the last years but the collaboration has developed. Suppliers and customers are constantly changing as well as the market; however, the SCP process is unaltered. It might be so that it is not only the input to SCP, forecasts and market analyses, that need to be reconstructed but also the ways of collaborating. Collaboration should always be the first to be considered, then comes information system support. It may be so that it is not only the input in SCP, such as forecasts and market analyses which need to be reconstructed.

This study has shown that there is a gap in SCP when a high degree of integration and trust is needed for exchanging and spreading information in a robust way with the help of a supporting information system. Different levels of integration in coordinated relations are aimed at in order to at the same time gaining trust for each other. Theoretically it is discussed that supply chains will obtain synchronized relations with a high level of integration and trust for each other. However, segmentation and categorization of relations should be more prioritized. Collaboration with certain actors in SCP (e.g., larger and reliable actors) should be prioritized and working for a high integration and trust with these actors is important. Actors less reliable demand more work and should therefore end up further down in the categorization.

As stated earlier today's market is changeable which generates numerous changes in demand, therefore SCP has to be able to quickly adapt according to the market. Several companies have for a long time used one and the same process in SCP. However, when the market is changing as fast as it is, the process has not been updated and followed the trend towards a changeable market. In many occasions the companies work actively with improving the quality of the information and collaboration while the development of the SCP process remains unaltered.

Today's tough competition and changeable market situation imply that more and more companies are making strategic decisions by creating alliances and partnership with different actors across the world. There is no coincidence that supply chains are using the advantages with SCP, common and long term decisions. Communication and information exchange is made by a supporting information system and makes it possible to exchange and transmit data no matter of geographical distance, cultural difference, or time difference.

Collaboration with strategic partners and creating an efficient supply chain are seen as a competitive advantage and generate an opening of surviving on a harsh market. To achieve collaboration on an external level in SCP there is first a need of a well functioning internal coordination.

5.2. Information exchange

VPT's exchange of information in SCP is based on the customers' forecasted volumes one year ahead. In order to start the process correct information is needed at the right time. This information is used as a base for decision making. The quality of the information is not always reliable and on special occasion demands manual corrections based on experience and "gut feeling". VPT has very sophisticated methods of calculating forecasts that considers an ever changing market. During SCP the reliability of information has increased due to further treatment and corrections at capacity checks and discussions.

Theoretically there are many relations that can burst, when the actors do not work towards common goals and use the same definitions. If there is no common goal of how all actors can benefit from the collaboration and simple definitions of common ideas it is hard to create trust for each other. The overall aim of SCP is about actors that jointly create plans and decisions to reach common goals. The information exchange has to reflect the quality. Jonsson (2008) discusses different dimensions of information quality. Information has to be of a certain quality in order to be seen as reliable and thus usable for support in decision making. The main differences between literature and VPT concerning information exchange are:

1) High reliability of information is an important factor in SCP. VPT adds missing information of incoming volume plans from customers at the first step of the process in order to increase the reliability of the information after experience and knowledge.
2) In order to be significant information needs to add value. This means that the information needs to be complete and received in the right time. VPT exchange information, but it is not always complete to all the actors in the supply chain. Several interpretations of definitions may occur, and therefore the information is not creating value for the separate actor.
3) Information that is not complete cannot be exchanged and used for decision making. VPT increases the reliability by correcting deviations, which increases the quality by making the information complete and thereby usable and interpretable for all actors in SCP.
4) Up-to-date information needs to be present at the correct time in order to be useful. VPT receives volume plans every time they make the SCP and if the information is not received in the right time, it could have consequences when making decisions in SCP.

5.3. Information system

SCP is about making decisions. An information system could support SCP when making these decisions by being a support with calculations, history, and stored data. There are many different information systems, for example decision support systems (DSS), which is a specific system used for support at different decision situations (Kengpol, 2008; Luong et al., 2002). DSS can show different scenarios of what will happen, if for example forecasts are not corresponding to the actual outcome. This kind of support tool could give competitive

advantages when companies more easily could adapt to sudden changes in demand by early being able to predict different situations that could come across.

VPT's system support for SCP is PCC, which calculates the exactness and the precision of the customers' volume suggestions as well as calculating the available capacity for both internal and external suppliers. This is done before VPT is giving an answer to their customers' preliminary and firm volume plans. The information in PCC generates treated volume plans that are used as support for decisions further on in the process. All VPT's factories and most of the internal and external key suppliers have access to PCC on a local level. Still, the suppliers that do not have access instead have to calculate the available capacity manually and thereafter react on the normal delivery schedule information.

VPT has a good knowledge for what to use the information for and which data is needed for decisions. What could make it difficult at SCP is to find data. Their system and applications are demanding a lot of manual work and good knowledge and orientation for how to get the data. Thus, there is a need for a more user-friendly interface and knowledge of what can be extracted from information systems and other applications. The main differences between literature and VPT concerning information systems are:

1) The literature says that information should be exchanged with the same format in order to be treated in the information system as easy as possible. At VPT this is not the case, and standardized routines are only used to a limited extent.
2) The literature emphasizes physical meetings and conferences as irrelevant, when using information systems as an efficient support for information exchange. VPT uses an information system as well as both physical meetings and conferences.
3) Information systems have the capacity to store large amount of data and for a certain decision situation it could be complicated to retrieve the data needed. VPT uses a complex information system that contains large amount of data, but that could be difficult to navigate in. It can take a lot of time and effort to get the desired data. Today the full capacity of PCC is not used, since other applications are used that are integrated with it. This decreases the automatization as well as the knowledge and trust of the information system from the other actors in the SCP, since this structure is relatively complex to work with and not user-friendly.
4) The literature discusses extranet as a facilitator for exchanging information creatively and efficiently. VPT uses a web based information system where actors in SCP can gather and spread information. Another solution is the use of Internet and web pages to spread information.
5) The literature bring out information systems as a tool for analyzing and calculating data that can be used for follow-up and finding different key performance indicators (KPI) to make businesses/processes more efficient. Analyses and calculations can also be used for categorize actors in SCP. VPT analyses and perform calculations in the shape of graphs and pivot tables used for follow-up for customers and to a certain extent also for categorization of customers.

Information systems facilitate the communication between actors of different cultural background and different languages. The dissemination of information between internal and external actors can be made in different ways (often e-mails or web based solutions are used). Actors in the supply chain could use Internet and different online stores, where the

environment is individually adapted for the SCP actors. This is also a less costly solution, as actors do not have to implement an expensive and complex information system, which could enhance the collaboration on a strategic level.

This study reveals that there is a need to have a supporting information system and to integrate different applications with each other to maintain companies and the supply chain competitive. In order to creatively use the information system, there is a need for education in using it as well as a motivation to why it can favor the work in SCP. What is more interesting is the transmission of information, which makes it possible to involve several applications, and opens up the opportunity to use more functions of the information system, if needed. The transmission of information could be facilitated by a communication link that connects more functions. A communication link could decrease the duplication of work as registration of data automatically triggers the next activity at the first input. In order to make the automatization to work, it is important that the input data has high reliability.

Registration of data and information may be done both internally and externally, which means that there might be more than one version to interpret, register, and to store. This implies that standardized definitions of common ideas have to exist. It should not be possible to interpret information in more than one way. Information should be easily accessible and sorted out for the correct purpose and given to the right actor at the right time. By gathering relevant data improvements of collaboration can be made as trust can be built with the help of concrete feedback of historical data and communication.

6. CONCLUSIONS

This study has led to conclusions regarding how collaboration, information exchange and a supporting information system are used to achieve a successful implementation of SCP. An integrated and user-friendly information system supporting the SCP is vital to facilitate collaboration and information exchange between different participants which results in higher efficiency in SCP. The capacity of an information system has to be used continuously by all actors in the supply chain, which can generate that high quality information effortlessly can be exchanged and thereby be used as a support for common decision making. Depending on which kind of collaboration that is used the trust may be affected. By letting trust direct the credibility of the information the information exchange can be more reliable and subsequently be made more efficient with the help of an information system. Integration, communication, trust, and usage are the catchall terms that connect these areas. The integration of actors and information applications has to be made in order to make SCP more efficient. The communication between actors in SCP is improved by the use of a supporting information system and thus the information exchange is facilitated. In order for the exchanged information to be of high quality first-class collaboration is needed which is based on trust between the involved actors. The literature clearly states that trust is the basis for exchanging reliable information. However, this study has undoubtedly validated the literature but also shown that there still is a gap in SCP regarding integration and trust. This study also reveals something that goes hand-in-hand with earlier research: that there is a need to have a supporting information system and to integrate different applications with each other to maintain companies and the supply chain competitive. Finally, it does not matter which kind of collaboration that is used, how the information is exchanged, or which information system that is used if not the full capacity from all three areas is used to the full

extent. Interesting aspects for further research would be to continue the investigation of SCP at Volvo Powertrain (particular achieved benefits and further requirements), to enlarge the study to include more case companies from other similar and other types of businesses, and to develop a simulation model to analyze the performance and benefits of SCP.

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