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Information-sharing in supply chains - five proposals on how to proceed

Riikka Kaipia, Helena Lakervi

Abstract

Sharing information is regarded as one of the most effective ways of improving supply chain performance. Benefiting from visibility requires the efficient use of real demand and market trend information and sharing it with your suppliers. However, to implement visibility in supply chains in practice in a manner that improves the performance of the supply chain is challenging.

The current state of visibility in the demand-supply network of an original equipment manufacturing company was studied. The project concentrated on the end-to-end view of demand information. The most relevant information from the various information sources was identified and tested in order to improve the performance of the supply chain.

On the basis of the test results and a literature survey, five proposals on how to proceed in benefiting from visibility are presented.

Keywords: Logistics, supply chain management, information sharing, supply chain visibility

Introduction

Supply chain visibility does not mean sharing all information with all partners in the supply chain, but that the shared information should be capable of being reacted to and meaningful. End-to-end visibility can be defined as *'the sharing of all relevant information between supply chain partners, also over echelons in the chain'*. The focus of this research is on the whole supply chain, or the demand supply network, as the case company calls the environment it operates in.

Supply chain visibility has been discussed and studied widely in recent years. Many researchers who have approached the issue have proved that increased visibility will improve the performance of the supply chain (Kulp 2002, Gavirneni et al 1999, Lee et al 2000, Lee and Whang 2000, Yu et al 2001, Li et al 2001). The benefits of information-sharing include improved inventory management, higher sales, and better understanding of demand. However, the research is mainly theoretical and does not address the problem of implementing visibility in practice.

Examples of companies that are using demand information from points of sale effectively can also be found. For example, 7-Eleven Japan, a fast-growing convenience store retailer, has built an efficient process on the basis of point-of-sale data to offer exactly those products that the customers want and to refresh the assortment continuously. The success of the chain is based on store-by-store and item-by-item management (Sparks 1995, Best 1993, Bensaou 1997). The local use of demand data is effectively combined into a centralized management system (Ishikawa and Nejo 1998). In a weekly process, the sales trends of each individual product are analyzed centrally and strategies are developed on this basis for the current week in a large management meeting. The decisions and plans are taken to the store via area managers who visit the stores during the week.

Another example is Zara, a Spanish apparel manufacturer and retailer that has been successful in integrating the use of demand data into operations across echelons of its supply chain. Zara designs and manufactures clothes for women, men, and children, and it has 500 retail outlets in big cities around the world. Zara is able to react to trend changes and to design, manufacture, and deliver new garments to stores within only a few weeks. This responsiveness is created through a combination of its own manufacturing and local flexible capacity, of postponement of some production phases, such as dyeing, of reservation of unspecified capacity from suppliers to make last-moment changes possible, of an efficient

logistics system, and of efficient store management and store concepts (D'Andrea and Arnold 2003, Ferdows et al 2002, Harlé et al 2002, Carruthers 2003).

The success of the two example companies is based on direct access to demand data through ownership and control of the retailing echelon. They have the power to actively gather additional information from the points of sale. In Zara's case, the company also owns the manufacturing echelon. And because the company operates in fast-changing fashion markets, it is of great importance that they design the models themselves. This structure makes possible fast reactions to the trend data gathered from the markets.

However, in most supply chains manufacturers, retailers, and other players are independent decision-makers with different objectives and different information. Realising visibility in such supply chains is challenging, as the parties may not be willing to share information. The objective of this paper is to point out development areas on which original equipment manufacturers can focus in order to benefit from visibility.

Methodology

This research was carried out to find ways to benefit from the available visibility in supply chains. The objective is to point out where the focus areas are in increasing visibility and how the accessed information can be used in operations. The research question is: how can incremental visibility improve the performance of the supply chain?

This research aims at presenting relevant and functional solutions. When considering different levels of problem-solving, Simon (1996) suggests that there are four aspiration levels of problem-solving: three are novelty, relevance and functionality. The fourth criterion is optimization. In this paper the goal is not to present optimal solutions, but to find functional answers to the research question.

The research was conducted in three phases. First, a literature study concerning different data sources and data types in the supply chain and the impacts of information-sharing on supply chain performance was carried out.

The second phase, the case research, is based on a research project conducted by an original equipment manufacturing company in order to find out the state of visibility in its supply chain and to identify and test different ways to improve the situation. The analysis of current operations and information processes was carried out through interviews with key operational personnel and quantitative analyses. The focus was on clarifying the principles of setting up and using downstream information. The project team documented the actual information flow from markets all the way to suppliers in order to find out how and where the information is modified and how decision-making affects the information. Because of the complexity of the supply chain that was studied and in order to ensure a deep enough level of analysis, the data analysis was limited to the information flow concerning two product groups. The project group studied the current availability and use of two demand data sources, demand information from the markets and channel sell-through data. In the distribution channel the focus was on the forecasting processes and forecasting accuracy in each phase, compared to actual orders and deliveries. In the supplier interface the focus was on how information is transferred between the manufacturer and its suppliers.

The analysis of real-life data flows gave the project team leads and ideas on what information-sharing efforts would be the most beneficial and also where information-sharing is a waste of resources. In this way the project team defined a target state of visibility and how to get, share, and utilize the demand information when taking into account the necessary decision-making mechanisms. The processes in which the available information was utilized were also defined. For example, the frequency of updates in each phase and for all information-gathering types was defined. The concept ideas were tested in six pilot projects in order to find out the practicability of the concepts that had been developed. In these pilot projects different visibility improvements were tested using real data and they were run in parallel with current processes.

The third phase of this research involves the formation of proposals of more general interest. On the basis of the literature study and empirical analysis and tests in the consumer durables supply chain, five proposals concerning visibility in supply chains were made. These are proposed rules of thumb on how to proceed in increasing the use of demand data to improve the performance in supply chains where comprehensive demand information is not feasible.

The structure of this article follows the research process. First, recent literature concerning information-sharing is discussed. The focus is on covering different information types and on the research concerning the benefits of information-sharing between two or more echelons in the supply chain. Second, the case based on an empirical research project is described. Next, five proposals about how to proceed in increasing visibility in supply chains are presented as conclusions. Finally, the research is briefly discussed and further research needs are identified.

Literature review

The focus of the literature review is on demand information types and their usability and on the benefits of information-sharing.

Demand information types and sources

Sources of demand information from point-of-sales, POS, to the manufacturers presented in Figure 1 are reviewed. They are discussed in the light of their availability and usability in different demand-supply network phases.

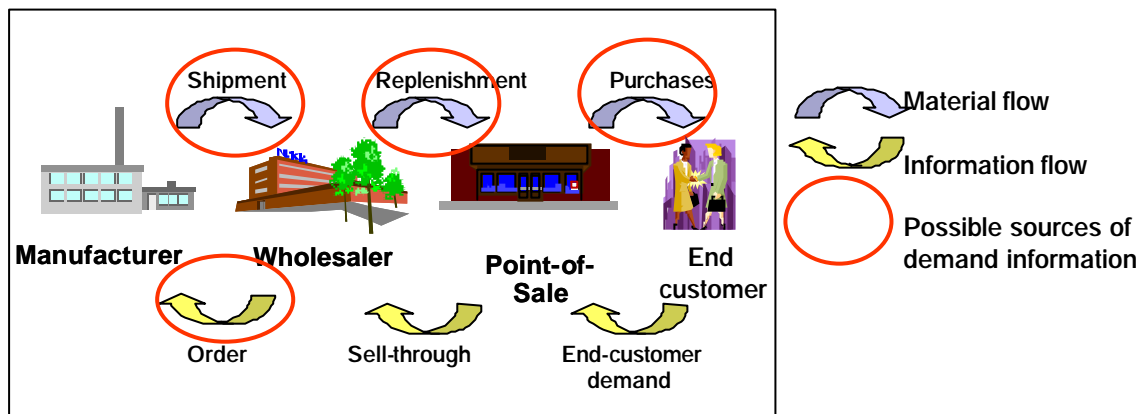


Figure 1. Sources and types of demand information.

The end-customer demand can be accessed at the POS. The main benefit of using POS data is that they represent independent demand – none of the supply chain partners have control over them. It is suggested that forecasts should be primarily based on data gathered from the POS in order to synchronize supply chain plans with consumer demand (Kiely 1998).

The downside of using POS data is that the number of points of sale may be large, the sales of one POS may be small, and not all POS's are able to collect, process, and transmit consumer data upstream (Kiely 1998, Salmi et al 2002). The information collected from a POS may be inaccurate, as items may not be scanned into the system on an individual level or returns may be handled improperly (Fisher et al 2000). In addition, the granularity of POS data is too high, especially for upstream partners, and some level of aggregation needs to be performed before the full benefit can be realized (Kiely 1998).

As access to POS data may be limited, retailer sell-through data can be used to emulate POS data. The time delay between POS data and sell-through data does not usually exceed one week. However, the retailer is one step further from the final point of consumption and order batching distorts the demand information (Kiely 1998, Salmi et al 2002).

Retailers' order data can also be used to describe demand information. Unlike the first two information types, order data are rather easy to obtain on a daily or weekly level from order management systems. However, the downsides of using customer order data are that they reflect dependent demand and do not capture consumer take-away in the current period, they

are transmitted in customer units of measure, e.g. cases, and, in the case of a no-back-order environment, the history of customer orders in a stock-out situation is lost.

However, obtaining demand information may seem irrelevant in the eyes of the supplier. Shipments from the manufacturer to the retailer may be used as a substitute. However, the manufacturer lies one stage further from the point of consumption, which results in a longer time delay from actual demand and one set of additional processing. In addition, factory shipments represent supply, not demand (Kiely 1998). Visibility to demand plans and production plans is, in many cases, more important to suppliers than the actual demand from downstream.

Research on the impacts of information-sharing on supply chain performance

Sharing only order information between the supply chain parties tends to increase demand variability, which increases the need for safety stock. As the number of stages increases, the variance of orders relative to the variance of demand grows in the upstream parts of the demand supply network (Li et al 2001). This effect, called the bullwhip effect by Lee et al (1997), can be at least partly eliminated by information-sharing (Disney and Towill 2003a and 2003b). If all parties have the POS data available, some components of the bullwhip effect can be reduced, especially concerning the upstream members (Croson and Donahue 2003). Instead, order amplification still existed despite the participants having access to POS information. Furthermore, the bullwhip effect can be reduced but not completely eliminated by centralizing demand information (Chen 1998, Chen et al 2000).

Sharing customer inventory information enables the supplier to synchronize its own production and delivery schedules in order to ensure a good service level (Li et al 2001, Gavirneni et al 1999). This mode of operation is widely called VMI, vendor-managed inventory. Frequent communication enables the supplier to react to demand changes but, as the responsibility for replenishments is shifted from the retailer to the supplier, the supplier can plan its operations better (Kaipia et al 2002). If the retailer shares customer order information with the manufacturer in addition to placing orders, the retailer will not obtain any benefits, while the manufacturer is able to reduce inventory levels. However, if the retailer outsources inventory replenishment to the manufacturer, both the retailer and the manufacturer benefit through lower inventory costs. On both information-sharing levels, the manufacturer obtains more benefits than the retailer (Yu et al 2001).

Order information-sharing leads to almost equally good results as inventory-level information-sharing if orders are placed frequently enough and demand is stationary (Cachon and Fisher 2000). By sharing inventory-level information, communication frequency can be increased without increasing ordering frequency. This means that if orders are placed frequently, communicating inventory level or other similar information does not add much value (Kaipia et al 2002).

The supplier may use sell-through information to estimate the customer demand. The higher the customer's fill rate, the better the approximation the sell-through data give about demand and the less variable the demand signal is. However, if stock-outs occur at the customer's end, the outbound deliveries under-represent the real demand and underestimate the need for safety stock (Li et al 2001).

If the supplier is able to use the customer's demand information, as opposed to the customer's order information, one stage of information distortion is eliminated and the demand is less variable than in the "no information-sharing" case (Li et al 2001). Compared to other information-sharing levels, demand information-sharing can make it possible to reduce costs by 1-35% (Gavirneni et al 1999) and decrease inventory levels by 53% (Li et al 2001), or, as Lee et al (2000) have calculated, 0-40%.

Forecast information-sharing is very valuable to the retailer if variance in demand data is high, the retailer's forecast is more accurate than the manufacturer's, and the correlation between forecasts is low (Mishra et al 2001). On the other hand, demand information-sharing is not that beneficial if demand variance is high while the available information relative to the uncertainty in the demand supply network is small and thus the cost reduction is not that effective (Gavirneni et al 1999, Li et al 2001). Forecast information-sharing is especially

beneficial in industries where demand is more dynamic and customer taste changes frequently. The manufacturer obtains a larger reduction in inventory levels and costs when demand variability is high and highly correlated over time (Lee et al 2000). High production capacity tightness makes information-sharing more valuable (Zhao 2002).

Full demand information-sharing considers a demand supply network in which all stages are informed about downstream demand. Inventory control is often centralized. Full demand information-sharing reduces both the bullwhip effect and the level of safety stocks. When consumer demand variability is low, full demand information-sharing makes possible a 75% reduction in inventory levels compared to only order information-sharing (Li et al 2001).

Notes on literature review

The value of information-sharing can be defined as the benefits derived from sharing information minus the associated costs. Typically, in research studies, it is assumed that information-sharing is beneficial and the investments are not considered. An exception is the result from Raghunathan (2001), where he states that if the manufacturer uses its available information about historical demand intelligently, there is no need to invest in information-sharing. Furthermore, research concentrates on estimating the value of information between two supply chain partners. The approach is theoretical and simulation is used as a research method. A situation where the retailer is not willing to share information has also been studied (Fransoo et al 2001).

Upstream operations in the light of information-sharing are typically not considered. The research focus is mostly on the relationship between a manufacturer and retailer, and the position of component or raw material suppliers is ignored.

One aspect not often considered in research studies of information-sharing between supply chain partners is the coverage of demand information. This can be divided into two viewpoints: first, how many stages in the network are sharing the information, and second, how many parties are sharing the demand information within one stage in the network. One example of the research findings is that the reduction of the manufacturer's forecasts fluctuate less when more retailers share their demand information (Raghunathan 2003). Some writers point out the importance of full demand information (see, for example, Simchi-Levi and Simchi-Levi 2002). However, in complicated demand-supply networks it may be almost impossible to share all information with all parties. Additionally, increased visibility through, for example, new information sources is meaningful only when the information is used to improve operational efficiency (Hahtola 2001). There is a need to define what the expedient coverage of demand information is.

Description of the case

The case concerns a demand-supply network supplying electronic consumer products globally. The state of visibility in this demand supply network was investigated by a research project during the time period October 2002 – April 2003. The research project was initiated in a manufacturing company and it was attended by two supplying companies, one being a contract equipment manufacturer and the other a component supplier, and a research institute.

The project commenced with an analysis of the current state of visibility in the supply chain. The state of visibility and the utilization of visibility were ascertained by following data and planning flows throughout the supply chain concerning two product groups. Data analysis concerning planning accuracy in each phase was carried out. The work continued through concept creation, which aimed at forming a picture about the information that was needed in the supply chain in order to improve the performance of the chain and how the information should best be accessed and used in the chain. To test and verify the concept ideas, pilot projects were defined. They were run in parallel with the current processes in order to make it possible to compare the pilot results to current operations.

Five pilot projects were carried out in order to increase the visibility in the supply chain. They focused on customer collaboration, demand data sources, planning efficiency, product life-cycle phases, and supplier collaboration. In this article, pilots are treated in the light of

demand information-sharing. Without separate pilot projects being considered, the subjects that were tested are explained next.

The first of these was the analysis of the possibilities of collaborative planning with customers in order to improve end-to-end visibility. The availability of POS data and channel data was considered, as well as how and where the data can be utilized. The study was realized by gathering POS data, channel data and plans from collaborative customers, and comparing these data to actual orders and deliveries and product mix changes. Additionally, an analysis concerning customer plans compared to POS data and, furthermore, to sales unit plans, was carried out.

Second, the supplier interface was considered in order to define what information, from the supplier's point of view, is critical to improve component availability. Several improvements in planning logic and in supplier visibility were tested. One is sharing the information concerning the degree of uncertainty in plans. Planned volumes are partly based on orders and the remaining demand on forecasts, and the suppliers need to know the share in order to be aware of the level of uncertainty. Another test was carried out to identify from the POS data the sales split between colors in product ramp-ups. The total volume was planned in advance, but the sales of different colors were updated on the basis of the latest end-customer demand.

Third, different demand information sources were compared in order to test what information can be utilized, by whom, and in which format. A comparison between POS and channel data was conducted and a proposal as to how they can be utilized was formed. The following data types were analyzed and compared in terms of quality and usability: POS sell-through data (for product mix planning and color split), channel inventory and sell-through data, and commercial POS data, which include competitor data.

The fourth issue was the planning processes and decision-making. The quality of plans was to be improved by choosing the right planning levels and eliminating unnecessary planning rounds. One problem was noticed in the VMI model that was being used, where an additional decision-making level, which caused demand distortion, was identified. Different calculation logics were tested in order to find a method that levels the information to suppliers. The necessary decision-making mechanisms and rules were defined and a definition was also reached of how the available information needs to be processed to enable it to be utilized. One point was to define what frequency of updates is feasible.

Finally, the methods and tools to be used in the product ramp-up phase were tested and further developed. These include forecasting product volumes on the basis of the historical demand for similar products, updating plans based on channel sales, POS sales and weak signals, and updating sales unit plans, regional plans, and supply plans during ramp-up on the basis of available demand data.

Selected results from the case

It was discovered that end-to-end visibility does not exist in the case supply chain. Current visibility was based on the demand-supply planning process, which combines demand information from the sales channel and supply capability from manufacturing phases. The goals of the planning process were to balance demand with supply capability, to ensure availability, and to capture sales opportunities. It was remarked that many decision-making points and planning cycles delayed the information flow and distorted and transformed demand information. The planning process is complex and includes multiple phases and different planning levels and decision-making points. The problem of demand planning is that it is based on sales unit forecasts, where the forecasting accuracy is not satisfactory.

The OEM's main source of demand information is channel data, consisting of channel inventory information and sell-through information. Until now, there have, however, been no formal processes that utilize the data in demand-supply planning. However, when considering demand data utilization the problem for the OEM is that the points of sale are located far away from the OEM and access to the POS data is limited. The number of points of sale is large and they differ greatly in size and type. A comparison of the current and target use of POS data and channel data is presented in Table 1.

	<i>POS data</i>	<i>Channel data</i>
Sources	Tens of thousands	Hundreds
Current state	Initial phase: data from some tests available	70% of volume
Access to data	Limited: commercial sources, customer collaboration, company collects itself	Customers report data weekly
Time delay	0-a few days	One week
Contents	POS sales data, from commercial data providers, also competitor sales and prices	Sell-through at customer and inventory data

Table 1. Comparison of the use and availability of POS data and channel data.

The gathering and use of POS data is in its initial stage. At present, POS data are available only from some test areas or through customer collaboration. Commercial service providers are able to offer data from some countries. The problem with collecting the data is the large number of points of sale the company's products are sold at. Therefore, the data should be gathered from an adequate sample of POS's. The most promising use of POS data is in new product ramp-ups. Before ramp-up, all operations are based on forecasts made on the basis of historical data or the sales data of similar products. When the sales start, the forecasts can be updated on the basis of early sales data. An accurate description of these ideas generated in the project in question can be read in Lakervi (2003) and in Holmström et al (2004).

Another possible use of POS data is replenishment. In customer collaboration, POS data can be used in determining the product mix and in campaign planning or as additional information in making pricing decisions.

When comparing the contents of POS data and channel data, it was noticed that the product mix is quite similar in channel data and in the end-customer sales (Figure 2).

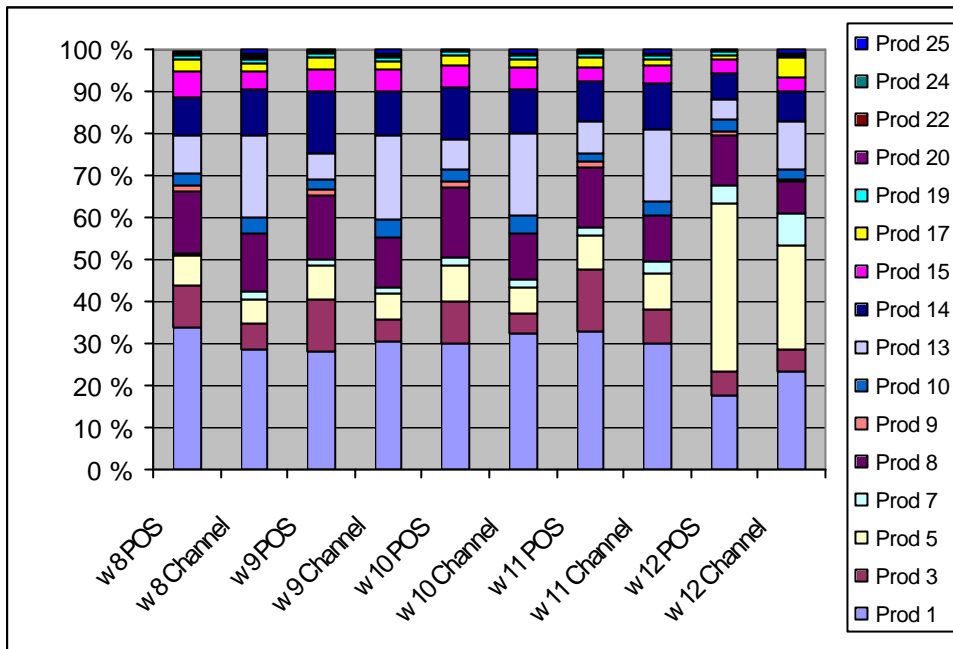


Figure 2. Comparison of product mix differences in weekly channel data and POS data. The adjacent stacks present the same weeks' channel sell-through and POS data.

Suppliers receive multiple visibility reports. These include monthly, weekly, and daily demand reports, and a product life-cycle volume plan, but when the reports were being investigated, it was noticed that they included conflicting contents. In addition, the data had gone through several planning phases in the planning process and therefore the information was based on data that were four to five weeks old. Delays in the planning process caused demand fluctuation for the suppliers. Suppliers report supply capability weekly to the OEM. However, as the delivery time of many components is very long, plans are needed months before.

The replenishment cycle is fast for customers as inventories are kept in the channel to ensure availability to the points of sale. Customer collaboration was implemented with a few customers with good results; forecasting accuracy improved remarkably. Outside the collaborating customers, customer data visibility is limited.

A growing product mix increases the complexity of demand planning. For example, a new product launched on to the market may consist of several color variants and of customer-specific models. The availability of products becomes a problem for customers if forecasting demand split between different variants has not succeeded.

Proposals: five rules of thumb on development areas in information-sharing

In the research project the following development areas were identified as the most promising in improving the performance of the demand-supply network from the point of view of visibility. These rules of thumb were formed on the basis of the findings in the case supply chain but are here presented in a more general context by using literature review findings to assess the practicability of these proposals in other environments.

The proposals for finding functional solutions are:

- 1 Share only information that improves supply chain performance
- 2 Simplify, synchronize, and stabilize demand-supply planning processes
- 3 Use a combination of different demand data sources

- 4 Benefit from collaborative relationships with customers
- 5 Understand suppliers' real needs for demand information

1 Share only information that improves supply chain performance

The focus of visibility development should be on sharing information that can be used to improve the performance of the demand-supply network. The shared data should enable the best business decisions to be made on the basis of the best available information.

Full visibility means that all parties in the network have all the information all the way along the supply chain. This is almost impossible to implement in complex demand-supply networks and should not be the focus of visibility development. In addition, the idea is in conflict with the principle that all shared data should be meaningful and useful. Instead, end-to-end visibility, which means that all demand-supply network players have access to all meaningful information concerning what happens in different parts of the chain, must be the target of development actions.

In the literature the main approach is to theoretically study the benefits of information-sharing in different situations. For example, sharing POS data between all partners in the supply chain reduces the bullwhip effect (Croson and Donohue 2003). The benefits of VMI, vendor-managed inventory, include bullwhip reduction (Disney and Towill 2003a and 2003b). Sharing inventory replenishment method information reduces costs by an average of 50% (Gavirneni et al 1999), or, under conditions of low consumer demand variability, decreases inventory levels by 35% compared to only order information-sharing (Li et al 2001). Kulp (2002) finds in an empirical study that the extent of VMI use increases with information precision, information reliability, and company size. Planning accuracy will be improved if forecasts can be based on POS data (Kiely 1998). Also, as Fisher (1994) proves, using early sales data to update forecasts improves forecasting accuracy remarkably. Smáros (2004) has tested the value of point-of-sales data in product introductions and indicates that early sales data help in identifying and correcting too-optimistic forecasts for new products or can reduce stock-out risks if sales exceed those estimated.

Typically, the researchers assume that information-sharing is beneficial, and only the benefits are considered, not the costs associated with information-sharing or investments in information technology. Furthermore, the connection between the shared information and process development is rarely considered.

There is a need to develop processes or to improve existing ones in order to benefit from incremental visibility. First, the process of gathering and handling the data must be developed. Second, the processes and physical operations must be able to utilize the data and take advantage of the increased visibility. For example, in the case supply chain there has been a process in place to gather the channel data since 2002; the coverage of the data is good and it is reported with a one-week delay. However, there are no formal processes for the utilization of the data. The main use of this channel data is in sales units.

Both 7-Eleven and Zara are using demand data to offer an optimal assortment in their stores. Zara uses the expertise of the store staff to catch demand trends and to base new product designs on these. 7-Eleven aims at serving the customers of each individual store. Integrated information systems are essential, but what is more important is integrating the operations in order to ensure the efficient use of demand data.

2 Simplify, synchronize, and stabilize demand-supply planning processes

The orders from downstream are a critical part of planning for future demand. Since these orders may have been processed several times in the downstream environment by the time they reach the supplier, the information may have been distorted in such a way that it differs greatly from end-customer demand.

In the case supply chain the information went through many decision-making points and planning phases. In addition, there emerged many manual phases between system phases. The plan was taken out of the system for some changes and then returned to the planning system. In general it was noticed that plans were generated on a very accurate level, for example on a sales package level.

Several improvements to be made to planning processes were identified. One was planning simplification; to plan on a coarser product level and as rarely as possible. This means reducing planning times, raising planning levels higher up the product hierarchy, or choosing the right time horizons. One aspect is to reduce how often the figures are touched; weekly planning under stable conditions should be replaced by exception-based planning.

The second improvement is to synchronize planning operations better. Time-related issues cause many problems in the demand-supply network that was studied. The length of the cycle is, from demand changes at a sales unit today, 1-2 weeks to the 1st-tier supplier and 3-4 weeks to the 2nd-tier supplier. Data-processing phases, manual steps in the process, and synchronization problems cause delays in the process. In addition to information delays, different planning periods cause problems. Combining weekly and monthly planning may cause problems when the customer's and supplier's planning periods differ. Plans may be based on, for example, data that are one week old, while fresh data are available only a couple of hours after the planning moment.

The third improvement is stabilizing planning and avoiding major last-minute changes in plans. In the supply chain that was studied, changes of production batches between plants in order to fulfill capacity caused problems in transportation and uncertainty about production volumes even for the next week. Additionally, changes in demand information may cause peaks in plans. To stabilize the planning system, the too-reactive features of the planning process need to be eliminated. An approach for stabilizing planning is presented by Disney et al (1997). They propose slow reactions to changes in demand signals by implementing the change needed during several future planning periods.

3 Use a combination of different demand data sources

Demand information is more than end-customer demand volume – it consists of forecasts, inventory levels, product mix, sell-through at the retailer's end, shipments from the manufacturer, or weak signals from the market. The source of demand information defines the granularity and dependence of demand information (Kiely 1998). The demand information received from POS's is very detailed and independent of other factors, such as order batching, but it is not always easy to obtain or process. The further from the end-customer the demand is measured, the more factors affect it but the easier it is to obtain.

The importance of point-of-sales data has been emphasized in the literature. However, in the case supply chain the channel data, meaning sell-through data and channel inventory movement, were considered to be more useful than POS data. Current access to demand information is based on visibility to trade customers' inventory and sell-through. Systematic collection of channel information was started at the beginning of 2002. Since then, the coverage of customers has grown to over 60%, with some countries continuously reporting 90% of their sales volume. No formal way to utilize the channel data has yet emerged. In some sales units the data are used as a basis for planning, but their use seems to be occasional and dependent on the planner's skills and interests.

However, the two company examples, 7-11 and Zara, showed how it is possible to collect and efficiently utilize POS data. The success of these companies is based on efficient and accurate use of demand data. It is also interesting that these companies base their product design and development on the demand data in order to ensure that they are a step closer to customer tastes than their competitors are.

4 Benefit from collaborative relationships with customers

Customer collaboration can be implemented on different levels. According to Bacon et al (2002), collaboration takes place in three forms: transactional relationships, information-sharing relationships, and the joint planning and development of business plans. A transactional relationship is the traditional way of operating; changing orders and bills. In an information-sharing relationship some additional information, such as inventory levels or order status, is shared. In the joint planning and development of business plans the shared information is used interactively. The CPFR collaboration initiative aims at the last form, while VMI can be located in the information-sharing relationship. Most current relationships are on the transactional or information-sharing levels.

In the case project, the importance of customer collaboration was emphasized because it was seen as making it possible to access point-of-sales data. In such supply chains, where the customer relationship is not based on ownership, this point is of great importance.

Additionally, collaboration may facilitate access to customer plans and forecasts and weak signals from the markets. As a counterbalance to the access to the demand data, collaborative customers get more secure deliveries, better availability of best-selling products and variants, and altogether more responsive operations according to the actual sales from points of sale.

In the case supply chain collaboration practices were started with a couple of customers. With one customer it was noticed that the customer's forecasting processes were inadequate, and only through collaboration was the customer able to provide feasible forecasts. The situation is the opposite in the daily products sector, where some large retail customers provide forecasts for their suppliers, because they are best qualified to forecast consumer demand (Kiely 1998).

Many researchers note that the benefits of information-sharing are bigger for manufacturers than retailers (Zhao et al 2002, Yu et al 2001). Therefore the customers may not be willing to share information unless some incentives are provided. These may be reduced wholesale prices (Kulp 2002) or, in VMI, also a reduced workload and frequent inventory replenishments and intensified competition between manufacturers (Mishra and Raghunathan 2004).

5 Understand suppliers' real needs for demand information

Upstream in the supply chain, the visibility needs differ from those of downstream players. Often, the suppliers have no use for end-customer demand; it should at least be aggregated to a level at which suppliers can utilize it. Instead, forecasts for a period that may be as much as several months are needed, since raw material or component lead times may be long.

Therefore, the first way to improve the supplier's visibility is to improve the quality of planning in the whole demand-supply network. The data would be received by the suppliers sooner and in a less modified form if the planning processes were synchronized and additional manual phases were eliminated.

It was noticed in the study project that suppliers receive several forecasts and demand reports. However, the reports seem not to be delivering the same data. Therefore, the suppliers have chosen one primary source of information and operated on the basis of that. This has led to a situation in which, for example, long-term forecasts are not used because the data do not include the same content as frequent short-term reports. In the research project it was emphasized that the suppliers should be provided with one set of numbers.

Choosing the right planning level and frequency of plan updates depends on different factors. The forecasting process is simplified and becomes less laborious if forecasts can be made on a rough product hierarchy level. However, the demand for certain variant-specific models may be needed months in advance, which makes variant forecasting necessary.

One solution is separating volume plans and variant plans. The total volume for a product family is planned in the base planning process and for the planning period in question according to component and raw material purchasing needs. In practice, separated variant and volume planning can take place as follows. The share of each variant's sales is taken from the freshest POS data. This share is used to update the product family forecast. The changes in the share of each variant's sales are considered each time the POS data are received, but changes in forecasts are updated only if the change is big enough, avoiding too-fast reactions to minor demand changes.

The position of component or raw material suppliers in the light of demand information-sharing is not widely dealt with in the literature. Kiely (1998) suggests that demand planning systems require the use of all customer-supplied data in order to provide better level forecasts. Li et al (2001) suggest a hybrid information-sharing strategy in which demand information is shared in the distribution network and in inventory information in the supply network. The real visibility needs of upstream players, consisting of, for example, production plans, long-term forecasts, and demand data, seem not to have been studied.

Discussion and further research

The future of visibility development is linked to other development activities, especially collaborative practices. Unfortunately, in many cases existing collaborative practices focus on short-term cost savings and operational improvements (Bacon et al 2002). Thus, collaboration seems to be on a tactical rather than a strategic level. Furthermore, the benefits for collaborative retailers and manufacturers are different. The retailer's benefits are derived from more effective coordination of wholesale and retail prices to manage consumer demand. Manufacturers benefit from better inventory and shortage management, in addition to better demand management (Mishra et al 2001).

When considering collaborative practices in the light of information-sharing, most collaboration initiatives and partnership relationships focus on the development of the relationship between two members of a supply chain. End-to-end approaches or collaboration over one echelon in the chain are rarely the case. However, from the point of view of visibility, the sharing of information should also take place over echelons in the chain. For example, suppliers' suppliers need forecasts from the manufacturer, or from further downstream in the distribution chain.

This research was carried out in order to get a picture of the current state of demand visibility in supply chains. In some supply chains, the companies have been able to implement working practices and gained benefits from access to their end-customer demand. In this article we have described Zara's and Seven-Eleven's solutions. These companies have a direct link to POS data through ownership. In the case company, where channel data is already available but POS data collection is more difficult, the greatest benefit will be gained through full utilization of channel data. In addition, the analysis revealed that POS data and channel sell-through data equated well enough.

The manufacturing company is located quite far from the end-customer and does not have direct access to demand. However, in the case company and case demand-supply chain, information-sharing would not solve the problems of long lead times and data-processing delays. Thus, synchronizing and simplifying planning processes and reducing planning phases would improve the performance of the chain. The quality of information will be improved and the demand data distortion in the channel will be reduced.

There are many sources of shared information. In addition to the demand data, there are forecasts, physical shipments in the chain, and inventory movement data. The selection of data sources depends on the ability of the process to utilize the data. In many cases local use is fruitful. For example, POS data can be effectively utilized in sales units in campaign planning and forecasting.

There seem to be difficulties in increasing visibility and utilizing incremental information sources. However, the benefits of collaboration are mostly based on improved information-sharing. The usage of visibility means especially improving the accuracy of plans, reacting proactively to changes downstream, and synchronizing activities across the chain. End-to-end visibility can also help to provide improved operating models in the demand-supply network.

Visibility, as such, does not improve the performance of the supply chain. Incremental sources of demand information are meaningful only if operational efficiency can be improved through their use. The value of demand information depends on how well the operations are connected to the use of new information sources and how well they support and react to changes in demand. In further research case studies should be provided on how demand information is used in processes throughout the chain. Another issue for further research is planning processes and their role in improving the quality of shared information and in improving supply chain performance.

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