Abstract number 011-0756

"Improved collaboration and information sharing by using supply chain contracts"

Bjørn R. Albrigtsen[1], Erlend Alfnes[2], Heidi C. Dreyer[2],

[1]Norwegian University of Science and Technology

Department of Production and Quality Engineering

S.P. Andersens veg 5, N-7465 Trondheim, Norway

Phone (+47) 73 59 37 60, fax (+47) 73 59 71 17.

Corresponding author: bjorn.r.albrigtsen@ntnu.no

[2]SINTEF Technology and society

Department of Industrial management

Operations management group

S.P. Andersens veg 5, N-7465 Trondheim, Norway

POMS 20th Annual Conference

Orlando, Florida U.S.A.

May 1st to May 4th, 2009

Paper type: Research paper

Keywords: Supply chain contract, information sharing, collaboration

Abstract

The main purpose in this paper is to analyze and propose how supply chain contracts can be the fundament for better collaboration and information sharing between a manufacturer and wholesaler. A literature review has been carried out to identify the main collaborative areas that can be supported by a contract. A framework is proposed to analyze the contractual aspects of collaboration. This framework has been tested in a case study in the Norwegian HVAC[1] sector. The experience from the case is that the framework can contribute to better collaboration and information sharing between partners in the supply chain, and thus strengthen the strategic position in the market for participants.

1. Introduction

A supply chain consists of vendors, manufacturers, distributors and retailers interconnected by transportation, information and financial infrastructure. The supply chains objective is to provide value to the end customer and for each participant in the supply chain. There is a significant physical flow and information flow between entities in the supply chain. Managing and controlling these flows effectively and efficiently requires a systems approach to successfully integrate and coordinate the interactions among entities. To do this is not an easy task. The often conflicting objectives among channel partners and the dynamic system, variations over time and uncertainty in demand can lead to many challenges for a supply chain.

The traditional way in which companies do business is at arms length of each other. Several studies show that this is the status in a lot of industries today. In a study of the British automobile industry concerning partnerships between suppliers and contractors they discovered that only 1 % of the contracts were partnering contracts while the trade volume in these partnerships

[1] HVAC: Heating, Ventilating and Air Conditioning

amounted to 12% (Weele, 2005). It looks like partnerships are more common in extensive and complicated than in minor and less complex supply chains.

Companies are mainly interested in their own interests which do not necessarily contribute to the best overall performance for the supply chain as a whole. Decisions taken by a single company without considering other entities in the supply chain can lead to inefficiency in the whole supply chain network and contribute to higher costs, reduced service level and a weakened strategic position in the market. Meanwhile, in today's global market, a larger share of the companies realize that the performance they can provide to their customers depends on how well they collaborate and coordinate their supply chain activities with other entities in the supply chain. Utilizing different forms of collaboration which integrate and coordinate different processes, product flows and information flows between the actors in the supply chain would gain considerable profit through reduced uncertainty, eliminate non-value adding activities and so gain a higher efficiency in their supply chain activities.

The main purpose in this paper is to analyze and propose how supply contracts can be the fundament for better collaboration and information sharing between a manufacturer and wholesaler. Further, how these can be developed to make the collaboration between the entities in the supply chain more effective and improve the service level in the supply chain.

Basis for this paper's basis is value chain theory[2]. Game theory and operation analysis methods are not a part of this paper and will not be discussed.

[2] Value chain theory: is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements (Simchi-Levi, 2008).

2. Research method

This paper presents an explorative case study with the aim of understanding how to improve collaboration and information sharing by using supply contact as a facilitator. A case study research strategy is used (Eisenhardt 1989; Yin 1994). The scientific fundament for the research is a combination of literature from operations management field focusing on supply contracts, information sharing and collaboration, applied on an empirical example from a supply chain in the Norwegian HVAC-industry. Empirical data from this case have been collected through observations, interviews and written documentation. Data from different sources were brought together to form a coherent picture of the case. This resulted in a case description that was checked by key informants in order to ensure validity. According to Eisenhardt's recommendations, the study was set up without any particular theory or hypotheses in mind in order to retain theoretical flexibility.

3. Literature

Supply chain operations aims at balancing the efforts needed for manufacturing and delivering products and services with the value created though customer demand. Today, the leading operations paradigm is to develop a SC system which is demand driven, coordinated and integrated and aligned on sharing information between the participants. This aims to create gains in the SC which is larger than the effort of a single company. The strengths of the SCM approach are that each company can be better off when collaborating with suppliers and customer, than within the traditional company to company competitive environment. In such situations we could experience double marginalization, and this could reduce the total profitability in the supply chain (Tsay et al., 1999).

Moving from a traditional competitive customer supplier relationship to a SC chain relationship where the flow of materials and information is demand driven and synchronized requires changes in processes (integration and collaboration models), behavior (trust and information sharing), and in contracts.

3.1 Integration and collaboration models

Integration means to join and connect physical and administrative processes so that redundancy can be avoided and activities are made seamless across organizational boarders. The achievements of integrations are a more or less friction free and coordinated flow of information and material throughout the SC (Christopher, 1998; Frohlich and Westbrooke, 2001; Bowersox et al., 1999). Achievements from integration depend on the integration level and how tightly the processes are connected (Tyndall et al., 1998). Among trading partners, a relationship can have various intensity levels ranging from open-market negotiations, cooperation and coordination to collaboration. Highly integrated processes lead to more gains than less integrated processes.

According to Holweg et al. (2005) the SC can be categorized in four different types. Type 1 is the traditional type of SC relationship where each company makes individual decisions and the relationship mainly is concentrated to price discussions. The integration level is low and with standardized short term contracts to secure the transaction. Type 2 has a higher level of integration with long termed contracts (Clemons and Row, 1992; Bensaou, 1997). The companies share demand information and action plans in order to control forecasts for capacity and long term planning. In type 3 the replenishment task is given to the vendor, who takes responsibility for maintaining the customer's inventory and therefore also their customers service levels. Type 4, synchronized supply, is the most extensive form of collaboration where the parties eliminate decision points and merge the replenishment decision with the production and

materials planning of the supplier. Here, the supplier takes charge of the customer's inventory replenishment on the operational level, and uses this visibility in planning in his own supply operations. Both in type 3 and type 4 the integration level is high and a can be characterized as a collaborative relationship (Tyndall et al., 1998). It is based on a high degree of trust, commitment and information-sharing as companies develop interdependent integrating activities and information flows across company boundaries. For example, it can be achieved when operations of all companies in the supply chain are unified enabling optimization of the entire supply chain (Campbell and Sankaran, 2005) or when several integration dimensions such as information integration, coordination and organizational linkage are integrated (Lee, 2000).

The initiatives to redesign and establish more demand driven and synchronized has led to several collaborations models, all with a high level of integration (Simchi-Levi et al., 2008). Collaboration concepts such as Quick Response (QR), Efficient Consumer Response (ECR), Vendor Managed Inventory (VMI), Collaborative Planning, Forecasting and Replenishment (CPFR), and automatic replenishment programs (ARPs) are examples that have been examined in recent research and applied in real life (Andraski, 1994; Daugherty et al., 1999; Ellinger et al., 1999; Myers et al., 2000; Sabath et al., 2001; Lohtia et al., 2004). Common for these models is that the customers are supplied according to their actual demand which is directly coupled with the orders from their customer. Both POS data and stock level can be used to allow for real time information on demand enabled by the use of information and communication technology (ICT).

3.2 Information sharing

Sharing of demand information is an important mechanism in SC collaborative models aiming for the SC to be more demand driven, responsive and synchronized. Without information sharing

the Bullwhip effect can hardly be avoided and the companies have to rely on inventories as a buffer against variability (Forrester, 1958; Lee et al., 1999).

Information sharing can occur at several levels. Under “no information sharing”, the only demand data the supplier receives are actual orders from his immediate customer. At the “full information sharing” level, complete information is available to support the specific decision-making environment. This could include one or more of the following: production status and costs, inventory levels, various capacities, demand data from all channel members, and all planned promotional strategies. Partial information sharing occurs between these two extremes.

Several authors have made research in information sharing risk in supply chain context. Yuan and Qiong (2008) have revealed at least nine potential risks to occur when sharing information: cost increasing, asset specificity, leaking business secret, damaging partners benefit, losing bargaining competence, monitoring difficulty, supply chain alliance dissolution, information transmission and information security. Though information sharing can improve overall performance in the supply chain, the potential risks of sharing information weaken the enthusiasm of the upstream and downstream companies to do so. These risks would, if not managed properly, be a threat to collaboration between companies in the supply chain. The same authors have underlined the importance of commitment between the collaborating companies and the authors have also suggested three possible incentives towards information risks:

a) First, profit allocation of information sharing can be based on productive behavior. This means rewarding information sharing lead to a specific mutual objective, rather than attainment of the objective itself.
b) Second, there is pay-for-information sharing, which suggests setting performance metrics to evaluate the partners and rewarding them based on outcomes of information sharing

activities. Pay-for-information sharing allows the participating parties to recognize each other for a job well done, to motivate desired information sharing, and to control costs and service levels.

c) The third type of information sharing incentive alignment is equitable compensation. They carry out open book practice that consists of the overall costs and benefits and the individual costs and benefits. They share risks and fairly assess the actual performance in determining the fair distribution of gains.

3.3 Supply Contracts

Behavior that is locally rational can be inefficient from a global perspective (Whang, 1995), and attention turns to methods for improving system efficiencies that can:

a) Reallocate decision rights
b) Rules for sharing costs for inventory stock-outs
c) Policies governing pricing to the end-customer or supply chain partners
d) Representation of the information structure and rules for information sharing

Supply chain contracts focus on operational details requiring modeling material flows and factors like uncertainty in the supply or demand of products, forecasting, production capacity and penalties (Tsay et al., 1999).

Simchi-Levi et al. (2008) discusses different forms of supply contracts between companies. These are:

a) Buy-Back Contracts: in this kind of contact the seller agrees to buy back unsold products for some agreed upon price above the salvage value. This reduces the risk for the buyer.
b) Revenue-Sharing Contracts: The buyer shares some of the revenue with the seller

c) Quantity-Flexibility Contracts: The supplier provides full refund for returned (unsold) items as long as the number of returns is no larger than a certain quantity
d) Sales Rebate Contracts: sales rebate contracts provide a direct incentive to the retailer to increase sales by means of a rebate paid by the supplier for any item sold above a certain quantity.

Coherent supply contracts between buyers or vendors in the supply chain could be a substantial instrument for better coordination and risk control. Supply contracts specify parameters like; price, discounts, quantity, lead time, quality, buy-back and time horizon. Purposes of supply contracts are to improve the performance, share risks, support long-term relationships and make the terms of a relationship explicit between actors in the supply chain (Tsay et al., 1999).

An important motive with establishing supply contracts are to avoid repetitive negotiations about prices, discounts and conditions between the participants in a supply chain collaboration. Repetitive negotiations could affect the implementation and performance in the supply chain (Amrani-Zouggar et al., 2008; Arnulf et al., 2005).

Based on the literature study we have composed a framework for supply chain contracts in Table 1 which will be used in the analysis of the case.

Framework for Supply Chain Contracts				
No.	**Supply chain area**	**No**	**Description**	**Authors**
1.	Price and discount - *deal with unit price, fixed price and different types of discounts*	a	The manufacturer gives the wholesaler a sales discount for sale above a forecasted volume. This gives the buyer a incitement to focus on sale of the product and at the same time as it increase the sale for the manufacturer	Simchi-Levi et al. (2008) Tsay et al. (1999)
2.	Service level – *deal with service level on deliveries*	a	Vendor pays a fee to a customer in case he doesn't deliver according to order from the customer. This will increase the manufacturers cost if he under invest in capacity, while it reduces the wholesalers loss by not being able to deliver the product (loss of sale)	Fracatore and Mahmodi (2008)
3.	Minimum and maximum purchase commitments – *deal with agreements in regard to minimum or maximum purchase quantity within an order or period*	a	Minimum order quantity within a period with penalty if the buyer doesn't meet the forecasted order quantity. This focuses on the importance of the quality of the forecast from the buyer and reduces the uncertainty for the producer in regard to utilization of production capacity.	Das and Abdel-Malek (2003), Cachon and Lariviere (1997a)
4.	Buy-back or return policy – m*ake clear the terms for product returns both on quantity and price*	a	Buy-back of unsold quantity from a wholesaler with a price deduction will reduce the uncertainty for the wholesaler for products that are unsold and will give the wholesaler a incitement for higher order quantity.	Simchi-Levi (2008)
5.	Quantity Flexibility – *buyer gets an opportunity to deviate within a limit (above or below) from the forecasted quantity subject to certain constraints and/or financial consequences*	a	The manufacturer gives the wholesaler an allowance for full refund for product return within a limited quantity. This will split the risk between the manufacturer and wholesaler	Simchi-Levi (2008)
		b	Quantity Flexibility which link the customer obligation (forecast) to buy a minimum percentage share of the agreed up on quantity and the manufacturers guaranty to deliver up to a certain level above the agreed up on quantity. This encourages the customer to plan more conscious. In exchange the vendor must give the buyer an incitement to participate by giving a discount. This leads to a risk sharing between the participants in the supply chain	Tsay (1999)
6.	Allocation rules – *specify how the manufacturers available stock or production capacity is to be distributed among multiple customers in a shortage situation*	a	If the manufacturer has to ration the deliveries between different buyers. This can induce competition between wholesalers and, therefore lead to strategic behavior such as the retailer that try to inflate their orders, which distorts the flow of information and could lead to bullwhip effect. This could be avoided if there is a norm of distribution which is known by the wholesalers. Possible methods are; (1) equal allocation between customers who have orders the product, or (2) allocation based on earlier purchase quantity of the product.	Tsay et al (1999), Lee et al. (1997), Cachon and Larriviere (1997b)
7.	Lead-time on deliveries – *this clause makes clear the possible benefits of adjusting that lead time in the supply contract*	a	A cut-down in lead time outside of the ordinary determined standards imply that the wholesaler pays a higher price to the manufacturer. This improve the flexibility for the wholesaler and covers for the higher cost the manufacturer has by carrying inventory and expedite rush orders	Das and Abdel-Malek (2003)
8.	Product and material quality – *Relationship between a vendor and customer is built upon the quality of the delivered product. This can be formalized in the contract agreement*	a	Manufacturer pay the cost of repair or improvement of the product failure and a extra fee for compensation to the wholesaler/customer	Reyniers and Tapiero (1995)
9.	Time horizon in the contract – *the contract period must be seen in the context with the obligation to the participants*	a	To achieve a profitable collaboration in the supply chain it is in most cases necessary to establish a long-term agreement. To gain profitable supply chain collaboration it is often a need to invest in production capacity, ICT-systems and to spend a considerable time involving organizations units in the collaborative companies. If this should be profitable there is often a need of a long horizon to depreciate the investment.	Amrani-Zouggar, Deschamps and Bourriéres (2008)
		b	Long term agreements can result in collaborative efforts in fields that is nor profitable on short sight, could be profitable at a longer sight.	Tsay et al (1999)
		c	Long-term contracts indicate increased revenue potential in the supply chain	Fracatore and Mahmodi (2008)
10.	Information sharing – *This clause is meant as an incentive for partners to share information*	a	Three possible incentives to strengthen the enthusiasm for information sharing 1. Profit allocation based on productive behavior. 2. Pay-for-information sharing 3. Equitable compensation based on open book practice that consists of the overall costs and benefits and individual costs and benefits. The companies share risks and gains	Yuan and Qiong (2008)

Table 1 - Framework for Supply Contracts

4. Case

This case is from the Norwegian HVAC industry and the parties presented are a manufacturer of soil pipes and a wholesaler in the HVAC industry. The manufacturer is part of an international industrial enterprise and is a market leader in the Norwegian market for soil and pipes. The wholesaler is part of a Scandinavian industrial enterprise and is one of three wholesalers in the Norwegian market. The HVAC industry in Norway is dominated by three wholesalers which control a major part of market sales and total sales were in 2007 estimated close to 8 billion NOK.

Forward buying is frequently used in the whole supply chain and is caused by quantity discount. It is also observed that the "hockey-stick" phenomenon occurs at the turn of the year because of the settling of bonuses accounts. This leads to extreme demand from wholesalers to the manufacturer and causes massive disturbances for the manufacturer and also unnecessary inventory at the wholesaler.

The tendering procedure includes a lot of layers and includes the end customer, the contractor/developer, plumbing companies, wholesalers and the manufacturer. This process is time consuming and includes a lot of negotiations.

The participants in the industry are introvert and are mainly interested in gross profit, bonuses, framework agreement, distribution, internal discounts, loyalty bonuses, quantity discount and less in the end customers' requirements.

The supply chain is characterized with high inventory levels and long lead times. There is a low extent of integration and coordination among the entities in the supply chain. Further, there are a

lot of actors and people involved in the ordering and purchasing processes. There is an understanding among the participants in the supply chain that the competition will increase in the near future.

The supply chain has an extensive distributed inventory policy. Entities in the supply chain do not have an agreement upon where in the supply chain different finished products should be stocked. Therefore the supply chain is characterized with a huge amount of inventory. The manufacturer has an inventory turnover of 8 times pr. year while the wholesaler has a inventory turnover of 3 times pr. year. Average flowtime from manufacturer's raw material stock through wholesaler's stock is 185 days - the manufacturer counts for 45 days and the wholesaler counts for 140 days.

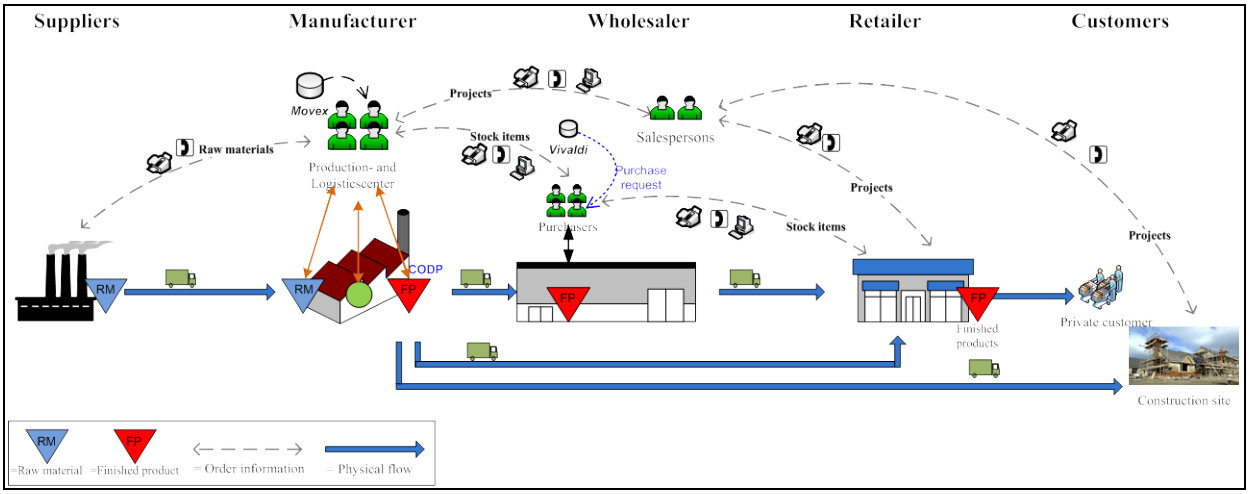

Figure 1 - The HVAC Supply Chain

The Supply Chain consists of suppliers, manufacturers, wholesalers, retailers and customers. The suppliers carry a stock of raw materials to supply manufacturers. The manufacturer has raw material, WIP[3] and a finished products inventory. The manufacturer bases their inventory policy on a "reorder level" and "order up to level". The production is based on MTS[4]. The manufacturer is responsible for the delivery (transportation) to the wholesaler, direct delivery to

[3] Work In Progress
[4] Make-to-stock

retailers and customers. The wholesaler carries stocks of finished products at eight regional warehouses which supplies different retailers like plumbing companies, chain stores and Proff-centers[5]. Smaller plumbing companies collect products at Proff-centers. Remote plumbers either get their deliveries directly from the nearest regional warehouse or Proff-center. Proff-centers are owned by the wholesaler. Customers may be ordinary consumers who buy HVAC-products at the retailers or chain stores outlets (like Comfort AS, Bademiljø AS or Rørleggerkjeden AS). Other end customers may be building owners - private or public, and construction companies. These other customers don't carry any significant inventory of finished products.

Order information travels upstream in the supply chain from end customers to suppliers. The flow and order information is decentralized in the whole supply chain. There is no sharing of demand information, like POS-data, monthly sales, forecasts between entities in the supply chain except between the Proff-centers and the wholesalers which belong to the same company and where the ERP[6]-system is incorporated in one database.

Sales between the wholesaler and the manufacturer in this case were in 2007 approximately 150 million NOK and discounts and bonuses amounts to 25 -50 % of the gross sales dependent on products.

The products are pipes and fittings. Annually there are approximately 5.200 orders or 22 orders every day delivered from the manufacturer to the wholesaler. Annually, the number of item lines is approximately 42.000. Mean order volume is 28.000 NOK. The assortment in the Norwegian market contains of approximately 950 articles. 34 are A[7]-articles, 87 are B-articles, 188 are C-articles and 636 are D-articles. Studies of transactions data indicates that 25 % of the articles are

[5] Proff-centers: Special stores for plumbers and other craftsmen.
[6] ERP: Enterprise Resource Planning
[7] ABCD-classification of the articles is done based on sales, were A-articles amount to 50 % of sales, B-articles 30 %, C-articles 15 % and D-articles 5 %

sold every week while only 2 % of the articles are sold every day. 50 % of the articles are sold infrequent 1 month. Sales are balanced evenly through the year, but are some percents higher in the period from April through October. Service level in 2008 was 95 % based on LIFR[8].

4.1 Supply contract between manufacturer and wholesaler

The supply contract is based on four main conditions which can be referred to as "supply contract area"; see Table 1 - Framework for Supply Contracts. This is (1) Price and discounts, (2) service level, (3) lead time and (4) time horizon of the contract.

First, the price is based on a gross price and discounts are given for orders above a certain amount. The wholesaler also receives free freight for orders above a specified amount. Additionally the wholesaler receives bonuses for special products, special product groups, industrial concern bonus, deliveries to warehouses and special invoice bonuses. All bonuses increase in steps with increased purchases.

Second, there is a condition on service level based on 95 % Line Item Fill Rate. If the manufacturer doesn't succeed to fill the lines he has to pay a fee. The service level is measured once a month.

Third, the contractual lead time is 5 working days. This is applicable also for direct shipments to retailers and customers ordered by the wholesaler. Actual lead time to the major part of the market is one day and more rural part of the market two days.

Fourth; the contract between the manufacturer and the wholesaler is based on an annual agreement and valid from January 1st to December 31st and is negotiated once a year.

[8] LIFR: Calculated as the total number of customer order line items filled divided by the total number of customer lines attempted.

5. Discussion

On the basis of the literature review and the case we will discuss and propose elements in a supply chain contract which will lead to improved collaboration and information sharing.

The literature study indicates the importance of integration and coordination between entities in the supply chain by extended collaboration and information sharing using coherent supply chain contracts between entities in the supply chain to prevent bullwhip effect, hockey stick effect, long and unreliable lead times and service level.

The case show a traditional supply chain characterized by continuous negotiations between companies, forward buying, discounts, bonuses, high inventory levels and poor service level across the whole supply chain.

This means that elements in a supply chain contract are an important issue and a basic premise for an effective supply chain. We will therefore discuss the different elements in a supply chain contract.

Price and discounts

The manufacturer and wholesaler have mainly based the supply contract on prices and discounts, like quantity discount, free freight, product group bonus, special product group bonus, warehouse bonus etc. These types of discounts and bonuses lead to several problems in the supply chain like bullwhip effect, hockey stick-effect and high inventories which leads to inefficiency in the supply chain. Instead of operating with gross prices and different discounts and bonuses the recommendations to gain operations efficiency are to use the principle of EDLP[9]

[9] EDLP: Everyday low pricing

(Lee et al., 1997) in order to reduce speculations, forward buying and high inventories. Further they should phase out discounts and bonuses and find the prices on net prices. This would contribute to the prevention of speculation which is present today. We experienced that the wholesaler placed an order which amounted to nine heavy goods vehicles of goods just to achieve the bonus this year. Further; this could also prevent the bullwhip effect known in supply chains where such price- and discounts are used. This episode led to overtime at the manufacturer's site and followed by uneven production and layoffs for workers later on. The example mentioned above is also a driver for the hockey stick phenomena and creates disturbance for the manufacturer which leads to overtime and higher cost. For the wholesaler this leads to higher inventory and cost of capital. This is partly confirmed by the registrations of inventory turnover which is very low (three times with the wholesaler).

Additionally the prices in the supply contract should be built on an open book so that the parties could openly discuss and improve operations so that the cost of the product and services become a low as possible. We recommend that the cost in the calculations should be based on ABC[10] which will contribute to maximum operational efficiency (Lee et al. 1997) and together with EDLC[11]. Additionally we recommend that combined with the concept of an open book calculation introduce revenue sharing among the companies. This will prevent or strongly reduce the opportunistic behavior and contribute to a higher degree of global optimization (Tsay et al., 1999) in the supply chain.

The tendering process in the industry is complicated and time consuming which mainly comes from the culture of ongoing negotiations between companies. This has taken place despite the annual agreement between the companies. This process seems to be inefficient for all parties. By

[10] ABC: Activity Based Costing
[11] EDLC: Everyday low cost

phasing out discounts and bonuses and rely on net prices based on EDLP, the tendering process will become more smooth and effective for all parties in the supply chain and make the supply chain more competitive as a whole. An example of this is an order of products from a small construction firm of approximately NOK 20.000 (≈$ 3.000) which achieved better prices and conditions than the whole range of discounts and bonuses of the agreement between the manufacturer and wholesaler built on a annual turnover of approximately NOK 140 millions. This shows the inefficiency in the tendering process with focus on prices and discounts. To solve the inefficiency in the tendering process we recommend that the companies introduce EDLP, EDLC and profit sharing to gain a higher efficiency in the supply chain.

Every company that plans to change its pricing and discount structure should be aware of the possibility of internal resistance, especially from marketing and sales people. To succeed in an operation such as this, it is necessary to include the people in the organization to the change ahead and prepare them for why it has to be done and how. That counts for both the organization at the manufacturer as well as the wholesaler.

Buy-back or return policy

The case companies do not have any agreement referring to buy-back or return policy in the supply contract. This seems unserviceable because the wholesaler could have a setback on sales for various reasons in the different regions and other mistakes could have happened when purchasing the products. An example of this is that the purchaser had misinterpreted the demand information and ordered products that was sold to a project but didn't have regular sales. The inventory of this product is stocked at the regional warehouse which has no sale on that particular product, but the manufacturer sells this product to other customers in other regions. As the arrangement is today, the wholesaler bears all risk for uncertainty and the manufacturer none.

Sharing risk is part of a close relationship and it seems appropriate that the manufacturer bear some of that risk. The manufacturer also has the possibility for risk pooling (Simchi-Levi et al. 2008) uncertainty along the supply chain and has the opportunity to deliver the product to other wholesalers in other regions or markets outside Norway. The conditions for buy-back or returns could be that the products were bought within a certain period (last year or two years), be undamaged etc. The wholesaler should also accept a price reduction and pay the return costs (fright, taxes etc.). This effort will result in a better suited risk sharing among the collaborative parties and reduce uncertainty for the wholesaler and at the same time increase the uncertainty for the manufacturer. Meanwhile the manufacturer has a better opportunity to sell the products by risk pooling among other customers or in other markets.

Allocation rules

Even if a company does all the necessary planning, still there may occur unforeseen accidents which will influence other companies' ability to supply their customers. If such an incident occurs it is important for both the manufacturer and wholesaler to know how the manufacturers' available stock or production capacity is to be distributed in case of shortage situations. The supply contract does not contain any such clause today. An example of this is a promotion event that happened when launching a new product. One of the wholesalers orders the whole stock of that product and all of the other wholesalers were unable to participate in the promotion of the new product. New products for the campaign were scheduled and ready for delivery in 8 weeks. According to Lee et al., 1997, Tsay et al., 1999 and Cachon and Larriviere, 1997b they all argue for a standard for distribution which is known by the wholesalers and assign two possible methods: (1) equal allocation between customers who have ordered the product, or (2) allocation based on purchase quantity of the product. This can reduce competition between wholesalers and reduce strategic behavior such as the wholesalers that try to inflate their orders, which distorts

the flow of information and therefore could lead to bullwhip effect in the supply chain. We strongly recommend the parties to implement such a clause to prevent making the terms explicit to their customers.

Product and material quality

This condition is not a part of the supply contract in this case. Relationship between vendor and customer is built upon the quality of delivered products and this should be formalized in the contract agreement. The consequence of product failures is that the wholesaler must take this in to consideration when deciding safety stock. Alternatively they will face stock outs and decreased service level. Reyniers and Tapiero (1995) and Tsay et al. (1999) both suggest that the manufacturer should pay a cost for repair or improvement of the product failure and an extra compensation to the wholesaler for their inconvenience and lost goodwill from their customers again. This may influence the manufacturer to consider the allocation of resources that prevent quality failure and not neglect product quality. This is also a kind of risk sharing between the manufacturer and wholesaler in cases where there occur quality failures in products or services. We recommend the companies to implement this clause in the supply chain contract.

Time horizon in the supply contract

Long term agreements can result in collaborative efforts in fields that are not profitable on short sight but could be profitable at a longer sight. An example could be investments in production capacity, ICT-systems and time involving organizations units in the collaborative companies. As we have argued earlier, information sharing is an important enabler for a coordinated and effective supply chain. Implementing EDI and sharing POS-data etc will bring along investments. If this should be profitable there is often a need of a long horizon to depreciate the investment. The supply contract in this case is based on a one year contract which is negotiated

every year. This seems to be too short to gain the benefits. Kraljic (1983) argue for a time horizon up to ten years for supply chain contracts. We recommend that the agreements should be no shorter than three years and should be aligned to the depreciation time for investments which often is of a time horizon of three to five years.

Lead time

Lead time is a key factor in a supply chain both on the safety stock and service level. The reliability is as important as speed in deliveries. The consequence of low reliability has consequences for determination of the safety stock, and therefore also for the service level the wholesaler can offer to their customers. The supply contract between the manufacturer and wholesaler in the case includes a contractual obligation for the manufacturer to deliver with a lead time of five working days from receiving the order from the wholesaler. If the manufacturer doesn't meet this lead time they have to make compensation to the wholesaler. This seems reasonable taking in to the consideration of the possible loss the wholesaler could have by losing sales and gaining badwill from their customers. However, in practice the manufacturer meets an even lower lead time which in central part of the sales area is one day and the rest of the area is two days. It seems that the manufacturer has streamlined his processes and therefore has been able to lower the actual lead time. Slack in lead time seems unnecessary and should therefore be adjusted to practice without the slack built in today's supply contract. This will create a better business opportunity and strengthen the competitiveness for the whole supply chain and it can also contribute to lower the safety stock and increase service levels downstream the supply chain.

The supply contract doesn't have a lead time outside of the ordinary determined standards, e.g. rush orders. The supply contract should have such a clause. This would contribute to a more

responsive supply chain and meet extraordinary demands from the wholesalers or their customers. An arrangement like this would be more costly than the ordinary and the supply contract should take this into consideration and the price for such rush orders could have a higher or premium price.

Service level

A service level of 95 %, compared to other comparable industries seems low. The result of this is that the downstream entities have to take this relatively low service level into consideration and increase their safety stock to a higher level because the retailers and end customers have higher requirements to the service level than the actual service level today. Collaboration between the manufacturer and wholesaler in information sharing could make the supply chain more visible and therefore contribute to a more responsive supply chain. A result of this initiative could decrease safety stock and at the same time increase competitiveness in the whole supply chain.

In today's supply contract the manufacturer has an obligation to deliver a certain service level based on LIFR[12] of 95 %. This service level is measured every month. If the target level isn't reached, the manufacturer has to compensate the wholesaler for missing deliveries. This contractual obligation works as a risk sharing point in the supply contract which compensates the wholesaler for missed deliveries. This seems reasonable taking in to consideration the possible extra work, uncertainty and therefore also the extra safety stock the wholesaler has to bear to cover for that uncertainty.

[12]LIFR: Line Item Fill Rate. [Calculated as the total number of customer order line items filled divided by the total number of customer lines attempted.]

Information sharing

The case companies have no agreement on information sharing. To really achieve a more visible supply chain that can cut bullwhip effect, cut lead times, reduce inventory and increase service level, the companies should establish information sharing as a part of the supply chain contract.

First, the supply contract should take in to consideration to establish an electronic exchange of order information, e.g. purchase orders from wholesalers, order confirmations, packing lists and invoices. This would give a positive effect on transactions costs and administrative lead time. An initiative like this calls for investments in ICT-technology and therefore a longer time horizon in the supply contract.

Second, the most important initiatives will be to extend the exchange of demand data and inventory levels between the companies. Extending the exchange of information up- and downstream the supply chain will increase the positive effect on coordination, bullwhip effect and demand uncertainty. Today the information flow is sequential between entities in the supply chain. A better way to share information is to centralize information along the supply chain so that all entities have the same oversight of real-time demand information. This initiative can begin with the manufacturer and wholesaler, but it should be extended further downstream within the supply chain, e.g. retailers etc.

Third, the two companies should take an incentive to share their promotion plans. This may help the entities to take this in to consideration both on short and long term and streamlining the supply chain in areas like production capacity on short and long term, production plans etc. Also this initiative should be extended to the retailers to get a full effect in the whole supply chain.

Information sharing would, according to Yuan and Qiong (2008), raise the risk in the supply chain. This calls for incentives to control and manage theses possible risks. These incentives should be a part of the supply contract and made explicit among the companies. Incentives could be; (1) Profit allocation based on productive behavior, (2) Pay-for-information sharing or (3) Equitable compensation based on open book practice that consists of the overall costs and benefits and individual costs and benefits. By utilizing these incentives the companies share risks and gains and it will therefore be a vast possibility for collaboration between companies.

Based on the discussion above we make a proposal for a supply chain contract based on a manufacturer - wholesaler relation:

- **Prices:** base the prices on net prices, EDLP, EDLC and combine it with an open book, ABC-calculation and revenue sharing.
- **Buy-back/returns policy:** implement buy-back or returns policy with a deduction in price for wholesaler
- **Allocation rules:** Assign a standard distribution known to the wholesalers based on either (1) equal allocation between customers who have ordered the product, or (2) allocation based on earlier purchased quantity of the product.
- **Product and material quality:** manufacturer should pay for the repair for product failure and a compensation to the wholesaler
- **Time horizon in the supply chain contract:** establish a time horizon in the contract for three to five years and maximum of ten years.
- **Lead time:** establish lead time in accordance to customers' needs and see to it that it's measured continuously. Additionally establish a lead time for rush orders in conjunction with the customer's requirements and with a premium price.

- **Service level:** establish service level as a part of the contract and see to it that it's measured continuously. Manufacturer should compensate if the goal for service level isn't achieved. Measurement-method must be known to both parties.
- **Information sharing:** make information sharing a part of the supply chain contract which commits the parties to establish an electronic exchange of order information, exchange of demand data and inventory levels and promotion plans. Include possible risks of information exchange and make a common strategy to avoid risks. Also include an incentive-plan for: 1) Profit allocation based on productive behavior, (2) Pay-for-information sharing or (3) Equitable compensation based on open book practice that consists of the overall costs and benefits and individual costs and benefits. By utilizing these incentives the companies share risks and gains and it will therefore offer a vast possibility for collaboration between companies.

6. Conclusion

The companies in the case study have a traditional supply chain relationship, but wish to achieve a level where they operate in a synchronized supply chain with an extensive form of collaboration. To achieve the level of synchronization they will have to implement information sharing as part of the supply chain contract. We have learned the lesson of the importance of information sharing and the reliability in deliveries. The case companies have accepted the need for better information sharing and modifications of the supply chain contract, and have already started to implement what we have suggested. Further work should concentrate on performance measurement connected to important contract elements.

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