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Centralised grocery supply chain planning: improved exception management

Centralised Grocery Supply Chain Planning:
Improved Exception Management

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Abstract

Purpose – This paper presents an operations model for retail replenishment collaboration and identifies its expected benefits and limitations for the members of a grocery supply chain.

Design/methodology/approach – A case study is conducted on a development project between a grocery wholesaler and two grocery product suppliers. Data is collected through semi-structured interviews with key respondents from four different companies.

Findings – Despite advances in collaborative practices in grocery supply chains, retail store replenishment management faces challenges. In particular, demand exceptions management is a challenge in the grocery industry. A replenishment model called Collaborative Buyer-Managed Forecasting (CBMF) creates a proactive planning approach and a platform for close collaboration in the supply chain. The centralised forecasting transforms retailer sales data into a plan which serves the whole supply chain by creating one order forecast. The CBMF model facilitates efficient demand management, improves demand responsiveness and promotes better availability of products in retail stores.

Research limitations/implications – CBMF provides a replenishment planning model for the whole supply chain. It is tested to a limited extent in one supply chain.

Practical implications – The study provides managers with a better understanding of the benefits of centralised forecasting and closer replenishment collaboration, especially during periods of exceptional demand.

Originality/value – A new approach for managing demand in grocery supply chains with centralised forecasting is provided.

Keywords: collaboration; demand management; forecasting; grocery industry; retail; Vendor-Managed Inventory (VMI); Collaborative Planning, Forecasting and Replenishment (CPFR), point-of-sale data (POS data).

Paper type Research paper

1. Introduction

In retail supply chains, poor replenishment performance leads to product availability problems in stores, or, on the other hand, oversupply of products. This shows particularly in managing exceptional demand situations, such as promotional campaigns, seasonal demand and product introductions, where demand is less predictable (Ehrenthal et al., 2014; Taylor and Fearne, 2009). These problems have a direct financial impact on the whole supply chain in the form of lost sales and profit (Corsten and Gruen, 2003; van Woensel et al., 2007; Ehrenthal and Stölzle, 2013), or, in cases of oversupply, the products being discarded because the expiry dates have passed or the season is over (Taylor and Fearne, 2009; Kaipia et. al., 2013). As a solution to the problem, collaborative retail replenishment practices have been presented, such as Vendor-Managed Inventory (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR), which are based on the efficient sharing of sales and inventory information (Cachon and Fisher, 2000). However, these models have not totally solved the challenge of how to manage exceptional demand situations throughout the supply chain. In these situations, having access to downstream information is often not enough, as the following example of a product introduction shows:

A wholesaler and manufacturer had a well-functioning, established vendor-managed inventory (VMI) programme, where the manufacturer made inventory replenishment decisions about the wholesaler's inventory on behalf of the wholesaler. During a recent product introduction, a well-known brand product was re-launched onto the Finnish grocery market with moderate expectations. After the introduction, the demand for the product increased quickly to levels above those forecast and caused out-of-stock (OOS) situations at both the wholesaler and retailers. Since the manufacturer of the product only had visibility over the inventory levels at the wholesaler, it could only guess if the OOS at the wholesaler was caused by actual OOS in the grocery stores or whether the stores had adjusted their inventory parameters. At the same time, representatives at the wholesaler wondered at the inability of the manufacturer to supply the newly introduced product. Even though the product was available in some smaller stores, availability problems in large stores caused significant losses of sales.

Therefore, in addition to purely technical information sharing, companies need to invest in collaboration with supply chain partners. Collaboration is a partnership where companies are committed to planning and executing operations together, aiming for the best possible solution for both parties (Simatupang and Sridharan, 2005). VMI and CPFR have been developed to create close collaboration and enable information to be shared between supply chain partners (Barratt, 2003). The benefits resulting from the supplier's responsibility for replenishing the customer's inventory, such as secured inventory availability on the customer's premises, are encouraging companies to invest in VMI (Waller et al., 1999; Sari, 2008; Claassen et al., 2008). However, problems in implementation have been reported, and especially manufacturers have found it hard to realise the expected benefits (Småros et al., 2003). VMI is suitable for products for which there is stable demand, but it faces difficulties in capturing demand uncertainties related to, for example, promotional activities (Barratt, 2003).

CPFR is one of the most developed supply chain collaboration practices (Attaran and Attaran, 2007). In CPFR, the jointly developed business activities create an agile supply chain that can better capture demand uncertainties in the market, compared to VMI. Still, CPFR does not solve all the challenges of grocery replenishment management as a result of the extensive human and financial resource commitment needed as well as the inability of manufacturers to utilise the detailed point-of-sale (POS) data from stores in their own planning (for example, Barratt and Oliveira, 2001; Fliedner, 2003; Holmström et al., 2002; Småros et al., 2003; Holweg et al., 2005; Whipple and Russell, 2007). While creating order forecasts is considered very important for upstream production planning and transportation and in reducing inventory risk, many suppliers still struggle to identify the best ways to utilise POS data for predicting orders and improving performance (Williams et al., 2014).

The replenishment challenges have been associated with the specific features of the grocery industry: high product variety and fierce price competition, which causes volatile sales. The volatility in demand is not only affected by promotional campaigns, but also seasons, the weather and more flexible opening hours of grocery stores (Småros, 2012). Furthermore, retailers may not be willing to share on-hand inventory levels, and, secondly, the shared data may be inaccurate. Supply chain planning in these circumstances is challenging, because accurate and reliable forecasts are needed to be able to create a responsive supply chain (Kaipia et al., 2013).

This paper presents a new approach to retail replenishment collaboration. The foundation of the model is in VMI and CPFR, but includes features to overcome the limitations of these replenishment models, particularly in enhancing the available visibility in supply chains. Hence, the new model can better capture marketing-driven changes in retail sales while keeping down the resources required. The purpose of the case study is to identify the expected benefits and limitations of this model for the members of a grocery supply chain. Against this background, we have designed and implemented an embedded single case study based on a current development project between a grocery wholesaler and two of its suppliers in Finland, which is the specific context of this study, and where we address the following three research questions:

> *(1) What are the main challenges for VMI and CPFR in the grocery industry?*
> *(2) How should a retail replenishment model be designed to overcome the challenges/limitations of VMI and CPFR?*
> *(3) What are the perceived benefits and limitations of the centralised retail replenishment model?*

The paper is structured as follows. First, previous retail replenishment models and the role of POS data in forecasting are reviewed, and thereafter the research design is described. Then results based on the case analysis are presented and propositions are developed. The paper ends with concluding remarks.

2. Forecasting and replenishment in retail supply chains and development of the new model

In order to understand the need for a new replenishment model, the use of POS data as a basis for forecasting, as well as previously developed retail replenishment models in the grocery industry, are studied. Two concepts, VMI and CPFR, are selected to be treated in this literature review because they represent the latest stage of development in retail replenishment collaboration and information sharing (Barratt, 2003; Holweg et al., 2005; Attaran and Attaran, 2007) and they have received attention from researchers. Other concepts were not selected because of their similarity to VMI or CPFR (i.e. Continuous Replenishment) or their focus on wider aspects of collaboration (i.e. Efficient Consumer Response, ECR).

2.1. Using various types of demand and inventory data as the basis for forecasting and planning

Using POS data as the primary data source for forecasting brings better forecast alignment with real consumer demand (Kiely, 1998; Kaipia et al., 2006). POS data represents independent demand, i.e. consumption data that none of the supply chain partners can control. However, benefiting from access to POS data is far from straightforward as a result of the detailed nature of the data (Kiely, 1998; Barratt and Oliveira, 2001). Improper scanning at the check-out counter may also cause unreliable data, which can cause a trading programme (such as VMI and CPFR) to fail (Kiely, 1998). In these situations sharing POS data is not enough; it needs to be complemented with data from multiple sources (Jonsson and Mattsson, 2013).

As a solution, creating order forecasts on the basis of POS data has been proposed (Williams and Waller, 2010; Williams et al., 2014). When comparing the benefits of using POS data instead of retailer order history it was found that forecasts combining both POS data and order history predict demand accurately (Williams and Waller, 2010), supporting the idea that several sources of data need to be combined in order to create the most realistic plan. The benefits of order forecasts include their better usability compared to non-processed POS data

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because they consider the timing of replenishment and quantity needed in individual stores or warehouses. Order forecasts combine three types of information (Småros, 2012):

      (1) the predicted retailer sales data that is updated on the basis of the latest POS data;

      (2) stock-on-hand information and already placed replenishment orders and

      (3) information on control parameters that affect the time and quantity of orders.

In order to realise the desired benefits of information sharing, decisions need to be synchronised to enable supply chain members to align and re-allocate decision making at the planning and execution levels (Simatupang and Sridharan, 2005). Supply chain members tend to have conflicting criteria and the planning result is not optimal for the whole supply chain. Therefore, the best solution may be that one supply chain member makes the decision for the whole supply chain (Simatupang and Sridharan, 2005). Collaborative forecasting has been proved to be challenging as well as resource-consuming in the context of CPFR (Ireland and Bruce, 2000; Fliedner, 2003; Whipple and Russell, 2007). In general, centralising forecast decision making has only been studied to a limited extent.

2.2 VMI and CPFR

This section presents the concepts of VMI and CPFR and evaluates their reported benefits and limitations (collected into Table 1), and thus contributes to the first research question posed. VMI is a classical application of the idea of substituting inventory with information, where the replenishment decisions for a customer are shifted to an upstream supplier (Kauremaa et al., 2009). The supplier monitors the buyer's stock levels and sales data (physically or electronically) and replenishes the inventory, subject to agreed-upon parameters (e.g. maximum and minimum inventory levels) (Waller et al., 1999). The supplier can choose the order quantities, shipping and timing within the agreed limits (Waller et al., 1999; Kaipia et al., 2002). The supplier generates order proposals in the VMI system and the traditional purchase order is therefore removed (Waller et al., 1999).

CPFR extends the idea of VMI to include joint planning processes (Seifert, 2003; Attaran and Attaran, 2007). The potential benefits of sharing information for enhanced planning visibility were considered to be enormous (Fliedner, 2003; VICS, 2008). Even though technology plays an important role in the execution of CPFR, it is not considered as a technical standard (Attaran and Attaran, 2007). Common tools between supply chain partners support the process and enable historical data and forecasts to be shared. Whipple and Russell (2007) present three types of collaborative approaches. This division of approaches differs from VMI and CPFR, but the results indicate the same limitation, namely that a cross-functional collaborative relationship with a high sustainable pay-off is difficult to implement with a large number of partners (Whipple and Russell, 2007).

VMI reduces the demand amplification effect in the supply chain (Disney and Towill, 2003), because it removes one decision-making phase in the chain. The other benefits of VMI include extending a supplier's option to more proactively plan their own production schedule, reductions in inventory and transportation costs, better customer service through higher delivery reliability, and an overall closer relationship (for example, Waller et al., 1999; Whipple and Russell, 2007; Claassen et al., 2008). VMI also has its limitations. The major weakness is that replenishment is usually based on the inventory level at the buyer's distribution centre, which disregards the inventories in stores and on shelves (Barratt, 2003; Whipple and Russell, 2007). VMI is also more suitable for products characterised by large volumes and stable demand, and it has been proven to be hard to maintain for small-scale products that are on promotion (Barratt, 2003; Hines, 2004). Some recent extended models of VMI (Pohlen and Goldsby, 2003; Danese, 2006) have shown that a wider optimisation of the

supply network creates a win-win situation in the supply chain. Thus, the main limitation of VMI is the limited ability to utilise POS data, as the model is based on inventory information usage. This makes it hard to manage promotions and other exceptional demand situations through VMI, and leads to the conclusion that VMI is best suited to managing product replenishments that are characterised by stable demand (Table 1).

CPFR includes some similar features to VMI, such as a strong focus on efficient replenishments and data usage. Both models are claimed to suit products for which there is stable demand, but CPFR is considered more suitable in cases of demand uncertainties. However, support for demand exceptions is limited. Additionally, several limitations of VMI are covered by CPFR (Barratt and Oliveira, 2001). These include more accurate forecasting of promotions and fewer stock-outs, lower total supply chain costs, and higher customer service levels and visibility of inventory levels in the retail stores (Seifert, 2003; Barratt, 2003; Attaran and Attaran, 2007). CPFR ties together sales of finished products and the manufacturing process, and the long-term collaborative relationship between the partners is considered to create value for the consumer and profitability for all collaborating partners (Attaran and Attaran, 2007). A simulation study showed that the benefits gained from CPFR were higher than those from VMI, which shows in lower total supply chain costs and higher customer service levels (Sari, 2008). When CPFR is compared to VMI, it suffers from its complex and resource-consuming nature, and therefore large-scale implementations are few (Table 1).

While CPFR is seen as the latest stage in development, it still cannot solve all the challenges in grocery replenishment management. The weaknesses of CPFR (Table 1) include the suppliers' inability to use the POS data and the lack of trust and incentive to collaborate at this high level (Barratt and Oliveira, 2001; Holmström et al., 2002, Holweg et al., 2005; Whipple and Russell, 2007). The collaborative forecasting aspect of CPFR includes several steps and needs a considerable commitment of human resources and investments in forecasting by all participating companies (VICS, 2008; Småros, 2003). The intensive nature of CPFR has caused several companies to abandon the model (Whipple and Russell, 2007). The importance of internal collaboration is highlighted in CPFR, as cross-functional forecasts made for the internal planning process need to be accurate before planning with external partners can be introduced (Fliedner, 2003; Nakano, 2009; Whipple and Russell, 2007). CPFR has also been criticised for being a static programme for collaboration, because it does not give guidance for incentive alignment or collaborative performance systems (Simatupang and Sridharan, 2005).

Table 1. Examples of reported benefits and limitations of VMI and CPFR.

VMI	CPFR
Information availability	
Automatic transfer of information (Whipple and Russell, 2007).	Visibility of inventory and sales data (POS data) at store level (Barratt, 2003; Whipple and Russell, 2007).
Limited visibility because replenishment is based on distribution centre inventory levels (Whipple and Russell, 2007; Barratt, 2003).	Includes sharing of historical data, forecasts, promotion data, production data and order planning data (Skjoett-Larsen et al., 2003; VICS, 2008).
Information usage	
Earlier access to information creates more proactive planning of suppliers' operations	Jointly created forecasts that enable exception situations to be revised and evaluated

(Kaipia et al., 2002; Whipple and Russell, 2007).	(Attaran and Attaran, 2007; VICS, 2008).
Ineffective usage of retail-level information (Angulo et al., 2004).	Supplier's inability to use POS data effectively (Barratt and Oliveira, 2001; Holweg et al., 2005).

Products included	
Suitable for products with high volumes that are frequently replenished (Barratt, 2003).	Should only be implemented with the suppliers of critical products (Whipple and Russell, 2007; Småros et al., 2003).
Small share of total business, long production cycles and large batch sizes limit the possibilities of benefiting from VMI (Kauremaa et al., 2009; Kaipia et al., 2002).	Challenges in selecting right partners and products to be included (VICS, 2008).

Suitability for specific demand situation	
Suitable for products with stable demand (Barratt, 2003).	More suitable for unstable demand situations compared to VMI (Sari, 2008).
Not suitable for small-scale products, promoted products or high demand variability (Sari, 2008; Barratt, 2003; Hines, 2004; Kaipia et al., 2006).	Ineffective replenishment in response to demand fluctuations (e.g. promotions) and difficulty in managing forecast exceptions/review process (Barratt and Oliveira, 2001).

Planning resources needed	
Not linked to planning	Supply chain partner specific planning integrated with planning and forecasting (Barratt, 2003).
	Extensive technical integration between companies' systems and forecasts needed (Attaran and Attaran, 2007; Whipple and Russell, 2007; Ireland and Bruce, 2000; Fliedner, 2003).
	Lack of internal collaboration and culture of sharing data (functional silos) and forecasts not clearly communicated throughout the supply chain (Fliedner, 2003; Whipple and Russell, 2007; Skjoett-Larsen et al., 2003; Ireland and Bruce, 2000; VICS, 2008; Seifert, 2003; Barratt and Oliveira, 2001).

Results and requirements	
Cost reductions, better inventory performance, increased sales, improved customer service levels and a collaborative mindset (Waller et al., 1999; Whipple and Russell, 2007; Claassen et al., 2008; VICS, 2008).	Detailed and well-defined process including four stages (VICS, 2008).
	Increased forecast accuracy, lower safety stock levels and increased sales (Fliedner, 2003; Whipple and Russell, 2007; VICS, 2008).
Lower bullwhip effect (Disney and Towill, 2003; Småros et al., 2003).	Requires high commitment of human

Elimination of one decision-making point (Kaipia et al., 2006; Claassen et al., 2006). Higher workload for supplier as a result of continuous monitoring and buyer unwillingness to give the purchasing function to supplier (Waller et al., 1999; Kaipia et al., 2006)	resources and financial resources by customer and supplier (Whipple and Russell, 2007; Holmström et al., 2002; Småros et al., 2003; VICS, 2008; Sari, 2008; Fliedner, 2003; Barratt and Oliveira, 2001; Seifert, 2003). Effective teamwork, trust and alignment of incentives are needed for success (Attaran and Attaran, 2007; Fliedner, 2003; Skjoett-Larsen et al., 2003; Ireland and Bruce, 2000; Barratt and Oliveira, 2001; VICS, 2008; Barratt, 2003; Simatupang and Sridharan, 2005). Large-scale adoption is lacking (VICS, 2008).

The literature review highlights the fact that companies continue to struggle towards successful collaboration, and a seamless supply chain is a utopia for many. Next, an emerging new replenishment model will be proposed.

2.3. Development of Collaborative Buyer-Managed Forecasting
In this section the new forecasting and replenishment model, Collaborative Buyer-Managed Forecasting (CBMF), is described. This section provides answers to the second research question as it describes how a retail replenishment model needs to be designed to overcome the limitations of VMI and CPFR. The origin of the concept of the model is in a development project between two manufacturers and a wholesaler in Finland with the aim of improving product availability in retail stores and supply chain performance as a whole. The objective of CBMF is to increase the visibility of retail sales further upstream in the supply chain by providing one single order forecast for the whole supply chain.

In CBMF, forecasting is centralised in the supply chain on the member that has the best skills and most interest and knowledge to perform it, allowing other members of the supply chain to focus on their core competences. The responsibility for forecasting should be on such a supply chain member, which is best positioned and equipped to perform the centralised planning task. First, it needs to uphold planning resources, for example by investing in dedicated planners or a specific planning team with adequate planning skills and resources to perform the task. Second, the member should have access to retailer sales information as well as supplier operations, to maintain an overview in both the upstream and downstream directions over the whole supply chain. Third, the member needs to have an interest in providing a planning service for the other supply chain members. In our case study, the wholesaler is responsible for conducting the planning task. It is has access to downstream and upstream data as a result of its close collaboration with retailers and suppliers, and furthermore, it is in its own interest to undertake the planning task as it sees centralised planning as a means to strengthen its own role in the supply chain.

Another important principle in CBMF is the intention to shift the responsibility for the wholesaler's in-stock availability to the manufacturers, and thus substitute the inventory with information. Furthermore, the ownership of the inventory would also shift from the wholesaler to the manufacturer (i.e. vendor-owned inventory (Piplani and Viswanathan, 2003; Rungtusanathan et al., 2007)). This creates an incentive for the manufacturer to keep accurate

stock levels and replenish the inventory with adequate intervals. The essence of CBMF is that it creates a forecast which uses rich retail sales data to respond to the needs of the whole supply chain. The order forecast that is created serves both base-level forecasting and exception management and is supported by VMI throughout the supply chain. Therefore, CBMF combines features from both VMI and CPFR, the ideas of combining buyer-managed forecasting and vendor-managed inventory.

The CBMF process is described as follows. The numbers represent the different stages in the information and goods flows (Figure 1):

(0)   every sales transaction in a retail store creates information about demand in the form of POS data. The retailers provide information about local campaigns and local situations for the needs of the forecasting process; otherwise, their role is minor;

(1)   the wholesaler receives POS data, inventory-level information and orders from retailers and has a good view of the downstream supply chain activities, compared to the manufacturers;

(2)   the wholesaler uses advanced forecasting tools and an aggregated picture of the demand for a specific product when forecasting. The forecasts are made by combining POS data, placed retailer orders, stock-on-hand information, expected coming fluctuations in sales (for example seasons and promotions) and different control parameters;

(3)   the aggregated picture of the demand for products is passed further on to the manufacturers in so-called *order forecasts*. These are shared via an internet-based software program used by retailers, the wholesaler and manufacturers. The forecasts cover several months, and are turned into an actual order just a couple of days before delivery, when the actual inventory levels and retailers' orders are known;

(4)   the manufacturer is responsible for replenishing the wholesaler's inventory according to the order forecasts provided (VMI replenishment). The important difference between demand forecasts and an order forecast is that the order forecast represents an order commitment from the wholesaler;

(5)   the wholesaler is responsible for the on-shelf availability in the stores (VMI replenishment);

(6)   the responsive supply chain improves the product availability in retail stores.
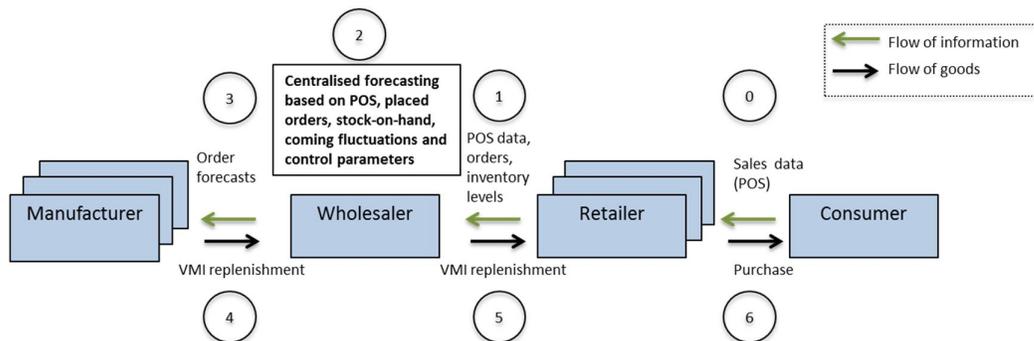
Figure 1. Collaborative Buyer-Managed Forecasting

Next, we take a closer look at how exception management is performed in CBMF, which is included in Stage 2 above. When looking at forecasting from the software point of view, one must distinguish between base-level forecasting and exception management. Base-level forecasting relies on a continuous flow of sales information about products and turns this into replenishment forecasts. Any action or external reason that causes variation in demand can be

considered an exception, and needs to be identified in planning. Particular activities causing exceptional demand changes and exceptional demand management include various campaigns, product introductions and seasons. Managing these may require steps in various dimensions, concerning products, durations or geographical areas. Figure 2 illustrates the types of demand exceptions and the planning parameters needed to manage them.
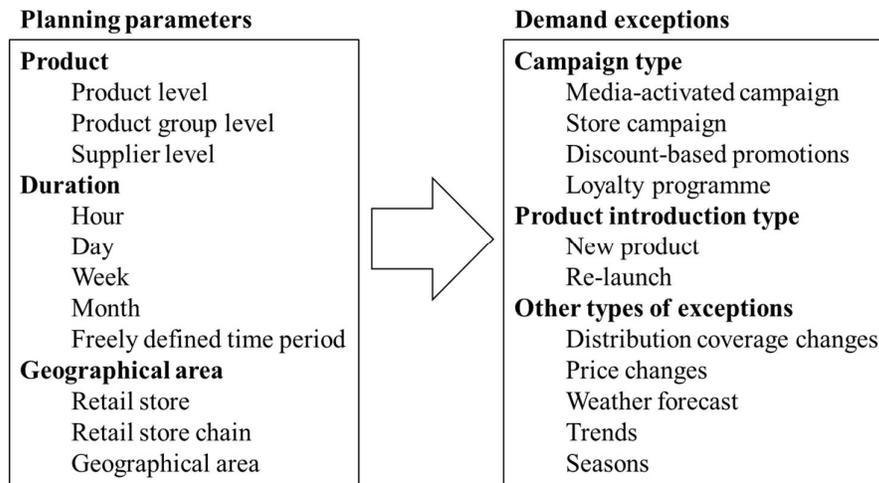
Planning parameters

| **Product** |
| Product level |
| Product group level |
| Supplier level |
| **Duration** |
| Hour |
| Day |
| Week |
| Month |
| Freely defined time period |
| **Geographical area** |
| Retail store |
| Retail store chain |
| Geographical area |

Demand exceptions

| **Campaign type** |
| Media-activated campaign |
| Store campaign |
| Discount-based promotions |
| Loyalty programme |
| **Product introduction type** |
| New product |
| Re-launch |
| **Other types of exceptions** |
| Distribution coverage changes |
| Price changes |
| Weather forecast |
| Trends |
| Seasons |

Figure 2. Planning parameters that CBMF uses to manage identified demand exceptions.

3. Research design

3.1 Research method

In order to explore the benefits and limitations of CBMF, this paper follows the case study research methodology (Eisenhardt, 1989; Yin, 2009). A case study gives a detailed and rich picture of the phenomenon under study in its complex real-life context (Patton, 2002; Yin, 2009). Case studies have been reported to be an ideal strategy when the researcher has little control over the event (Yin, 2009). The case study design in this paper is an embedded single case study (Yin, 2009), which was selected because of the exploratory nature of the study and the uniqueness of the project, and because it represents a previously inaccessible phenomenon (Eisenhardt, 1989; Ellram, 1996; Yin, 2009). With the embedded nature of the case study, the sub-units in one larger case are analysed on different levels to explain the whole case in the most in-depth way (Baxter and Jack, 2008; Yin, 2009).

The unit of analysis is a grocery supply chain with four echelons: manufacturer, wholesaler, retailer and consumer. These four echelons are studied by gathering interview data from four different companies, i.e. sub-units, in the upstream part of the supply chain. The sample in the case study was purposefully selected from the current development project (Patton, 2002). The companies are: (1) the wholesaler, (2) a juice manufacturer and (3) a confectionery manufacturer, which are suppliers to the wholesaler, as well as (4) the software provider, which has developed the software that is used in the project (Table 2). The retailers in the case supply chain belong to several retail chains. They are independent companies and independent in their decision making, but belong to the same group of companies as the wholesaler, and can thus be controlled to some extent. Therefore the focus is on viewing the unit of analysis, the supply chain, from these four companies' points of view.

The development project was initiated by the wholesaler, which has good capabilities in forecasting and planning, and has good ongoing relationships with the two selected suppliers as well as with the software company. One of the researchers worked at the wholesale company at the time of the project, and actively participated in the development of the model.

The research team was familiar with all the participating companies in advance, and was offered good access to all the companies to collect the interview data. During the time the case study was conducted, the project was in its planning phase, but no real steps had yet been taken to create a common forecast for the whole supply chain. However, during the research period the wholesaler was already responsible for retail store replenishment, which provided it with access to downstream data.

Table 2. Case companies and case data

Company	Wholesaler	Juice Manufacturer	Confectionery Manufacturer	Software Provider
Description	Purchasing and logistics organisation. In 2012: turnover > €500 million and no. of employees >500.	Part of leading producer of juice in Europe with a strong position in the market area under study. In 2012: turnover > €50 million and no. of employees >100.	Company with a diverse product portfolio and a strong market position in its home market. In 2012: turnover > €1,500 million and no. of employees >10,000.	Fast-growing software company focused on supply chain optimisation for retailers, wholesalers and manufacturers. In 2012: turnover > €4 million and no. of employees >50.
Interviewees	Planning Manager, Service Manager, Forecasting Manager, Commercial Director	Sales Director, Logistics Manager	Logistics Director, Customer Service Manager	Managing Director
Secondary data	Information on planning parameters. Presentation feedback on preliminary results from the wholesaler's employees. Magazine article and seminar presentation about previous projects.	Annual report and attendance at project meeting between juice manufacturer and wholesaler.	Company presentations, annual report and description of current replenishment model.	Information on planning parameters. Company home page and white paper. Additional data requirements about the performance of the model.

3.2 Data collection

The primary data collection method was interviews, which were conducted in 2013 (Table 2). One researcher was responsible for the data collection. Semi-structured interviews were used because the focus was on perceived benefits and limitations that are otherwise hard to capture and analyse (Yin, 2009). The nine respondents were selected from the companies together with the Planning Manager at the wholesaler (Table 2). The positions and areas of responsibility of the respondents, as well as their knowledge of the project and expertise in the area, were used as criteria for selection. Each interview lasted from 35 to 75 minutes. They were recorded and transcribed to document the data. The interviews were conducted following an interview guide (Appendix 1), but the focus on different questions differed according to the respondents' main area of responsibility, which proved more detailed answers about the areas of expertise (Yin, 2009). However, the main target of all the interviews was to understand the respondents' point of view on the project and its perceived benefits and limitations for all the members of the supply chain. The interviews were conducted as individual interviews at the companies' locations. At the two manufacturers the respondents were interviewed at the same time to facilitate discussion and to get insightful answers. Respondents from the retail and customer levels were not included in the study because of the early stage of the development project. The interviews were complemented with secondary

data such as annual reports and various types of documentation from the case, as presented in Table 2, in order to enhance the credibility of the study (Patton, 2002; Yin, 2009).

3.3 Data analysis
To be able to provide a full description of the replenishment model and its perceived benefits and limitations, the sub-units were first analysed separately and then across sub-units (Baxter and Jack, 2008; Yin, 2009). The levels of case analysis focused on different issues:
· the focus on the sub-unit analysis was designed to gain a deep understanding of the current situation in the supply chain and the most important perceived benefits and limitations of the replenishment model from each company's (i.e. manufacturer, wholesaler and software provider) point of view;
· the analysis across sub-units focused on the supply chain level and aggregated the major themes that emerged in the previous analytical levels. This triangulation between the different companies' respondents' views (triangulation of sources) was performed in order to capture a holistic picture of the case and identify the perceived benefits and limitations of the replenishment model (Patton, 2002).

4. Case study results
In this section the replenishment model is analysed on the basis of the case study. First, in order to understand the need for a new replenishment model, the current design of the case supply chain is discussed to provide insights into the first and second research questions. Second, to provide answers to the third research question, the perceived benefits and limitations are discussed from the viewpoints of the manufacturer, wholesaler, retailer and consumers, as well as the whole supply chain.

4.1 Case study supply chain at the moment
The current replenishment practices in the case supply chain exemplify arrangements that exist on the grocery market. In the case studied, the two manufacturers operate differently with this specific wholesaler. The juice manufacturer follows a basic order-delivery model, while the confectionery manufacturer has developed the process further and the replenishment between the wholesaler and retailers follows a VMI replenishment model.

The situation for the manufacturers is challenging. Even if information is available, decision making needs considerable human intervention and tacit knowledge. Furthermore, monitoring and interpreting shared data and transforming it into forecasts may be difficult and time-consuming. Therefore both manufacturers suffer from problems connected with limited visibility or limited benefit from the shared information, and the management of exceptions from normal demand. Features and limitations of the current operations models of the two manufacturers are presented in Table 3.

Table 3. Replenishment practices in the supply chain (SC) under study in 2013.

Features of current models	Juice Manufacturer	Confectionery Manufacturer
Replenishment model with specific wholesaler	Order-delivery	VMI
Information received from wholesaler	Orders and some demand estimates of seasonal beverages.	Daily inventory report and advance order from retail stores.
Replenishment quantity	According to order received.	Mutually agreed inventory level ordering points and with the help of tacit knowledge.
Delivery cycle	1-2 day(s)	1 day
Ownership of product	Wholesaler	Wholesaler

inventory at wholesaler		
Independent forecasting	Yes: based on historical sales data, the amount of grocery stores, estimated sales per grocery store, and known promotions and events.	Yes: done by sales department, based on rich data including historic sales, coming seasons and promotions.
Forecasting cycle	12 months' running sales forecast (1-month frozen period, because of ability to secure availability of critical raw materials).	12 months running sales forecast (updated weekly and transmitted to production planning), as well as weekly meetings with sales and production.
Characteristics of overall performance	Short lead-times tone down the information amplification effect to some extent. Decision making is based on tacit knowledge of workers (e.g. knowledge of product sales behaviour) and efficient communication between companies. Trust that has developed over time and through honest everyday activities (delivery reliability).	Short lead-times tone down the information amplification effect to some extent. Tacit knowledge of workers (e.g. knowledge of product demand behaviour) and efficient communication between companies. Trust that has developed through established daily routines and processes which provide flexibility in planning.
Main limitations	Demand forecast updating, periodic order batching, price fluctuations, moderate rationing and gaming. No visibility of inventory levels and decision making in the SC. Unexpected peaks in demand: e.g. larger national events and promotional campaigns.	Demand forecast updating. Review of ordering points is time-consuming. Even though replenishment is automatic, human intervention is needed on some occasions. Vague scale to decide amount replenished (more or less than normal). Duplicate forecasting and monitoring of inventory levels and delivery reliability. Seasons, promotional campaigns, new product launches hard to manage. Limited visibility of inventory levels and decision making in the SC.

According to our case analysis, despite using the VMI replenishment model, the confectionery manufacturer suffered from problems in implementing the model and reacting to demand. This showed particularly in exceptional demand situations, where the manufacturer did not have full access to the necessary data, such as campaigns or seasonal demand patterns. The inability to forecast campaign demand resulted in preparing for the campaign with high inventory levels. Even though the company was to some extent able to monitor POS data during the campaign, it was not able to react in its operations. Typically campaigns ended up with excess inventories, as the company wanted to ensure availability by forecasting high campaign demand rather than low. The situation was even worse at the juice manufacturer, which had no overview of the inventories' in the chain, and had to create responsiveness by keeping high inventory levels. CBMF was expected to bring responsiveness to demand for both companies by proposing coming orders. The juice manufacturer also benefits from shifting the responsibility of replenishment to the supplier, which improves visibility over the supply chain.

4.2 Perceived benefits for each supply chain echelon
In this section the benefits of CBMF for each party in the supply chain are presented. The results are based on interviews with the software provider, the two manufacturers and the wholesaler, who each estimated the benefits for each level in the supply chain under study. The retailers and consumers were not interviewed, and thus their benefits are based on the other supply chain players' estimates. These perceived benefits were observed in this specific grocery retail supply chain, and apply only in similar types of settings.

The most meaningful benefit for the manufacturer is linked to the increased visibility of downstream sales, plans and inventory levels. Similarly to VMI, CBMF provides a time benefit (Kaipia et al., 2002) for the manufacturers to plan their own operations better, from production planning to inventory management. In addition, the order forecast provides the manufacturer with a clear view of the decision making at the store level, which especially helps improve the management of promotional campaigns and product introductions, which was a limitation in VMI and CPFR (Table 1). The model also creates the possibility of implementing seasonal inventory parameters, which is expected to improve the response to seasonal demand peaks.

Second, the manufacturer gains more opportunities to manage inventory levels in the supply chain as it is responsible for the timing and quantity of the replenishment of the wholesaler's inventory. In CBMF, planning resources at the manufacturer can be concentrated on other planning functions as the wholesaler provides accurate demand forecasts. These order forecasts can be used to improve the production planning process of the total production volume at the manufacturer.

Third, when the availability of products in retail stores improves, the manufacturer gets stronger representation for its brands and can be expected to achieve higher sales. When a manufacturer's operations can be planned in advance, better customer service and delivery reliability can be provided for customers. This creates trust and commitment in CBMF as the manufacturer can serve its customers better. A closer collaborative relationship is created between the wholesaler and manufacturer.

Overall, CBMF enables the manufacturer to react rapidly to changes in demand and significantly improve the efficiency of its internal operations, especially if implemented with a broad customer base. The benefits for the manufacturer are:
- increased visibility and better management of demand exceptions
- more efficient planning of internal operations
- better availability of its own products in retail stores
- better customer service and closer collaboration with customers

For the wholesaler, CBMF is expected to bring financial benefits as a result of lower operating costs, lower inventory levels, faster throughput time, less manual work and more efficient planning of logistics activities (including the planning of warehouse workers, working shifts and transportation). Shifting the ownership of the manufacturer's products in the wholesaler's inventory to the manufacturer is an important aspect (vendor-owned inventory). One respondent stated: *"We have an opportunity to release a considerable amount of capital from inventories."* [Commercial Director, Wholesaler]. However, at the same time the capital of the manufacturer is tied up in the unsold inventory at the wholesaler. Therefore more accurate replenishments and better inventory management are expected.

Secondly, the wholesaler can benefit from possible financial compensation for providing the order forecasts. Thirdly, as the replenishment decisions are made by the manufacturer, the resources at the wholesaler can be concentrated on forecasting and managing the business relationships towards manufacturers and providing better customer service to retail stores and other customers, which in turn generates higher sales. One interviewee put it: *"Our customers are hopefully more satisfied by our service, as the reliability of our deliveries increases."* [Forecasting Manager, Wholesaler]. Initiating and entering into CBMF portrays the wholesaler as a forward-looking business partner. The benefits for the wholesaler are:

- better planning of its own operations
- lower costs, capital released from inventory, higher sales and new sources of income
- resources focused on forecasting and providing better customer service.

The perceived benefits for the retailers and consumers are both related to better customer service. When the POS data directs the operations of the manufacturer, the stores benefit from better customer service in the form of higher product availability and, at the same time, lower inventory levels. Better availability of seasonal products was especially highlighted by one interviewee: *"This [replenishment model] requires the retailers to be committed to the collaborative forecasts and advance planned amounts. The commitment results in higher delivery reliability for the stores."* [Sales Director, Juice Manufacturer].

The retailers can concentrate on in-store inventory management, refilling the shelves and serving customers instead of placing orders. In addition, the retailer can optimise the use of shelf space in stores and as a result provide a wider selection of products. This increases the retailer's sales and ability to compete on the market. Retailer benefits are:
- improved product availability and lower inventory levels
- less OOS and waste as a result of accurate planning
- focus on customer service and higher sales
- shelf space optimisation

Improved retail operations bring the following benefits to the consumer:
- better product availability and fresher products increase customer satisfaction
- freedom of choice, because purchasing decisions are no longer affected by OOS
- wider selection of products to choose from

4.3 Expected benefits for the supply chain
One important overall benefit of CBMF is the increased visibility of retail sales and inventory levels in the supply chain. The use of order forecasts to communicate demand information makes the supply chain members utilise the POS data and plan operations more proactively. CBMF enables more efficient overall inventory management in the supply chain to occur, which shows in released capital and reduced waste. In the interviews these benefits were expressed as follows: *"The biggest advantage is the use of one single forecast [for the whole supply chain]"* [Managing Director, Software Provider], and *"I think we have only winners in this project"* [Service Manager, Wholesaler].

When forming a closer collaborative partnership, the companies can focus on their core competences and excel in them. However, implementing a collaborative relationship requires investments in the relationship. There is the possibility of choosing which member of the supply chain has the most optimal position to bear the costs of e.g. forecasting. The increased collaboration and communication raise the level of trust and synchronise decision making. In CBMF the volatility of demand can be managed more accurately, thanks to the better visibility of demand and closer collaboration and communication between companies. For example, the supply chain can react faster to OOS situations during product introductions and seasons. This increased responsiveness provides higher delivery reliability on all levels, which translates into better product availability in stores.

As a summary, the performance of the whole supply chain is expected to improve as a result of increased dynamism and transparency, resulting in the following benefits:
- increased visibility and a more effective supply chain

- closer collaboration with a focus on core competences
- less pressure to raise prices
- low resource usage as a result of eliminating parallel planning processes and low system investments as a result of usage of internet-based software
- better management of demand exceptions
- better customer service on all levels

4.4. Expected limitations for the supply chain

When considering the possible limitations of CBMF, most issues are related to the handling of demand exceptions and the large-scale adoption of the model. Furthermore, the case supply chain operated on the basis of VMI and orders, and the comparison applies to those models only, not CPFR. If forecasts are not reliable enough and companies are not committed to them, the forecasts are hard to integrate into companies' own operations. From a manufacturer's point of view, the forecasts received from a single customer help in the planning of the total volume. In spite of this, managing different kinds of planning practices with different customers is not the most efficient solution. However, the aim is to create a model that can easily be multiplied to a large customer base when wanted. Realising the expected benefits is also difficult if processes are not streamlined or they are hard to implement. One interviewee pointed out: *"This type of longer supply chain integration has not been done very much so far."* [Managing Director, Software Provider].

Even though the order forecasts are the key to successful CBMF, communication between the right people in each company needs to be seamless and open in order to attain the best results. These limitations highlight the importance of people in the project and an overall planning culture throughout the supply chain. This observation is supported by the literature, which states that supply chain management is facilitated by information technology, but success is founded on people (Fawcett et al., 2008).

The limitations and risks with regard to reaching the desired benefits are:
- forecast accuracy
- manufacturers' and wholesalers' capability to integrate forecasts into their own operations
- too-complex processes
- selection of the right companies for CBMF
- commitment and trust
- honest division of benefits
- open communication

5. Development of propositions

On the basis of the case study, four propositions are developed. These propositions suggest how CBMF can improve the current retail replenishment practices and therefore further explain the benefits and limitations of CBMF.

Previous studies propose that access to sales data (POS) is not beneficial for manufacturers as they are not able to translate the detailed data when planning their operations (Barratt and Oliveira, 2001; Holweg et al., 2005). The data needs to be in a more usable form for manufacturers to benefit from it. The results of this case study support the idea of combining different sources of data in order to create information of the highest value for the different companies. The most useful information may vary, for example according to the product's life cycle phase (Småros, 2003). Shared forecasting data is considered to have a strong impact on

production, inventory management and shipping scheduling (Min et al., 2005). As the whole supply chain is following the same forecast in its planning, the CBMF model follows the extended VMI model (Danese, 2006).

In reality, few manufacturers get the same type of sell-through data from all their customers (Småros, 2003), which is true in this study as well. The results of this case study indicate that even with limited access to POS data, the two manufacturers studied both reported that they could benefit from more accurate production planning and reduce order batching. Greater benefits may be achieved if information sharing is linked to the development of a process or practice between organisations, for example VMI (Kärkkäinen et al., 2007). This supports the idea that in CBMF the manufacturer takes responsibility for replenishing the wholesaler's inventory. The lower inventory levels, faster inventory turnover and the shifting of ownership of the inventory release capital tied up in inventories at all levels in the supply chain. The overall benefits of CBMF are summarised in our first proposition as follows:

> **Proposition 1.** *CBMF extends the retail replenishment practice offered in VMI, as in addition to improved delivery reliability it benefits the manufacturers' internal planning in the form of accurate order forecasts.*

In CBMF, the increased visibility of retailer sales, inventory levels and decision making at the retailer level help manufacturers in particular to react rapidly to changes in demand. The increased communication and collaboration between the wholesaler and manufacturers, in connection with product introductions, for example, is useful in order to create the most accurate forecasts and to adjust them. Succeeding in these special events is vital for the competitiveness of the whole supply chain, especially in the grocery market. VMI has been criticised as being an inefficient tool to manage promotions and product introductions (Barratt, 2003; Kaipia et al., 2006; Sari, 2008). In the same manner CPFR has been accused of offering inefficient replenishment in response to demand fluctuations (Barratt and Oliveira, 2001). Compared with VMI, CBMF is more suitable for the management of promotional campaigns and other fast changes in demand. It can be seen as a less intensive form of CPFR, which is especially suitable for the management of exceptions to normal demand patterns and where forecasting is centralised at one decision-making point. This discussion leads to our second proposition:

> **Proposition 2.** *Compared to VMI, CBMF enables more accurate management of exceptions to normal demand, including campaign management, to take place.*

The need for a model that can be replicated for a large number of suppliers has been recognised in the grocery industry (Holmström et al., 2002). The complex nature of the business, with a large number of business partners and SKUs, requires a model that can be standardised to a certain level in order to provide benefits for all participants. CPFR is described as a resource-consuming model that should be implemented only with the most critical suppliers or customers (Seifert, 2003; VICS, 2008). The high implementationing and operating costs delimit the use of CPFR (Sari, 2003; Seifert, 2003). On the other hand, VMI focuses only on replenishment and does not directly include any collaboration in planning. CBMF seeks to improve these limitations by offering a new alternative, which could be used with a wide number of suppliers/customers.

CBMF does not need any extensive integration between systems compared to CPFR (Attaran and Attaran, 2007; Fliedner, 2003). CBMF uses internet-based software that can be integrated into manufacturers' planning systems. The web-based solution permits a faster and larger-

scale implementation. The model can be replicated on a larger supplier base than with CPFR by creating different groups of suppliers based on their volume, know-how and importance to the wholesaler and its customers. The interview respondents assessed that as much as 90% of the total volume of products could be included in CBMF. Further, it was suggested that implementation should first focus on high-volume suppliers, where the greatest potential savings are. This feature of CBMF is included in the next proposition:

> **Proposition 3.** *Compared to CPFR, CBMF is designed to enable the model to be implemented with a broad base of customers or suppliers.*

The analysis showed that CBMF still cannot overcome some of the limitations of current retail replenishment models. Collaboration always means the sharing of profits but also risks (Min et al., 2005). Processes and business practices need to change in order to gain the desired benefits. In particular, a culture of sharing information and trusting each other needs to exist. Trust does not come easily; it needs to be earned over time (Min et al., 2005). Creating a culture of "we are in this together" directs the actions of all the companies towards the same goal. Not all collaborative relationships are successful. By creating too close a relationship with a supplier, the buyer can become too dependent on the supplier and lose the chance of making economies of scale. Close collaboration can also lead to a level of comfort that causes inertia when both the supplier and the buyer are waiting for performance to improve but nothing actually happens (de Leeuw and Fransoo, 2009). Supplier collaboration is beneficial for buyer firms, despite the complex issues of trust and dependence, and it is a way to shift the balance of power in the supply chain upwards (Fawcett et al., 2010). The last proposition is as follows:

> **Proposition 4.** *Trust, commitment and internal cross-functional collaboration are prerequisites for all forms of collaboration; these even apply for CBMF.*

An analysis of the limitations of CBMF is important in order to understand the possible pitfalls. The reliability and completeness of the data affects the likelihood that the company can actually benefit from CBMF and integrate it into its own systems. Forecasts that are not clearly communicated throughout the supply chain have been reported as being a limitation of CPFR (Barratt and Oliveira, 2001; Fliedner, 2003). Commitment and collaboration are needed on all levels to guarantee that the information is interpreted in the same way in all companies.

6. Concluding remarks

The grocery industry needs efficient planning and replenishment practices, because multiple decision-making points in complex grocery supply chains create inefficiencies in inventory management and replenishment. Even though models such as VMI and CPFR have been developed, companies still struggle to attain sufficient results and to realise visibility in the supply chain. Particular concern is caused by exceptions to the normal demand pattern, such as campaigns, seasonal variations and product introductions, which are essential in the industry, but are challenging to manage (Ehrenthal et al., 2014; Taylor and Fearne, 2009).

A retail replenishment model called Collaborative Buyer-Managed Forecasting (CBMF) was presented in this research paper. A specific feature of CBMF is that forecasting is centralised in a specialised planning unit, which has access to accurate and rich sales information, can acquire the best know-how and capability to handle that information and has the ability to continuously improve the quality of the forecasts. The model offers a solution for a specific problem set for retail supply chains with volatile demand, good access to sales information and the ability to use it.

Several benefits for CBMF were identified on the basis of the case study. First, CBMF provides accurate order forecasts that manufacturers can use to plan their own production more efficiently. Combined with a VMI arrangement between the manufacturer and the wholesaler, this planning model provides flexibility to the manufacturer's operations, which has been the supply chain phase that has not been able to benefit from visibility (e.g. Småros et al., 2003). Second, the model was particularly planned to be able to handle situations characterised by exceptions to normal demand. Third, the model affects the resource usage in the supply chain: centralising supply chain planning frees planning resources along the supply chain, which can be used, for example, for internal planning purposes. The model is also expected to affect performance throughout the supply chain in the form of improved responsiveness, which shows in improved availability with lower inventory levels, and reduced waste. Fourth, when the model for CBMF is standardised, it can be implemented with a large base of suppliers/customers and therefore results in even greater benefits.

The study provides practical implications. Operating on the basis of order forecasts will benefit the supply chain performance as a whole, which includes a promising message for managers. There are three essential prerequisites in the model presented here. First, retail sales and downstream inventory-level information needs to be broadly and openly available, and second, there need to be skilled planning resources available. Third, planning was provided by one supply chain member, which means a remarkable change in the sharing of responsibilities in a supply chain. Therefore the model seems to be a solution for retail supply chains with partners willing to share information and to rely on an external actor to conduct planning. However, for managers one message of the study is that there is still room for innovative retail supply chain solutions, and this study presents a new approach for designing a retail replenishment system.

When interpreting the results of this study, it needs to be remembered that the study only reports the perceived benefits on a single case study in a particular supply chain setting, and gives only initial empirical input in relation to the model. Quantitative evidence on the outcome of the model is lacking, and, for example, costs were not treated in the study. Furthermore, although several improvements to the supply chain were identified and improved demand responsiveness was expected, this study does not answer the question of whether this outcome will be achieved or not. In addition, the results are influenced by the respondents' personal opinions of the current phase of the project.

The results of the study need to be validated in further empirical studies and with quantitative analysis. In addition to collecting real-life data on a CBMF model that has been implemented, simulating a multi-echelon supply chain in different replenishment approaches and with centralised and non-centralised decision making would be valuable. This can be done by extending the study by Ehrenthal et al. (2014) to incorporate exception management as introduced in the paper. An interesting question is how the manufacturer can benefit in practice from the order forecasts in its own production planning. Furthermore, the performance of the model needs to be measurable so as to support the sharing of benefits between the partners. Comparing the performance of VMI or CPFR with CBMF on the basis of these performance measures would be an interesting future research topic.

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Appendix 1. Questions in the interviews (part of the questionnaire used)

Current state of operating
1. Could you please describe the forecasting, planning and ordering process at the moment?
2. How are responsibilities divided between partners?
3. What do you consider are the problems with the existing collaborative model? Why do you want to improve it?
4. What are the greatest challenges for inventory management at the moment?
5. What do you consider are the good sides of the existing way of working?
6. Do you have experience of VMI or CPFR with other companies?
7. What type of information is shared with the suppliers/customer at the moment and how does this differ compared to the new model?
8. How are forecasts and plans generated at the moment and by whom?
9. What types of problems have you distinguished in the existing model?

The new model
1. How were the two suppliers chosen for the project?(Wholesaler) / Why did you decide to participate in the project? (Suppliers)
2. What are your expectations of the project?
3. What types of investments does this project require from you?
4. What do you see as being the greatest benefits of the new model for you, for your business partner and the whole supply chain (and ultimately the consumer)?
5. In the new model normal orders would be replaced by forecasts from the wholesaler. How could you benefit from this change, especially in the planning function?
6. Do you believe that the new model could reduce the amount of waste in the supply chain? How much and in which part of the supply chain especially?
7. How could the model improve your planning of promotional activities?
8. How would this new model change your position on the market and collaboration with other partners?
9. What do you consider as the biggest limitations on the success of this model in the short term and long term?
10. Demand information sharing is the key feature of the new model, but what other aspects have you considered in order to ensure the success of the model? How will you tackle them?
11. How will you measure the performance of the new model?