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Information sharing for sales and operations planning: Contextualized solutions and mechanisms

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ABSTRACT

We develop actionable design propositions for collaborative sales and operations planning (S&OP) based on the observation of contexts in which benefits are generated — or are absent — from retail information sharing. An information sharing pilot project in a real-life setting of two product manufacturers and one retailer was designed. The project resulted in one manufacturer, serving a retailer from its local factory, developing a process for collaborative S&OP, while the other manufacturer serving a retailer from more distant regional factories abandoned the process. The evaluation of the outcomes experienced by the two manufacturers allows us to examine contexts in fine-grained detail and explain why introducing information sharing in the S&OP processes produce — or fail to produce — benefits. The paper contributes to the supply chain information sharing literature by presenting a field tested and evolved S&OP design for non-standard demand situations, and by a contextual analysis of the mechanisms that produce the benefits of retailer collaboration and information sharing in the S&OP process.

1. Introduction

Even though successful case examples show that information sharing can be very valuable in sales and operations planning (Ghemawat and Nueno, 2003; Fisher and Raman, 1996), the operations and supply chain management literature recognizes that achieving the benefits may be challenging (Simchi-Levi and Zhao, 2003; Thomé et al., 2012; Tuomikangas and Kaipia, 2014). In this paper we design and evaluate an information sharing intervention in the field to identify the fine-grained contextual differences that affect achievable benefits, and assess the attractiveness of introducing collaborative S&OP.

A hallmark of S&OP is its ability for formalized planning and data management to enhance both intra- and inter-organizational integration (Oliva and Watson, 2011; Singhal and Singhal, 2007). In the S&OP literature, demand planning in general and accurate forecasting in particular are essential elements (Ivert and Jonsson, 2010; Nakano, 2009; Oliva and Watson, 2011) of enabling integrated planning. We know from previous research that collaborative S&OP using downstream sales data is potentially beneficial in situations of unknown or uncertain demand, such as product introductions or promotions (Alftan et al., 2015; Cachon and Fisher, 2000; Lehtonen et al., 2005; Ramanathan and Muyldermans, 2010; Ramanathan, 2012). Nevertheless, modelling research has concentrated on situations in which demand is either stationary or follows a well-defined pattern (Aviv, 2001; Cachon and Fisher, 2000; Gavirneni et al., 1999; Simchi-Levi and Zhao, 2003). In addition to the well-known descriptive cases such as Zara or Sport Obermeyer (Ghemawat and Nueno, 2003; Fisher and Raman, 1996), the numerous model-based analyses, and the rare controlled experiments (Tokar et al., 2011), this domain of academic research needs fine-grained design-oriented contributions on the design and effects of information sharing in real-life product introductions and promotions.

Design science research in the social domain and management aims to bridge the practice-academia divide through the development of actionable knowledge grounded in the empirical evaluation of how designs work in the field (cf., Holloway et al., 2016). This paper presents a solution design for information sharing in a collaborative S&OP process and evaluates how it can be effectively introduced in the real-life settings of two manufacturers for special demand situations. Point-of-sales (PoS) information sharing is too

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expensive to be used across the board and is potentially useful only in demand situations where conventional demand planning is inadequate, like in product introductions, promotions, and seasonal peaks. We find that for such situations it is effective not to use a standard procedure, rather to design procedures that are focused on the specific situation at hand, taking into account both demand uncertainty and supply responsiveness. Product introductions and promotions are often planned well before the action, and our proposal is that, in planning the introduction or promotion, one needs to decide whether sales information sharing is to be used and, if so, what the S&OP procedures are precisely, both in terms of how to determine the demand and how to adjust operations.

We report design science research addressing the field problem of introducing supply chain collaboration in S&OP. In so doing, we present findings from a longitudinal case study of collaborative S&OP in new product introductions. Hence, we combine a longitudinal case study approach with a design science approach (Holmström et al., 2009). Along with the case study, we participate in the design of a collaborative product introduction process and then observe (Näslund, 2002) what two supplier companies actually do in collaboration with a retail chain. The collaboration is based on the retailer giving the supplier timely access to retailer point-of-sales data during product introductions. A longitudinal approach to design science research makes it possible to investigate intervention designs in action and on a detailed level. We evaluate the results the two suppliers attain from their engagement in collaborative product introductions and identify how situational factors affect achievable outcomes.

The paper is organized as follows. Following this introduction, we present a literature review on the benefits of information sharing in S&OP. The methodology section describes how we apply the design science approach in a longitudinal case study setting. The case description starts with the problem of product introductions in the case context and presents the process of collaborative S&OP developed to address the problem. Observing the different outcomes of introducing the same process for the two suppliers constitutes a field experiment. How the collaborative planning of product introductions was included in the S&OP process is described for one of the participating manufacturers. After that, the outcome evaluation is presented and design propositions are developed. To conclude, we relate our field tested design and propositions to previous research and present implications for research and practice concerning the contextual factors that influence the usefulness of information sharing in collaborative S&OP.

2. Literature review

2.1. The contingent value of information sharing in collaborative S&OP

Previous research on retail sales information sharing indicates a need for contextualized investigations of solution designs in action. The research literature is divergent, presenting both significant potential benefits, and a lack of benefits of collaborative S&OP. Sharing downstream information in the supply chain has been found to result in significant efficiency improvements (Baihaqi and Sohal, 2013; Fisher, 1997; Gavirneni et al., 1999; Lee et al., 2000; Williams and Waller, 2011; Zhou and Benton, 2007). However, research also suggests that not all situations and products benefit equally from shared demand data. When demand is predictable, the value of information sharing is low, and demand uncertainty can be managed with intelligent use of historical data (Cachon and Fisher, 2000; Raghunathan, 2001; Williams and Waller, 2011). On the other hand, research suggests that different products deserve a different use of demand data (Fisher et al., 1994; Fisher, 1997; Holmström et al., 2006). Collaboration intensity between suppliers and retailers (Nagashima et al., 2015) or with suppliers (Goh and Eldridge, 2015) increases forecast accuracy.

Model-based studies are not unequivocal in how benefits depend on the features of the model and the assumptions used (Aviv, 2001; Li et al., 2005). The problem context has typically been simplified to that of one supplier evaluating the benefits of accessing demand information from a single retailer (see, e.g., Aviv, 2001; Cachon and Fisher, 2000; Gavirneni et al., 1999; Simchi-Levi and Zhao, 2003; Zhao and Simchi-Levi, 2002). Lee et al. (2000) and Simchi-Levi and Zhao (2003) model the benefits of sharing information and suggest that information is valuable only if the system has the flexibility to respond. However, most studies assume that when companies have access to better demand, inventory, or process data in the supply chain, the operational performance of the chain improves (Barratt and Oke, 2007; Gavirneni et al., 1999; Nagashima et al., 2015) without considering that there may be contexts where benefits cannot be realized. In many studies, operational improvements such as more accurate forecasting (Weber and Kantamneni, 2002; Williams and Waller, 2011), lower inventory levels or costs (Wu and Cheng, 2008), shorter lead times and a reduced bullwhip effect (Agrawal et al., 2009; Croson and Donohue, 2003; Kelepouris et al., 2008), and reduced risk (Zhao et al., 2013) are found. Thus, information sharing in modelling studies recognize that information sharing does not lead directly to improved performance, but assume improved performance when information sharing is used in operational processes within and between the participating companies (Baihaqi and Sohal, 2013).

To sum up, research recognizes that the potential value of more accurate prediction of sales volumes through information sharing and collaboration for upstream supply chain partners is high. Specifically, a reduction in sales information lead times is seen to result in faster responses of supply to sales variations. Furthermore, there is recognition of the contingent nature of the benefits of a more collaborative S&OP process. Still, exactly when to expect benefits from sharing more up-to-date sales data among the supply chain partners, and through which mechanisms better information transforms to actual performance improvements in operations, remains a challenge for both research and practice.

2.2. Benefits in special situations: manufacturer's perspective

Examining when more collaborative S&OP becomes useful is a well-established research stream. Several authors suggest that improved retail promotions management based on collaborative action and shared information becomes beneficial when the demand factors are known (Alftan et al., 2015; Ramanathan and Muyldermans, 2010; Ramanathan, 2012). The simulation study conducted by Mason-Jones and Towill (1997) suggests that with a sudden step-change in demand, access to PoS data becomes most valuable to a manufacturer. Conversely, in their model-based study, Ferguson and Ketzenberg (2006) find that the value of information sharing in the retail replenishments of a perishable product depends on a combination of factors: demand is variable, the product is expensive, and the shelf-life is short.

On the basis of a survey with 125 respondents, Zhou and Benton (2007) conclude that supply chain dynamism, which they define as the pace of change of both products and processes, enhances the value of collaborative planning based on information sharing. Based on case studies, Alftan et al. (2015) and Dong et al. (2014b) emphasize that collaborative demand forecasting is needed as an exception management mechanism. Using simulation, Lehtonen et al. (2005) demonstrate the potential value of collaborative planning in product introductions, but do not elaborate on how to use downstream demand data in the S&OP process of a manufacturer.

Improving the management of product introductions by more efficient access and use of demand information has been of interest to researchers. Forecasting the potential sales of new products is challenging in situations where the velocity and volume of sales is subject to global distribution of a product, historical sales are not available, and market demand needs to be predicted well before entering the market (Garber et al., 2004; Urban et al., 1996). The literature has suggested both quantitative and qualitative models for estimating new product growth and for predicting market penetration (Bass, 2004; Sood et al., 2009). Responding to demand may be eased by utilizing early sales information (Fisher and Raman, 1996) and online search data (Kulkarni et al., 2012). Holmström et al. (2006) propose a planning approach tailored to each phase of a product's lifecycle, using information sources to support the planning needs of each phase. Salmi and Holmström (2004) study the problem of gaining access to demand information and propose using channel data (e.g., distributor sell-through data) as a substitute for PoS data. Kaipia and Holmström (2007) and Holmström et al. (2002) suggest differentiated planning solutions according to demand features, and Alftan et al. (2015) present a retail store replenishment solution for exceptional demand. Overall, research suggests that an adaptive planning process can smooth the production process (e.g., Aviv, 2007) and rescheduling and information sharing are seen as supply chain improvement strategies (Cavusoglu et al., 2012). In the S&OP literature, the prevailing view suggests that the process should be formalized and strictly scheduled (Oliva and Watson, 2011), completed with the view that the process should be contingently aligned to the environment (Ivert et al., 2015; Kaipia and Holmström, 2007).

Analytical studies examining how the potential advantages of more collaborative S&OP are divided between retailers and suppliers indicate that the major share of benefits is likely to be on the supplier side (Raghunathan, 1999; Yu et al., 2002), but are reduced if the products are substitutable (Ganesh et al., 2014). A positive connection between collaborative replenishment and manufacturer sales margins has been identified (Kulp et al., 2004), while collaboration in new product introductions has been positively correlated with intermediate performance measures, such as lower stock-out rates at the retailer and manufacturer. The expected improved performance for manufacturers resulting from vendor-managed inventory (VMI) arrangements in the form of higher wholesale prices has not always been realized (Kaipia et al., 2002; Niranjan et al., 2012). Many manufacturers have struggled to realize any benefits from collaboration in practice (Aviv, 2007; Småros, 2007; Vergin and Barr, 1999). Moreover, a recent literature review revealed no evidence from empirical academic articles of manufacturer benefits from using downstream demand information over multiple echelons in a supply chain (Kembro et al., 2014).

Many factors affect suppliers' possibilities to benefit from collaborative planning in practice. According to Småros (2007), the suppliers' and retailers' needs for forecasting and collaboration differ and, furthermore, retailers' forecasting capabilities may be low. A study in the semiconductor industry observes that suppliers may perceive shared forecasts as unreliable if customers change the forecast figures frequently or inflate forecasts to assure supply (Terwiesch et al., 2005). This does not, however, prohibit the retailer from sharing demand data, so a manufacturer-driven collaboration may be an option. However, delays in receiving demand data and quality problems of shared retail PoS data make it difficult for a supplier to implement a collaborative S&OP process (Lehtonen et al., 2005; Salmi and Holmström, 2004). Retailers may be reluctant to share timely information because they may fear possible negative effects on their revenue and profits should critical information be leaked to competitors (Kong et al., 2013).

To summarize, previous research has contemplated collaboration for improving product availability in retail stores and identifying demand situations and product characteristics for increasing the value of collaborative forecasting and PoS data sharing. This is certainly important for ensuring sales during periods of exceptional demand. Still, investigating the mechanisms that produce — or fail to produce — outcomes for introducing information sharing in supplier operations, in particular in a manufacturer's operations planning and production, has not been studied up close. This leaves room for fine-grained empirical research on how a collaborative planning process produces results in particularly challenging demand situations where the demand is affected by seasons or promotional activities, or when introducing new products to the market.

2.3. Generative mechanisms for seizing the benefits of downstream sales data

The influence of supplier capacity, lead time, demand correlation between retailers, and demand variability on the ability to benefit from downstream data has been examined in the literature (cf. Chen, 1998; Gavirneni et al., 1999). In particular, the model-based literature describes many ways for generating benefits from more collaborative S&OP, such as using downstream information to improve the forecast accuracy of the manufacturer (cf. Gavirneni et al., 1999; Lee et al., 2000; Ramanathan, 2012), or optimizing inventory levels and inventory allocation in the supply chain (cf. Cachon and Fisher, 2000; Fransoo et al., 2001). However, in the use of downstream sales data the impact of other factors, such as product characteristics or specific features of the manufacturer's production planning process, have not been subjected to detailed investigations.

Supplier capacity constraints have been modelled to have an impact on how efficiently retailer demand information can be used by suppliers, with a diminishing value of downstream demand information when production capacity is very high or very low (Gavirneni et al., 1999; Zhao and Simchi-Levi, 2002). Other modelling research posits that when production capacity is limited, sales information is not very beneficial since the production quantity is determined by capacity, not by realized demand (Simchi-Levi and Zhao, 2003).

Småros et al. (2003) identify the production planning cycle for stationary demand as a factor that potentially affects the value of information sharing. Access to downstream demand information is likely more valuable when the manufacturer employs a short planning cycle (i.e., faces more variation caused by customer order batching) as compared to the situation where the manufacturer's production planning cycle is long (i.e., when the batching effect is reduced by averaging). Moreover, Kaipia et al. (2002) demonstrate empirically how order batching affects the value of information sharing, and how the value of information sharing is higher for slow-moving products (i.e., products that have large replenishment quantities compared to their demand) than for fast movers.

How the manufacturer can take advantage – particularly in running its operations – of downstream demand information is treated in a few articles only. Aviv (2007) only states that the supply side needs to be agile enough. Lee et al. (2000) find that when supplier replenishment lead time (i.e., time from order to delivery) is short, the cost savings provided by information sharing to the manufacturer remain low. The authors explain this stating that, by serving customers from inventory, the manufacturer can meet and react quickly to the retailer's orders with a small amount of inventory. A recent empirical study (Dong et al., 2014a) investigates the benefits of downstream data sharing in manufacturer-distributor dyads and finds significant benefits in reduced inventory and stock-outs for distributors. On the manufacturer side of the dyad, it is suggested that the reduced variability in distributor inventory levels also benefits the manufacturer.

The timing and frequency of information sharing in the S&OP context is addressed in only a handful of research articles. One study suggests that demand-related information should be shared as early as possible (Aviv, 2001) to take advantage of it. The accuracy and frequency of information sharing has also been studied in Kulp et al. (2004) and Ramanathan (2012). Sharing information about inventory and demand between companies in the supply chain has been proposed as a mechanism to increase resilience and robustness (Brandon-Jones et al., 2014). Holweg et al. (2005) propose that the shelf life of the product affects the speed at which the supply chain should operate and, therefore, dictates planning frequency.

2.4. Research gap

The existing studies on the sharing of PoS data (see e.g. Croson and Donohue, 2003; Ramanathan, 2012; Williams and Waller, 2011; Småros et al., 2003), focus on outcomes for manufacturers, but do not elaborate the mechanisms in context through which outcomes are achieved. Prescriptive and contextualized research outlining how a manufacturer can take advantage in its physical operations of access to PoS data is largely missing, leaving practitioners with a lack of research-based guidance on how to make best use of retailer sales data. This leaves room for fine-grained design science research on the design of the collaborative S&OP process and for investigating the mechanisms through which particular process designs produce intended outcomes in some contexts, but in other, no outcomes at all.

3. Methodology

This study develops actionable knowledge on the effects of sharing and use of retailer sales information in collaborative S&OP, by designing and evaluating a process for using retail sales data in the product introductions of two manufacturers. Based on the knowledge gained, we develop actionable propositions on how to achieve intended outcomes in particular settings. The presentation and analysis of the design study follows the context-intervention-mechanisms-outcome (CIMO) logic (Denyer et al., 2008), which identifies a problem in its context (C), performs an intervention (I) and analyses the generative mechanisms (M) through which the designed system produces verified outcomes (O). First, the contextual factors of running the product introduction in the case companies are studied, then the intervention type is described, and the generative mechanisms to deliver the outcomes are observed. The study is explorative, as it develops and evaluates a solution design in a particular field-setting, but design propositions are not yet field-tested in a setting different from where developed (van Aken, 2004). In so doing, it explores a solution for innovative S&OP, relying on processes and systems implemented in the case organizations studied.

3.1. Research process: interplay between the case study and design science approaches

The research design combines a case methodology and design science approach (Fig. 1). Case studies are used primarily to develop theory (e.g., Benbasat et al., 1987; Harris and Sutton, 1986; Van de Ven, 1989). Here, we compare two cases to observe how information sharing in product introductions produces different operational outcomes for manufacturers, depending on their situation. The study is carried out by combining design exploration (Holmström et al., 2009) and participant observation (Näslund et al., 2010). The research question of this study is: *In what situations and how should retail sales data be shared for collaborative S&OP?* The study focuses on managing exceptional demand situations in manufacturing companies. In the cases, the unit of analysis is the S&OP process for product introductions.

The problem of planning sales and operations in product introductions is studied in a two-case setting, where a new collaborative process using retail sales data is designed and tested in two case companies. Evaluation of the differences in the outcomes is used as the basis for proposing generative mechanisms for successful and unsuccessful outcomes for equal information sharing intervention (Denyer et al., 2008). Longitudinal observation of how the sales and operations planning for new product introductions changed after introducing collaborative product introductions is used to further elaborate the mechanisms for successful outcomes.

As the research question focuses on designing a solution and describing the outcomes of the solution in use, a longitudinal study of the case is appropriate (Stuart et al., 2002). The longitudinal case makes it possible to observe how a collaborative product introduction process is improved and developed in use. Rather than trying to model how information is shared and used, we examine how actual companies share information and monitor the ways in which PoS data is used, as well as the results of its usage. This approach allows us to study the experiences of managers in a real-life context and thus increases the practical relevance of the findings (Yin, 2013). The longitudinal study has also previously been found suitable for design science research (see e.g. Tanskanen et al., 2015).

3.2. Case selection

We select companies that operate in the same problem setting, but which exemplify contrasting characteristics (Miles and Huberman, 1994), thus enabling a theoretically interesting cross-case analysis in the form of outcome evaluation (Barratt and Choi, 2007). The research design constitutes a field experiment on demand data sharing for observing how a designed solution triggers — or fails to trigger — mechanisms producing outcomes. The case study consists of two supplier companies operating in the grocery sector and delivering to the same retailer. The retailer operates in northern Europe and emphasizes efficient logistics as a source of competitive advantage, and is active in developing collaborative activities with suppliers.

The supplier companies are selected from the investigated retailer's supply base. They were chosen on the grounds of their previous participation in collaborative efforts with the retailer, and the interest shown in collaborative development of supply chain

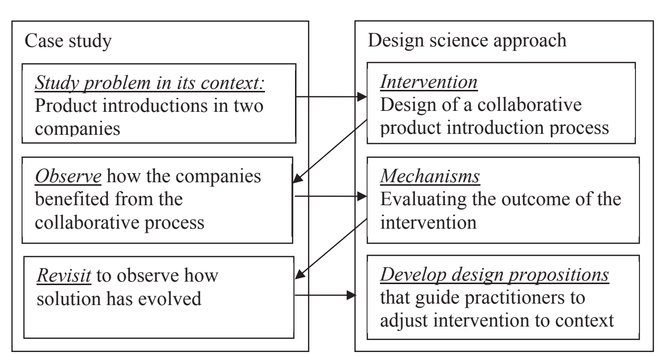


Fig. 1. Research process.

operations. Both companies are suppliers of packaged consumer goods and are prone to strong marketing efforts, campaigning, frequent product offering changes, and face seasonal demand. FoodCo is a supplier of food products with a time-limited and relatively short shelf life, ranging from a couple of months to one year. ChemCo is a multinational supplier of techno-chemical products, such as hygiene products and detergents, with an almost unlimited shelf life. The company runs specialized production plants centrally positioned to serve large regional markets and the country where the study was carried out represents a relatively small part of its sales. FoodCo is an international but significantly smaller company. FoodCo maintains a few production facilities, located close to its home market.

It was ChemCo who presented the first ideas toward digging deeper into the benefits of information sharing, as it sought access to PoS data instead of just monitoring order data. The company wanted to investigate if the use of accurate demand data in forecasts could be transformed into benefits in its operations. FoodCo was motivated to study different ways to improve forecast accuracy. A particular interest was directed towards new products, which often suffered from either out-of-stocks or overproduction and excess inventories in the early phases of their life-cycle.

Selecting just two cases allows for deep observation of the cases and capturing in much greater detail the context within which the phenomenon under study occurs (Voss et al., 2002). This arrangement allows deep researcher involvement in the intervention design and follow-up, with several planning meetings at the retailer and the two manufacturers, as well as agreements on design principles, timetables, and committed resources. Moreover, during the intervention, the researcher resources can be directed towards assisting the companies in the follow-up and analysis of data, co-developing the process further, and observing discussions about the decision making. The shared problem setting allowed for a deeper understanding of the criteria behind decisions in the cases.

In the research process, FoodCo is studied longitudinally, with the purpose of following up the impacts of the pilot intervention in the long run. The researchers stayed in contact with the company and were aware of the development of the process in the company, and that collaborative S&OP was an established practice. After eight years, when FoodCo faced two particularly challenging product introductions, the researchers got the opportunity to study the collaborative practice up close and in action. For longitudinal research, single case studies are common (Narasimhan and Jayaram, 1998; Voss et al., 2002).

The researchers also stayed in regular contact with ChemCo, but decided not to include the company in the longitudinal study. The reason for the exclusion is that the piloting did not indicate opportunities for improvements in physical operations, and the company did not further develop PoS information sharing with the retailer. Nevertheless, the ChemCo pilot experience provides us with an interesting opportunity to explore the factors that influenced this outcome.

3.3. Data collection and analysis

The study uses a variety of methods for data collection and analysis (Table 1). In the first phase, the problem under consideration was discussed in initial meetings with representatives from the two case companies and with the retailer. It was revealed that forecasting demand for recently introduced products as well as managing operations for these products include several challenges and significant risks, forming a potentially interesting and profitable problem context to be studied. The topic of introducing retail sales data into the planning process was presented and the companies' interest in participating in the study was established. For both case companies, the product introduction process was investigated through intensive discussions and meetings with the key stakeholders involved, where participant observation of the planning activities was used as the main approach for collecting qualitative data. In addition, quantitative PoS data were collected to analyse the daily sales outcomes of all recent product introductions. Using this quantitative data collected from the retailer, 109 products were analysed. The retail sales profiles were studied with key stakeholders in the companies and used as the basis for proposing a collaborative product introduction process for updating forecasts during introduction. The data collected from the retailer consisted of product and chain-level daily sales for time periods ranging between three to six months following product introductions. The data was analysed in more detail using graphical representations of sales profiles for the products, scatter plots of the relationship, and correlations between early and later sales.

The intervention focused on the establishment of a new process for collaborative product introductions, based on the understanding of the studied problem in its context. The process was developed by the researchers in collaboration with key account managers from the two case companies — one from each — and a development manager from the retailer. All product introductions taking place at the companies at the time of the pilot were included in the study; thus, the piloting consisted of 7 ChemCo products and 12 FoodCo products. The researchers initially participated as observers while the piloting was conducted. The focus was on analysing how the PoS data were used and what kinds of forecast updates resulted from using the data. As the process was established, the researchers collected quantitative data on the product introductions and interviewed the participants to evaluate the outcomes.

The last phase of the research was conducted eight years after the beginning of the initial intervention. During this period, FoodCo was re-visited several times to determine the current status of the utilization of the PoS data. During the process, actual data from the decisions and the outcomes were provided by the company about sales, orders, forecasts, and inventory levels. In addition, qualitative data were collected in our interviews with the supply chain manager, planning manager, and a planner. Based on the outcome evaluation and analysis of the problem in context, actionable design propositions were formulated (Denyer et al., 2008; Holmström et al., 2009).

4. Case study

4.1. Field problem: not all product introductions are alike

Following the CIMO-logic, the first part of our empirical study focused on the problem in its context, including the external and internal factors, as well as the behaviours of the human actors that influenced the desired change in the cases (Denyer et al., 2008). By participating in the study, the retailer and suppliers agreed to start by examining whether PoS data could be of value in updating forecasts for recently introduced products. Both case companies had earlier collaborated in supply chain management initiatives, such as VMI, with the retailer (see Kauremaa et al., 2009). Thus it was initially thought to be possible to deepen the collaboration in practice, including joint forecasting of the sales volumes during product introductions.

We investigated the potential usefulness of PoS data in product introductions by analysing 38 recent product introductions in two of ChemCo's product categories and later, when the initiative was extended to FoodCo, in 71 product introductions in FoodCo's main category. Graphical representations were used as a basis for

Table 1
Data collection.

Phase	Company	Meetings	Researchers' role	Informants	Quantitative data
Studying problem in context	FoodCo	Initial planning meeting Meeting for studying retail sales profiles	Facilitators Providing and presenting analysis	Key Account Manager and Logistics Manager	
	ChemCo	Initial planning meeting Meeting for studying retail sales profiles	Providing and presenting analysis	Key Account Manager and Supply Chain Manager	
	Retailer	Initial planning meeting	Facilitators	Supply Chain Manager	3-6 months' retail sales of product introductions of 109 products, daily level
Intervention design in collaboration with practitioners	FoodCo	Meeting for designing the pilot and agreement to participate	Facilitators	Key Account Manager and Logistics Manager	Forecasts, forecast accuracy figures, production plans for 12 products.
	ChemCo	Meeting for designing the pilot and agreement to participate	Facilitators	Key Account Manager and Supply Chain Manager	Forecasts, forecast accuracy figures, production plans for 7 products.
	Retailer	Agreement on using the data shared in the pilot intervention	Facilitators	Supply Chain Manager	Point-of-sales data delivered to both manufacturers
Observing outcomes	FoodCo, Retailer	Three bi-weekly decision meetings during pilot project Interviews Meeting to conclude pilot project and to agree on widening the practice with weekly data	Observers, interviewers	Supply Chain Manager, Key Account Manager	Weekly sales figures of new products, forecasts, production plan and batches, inventory levels, deliveries for the sales period
	ChemCo	Participation in three decision meetings while the pilot was running Interviews with two stakeholders Meeting to conclude the pilot	Observers, interviewers	Key Account Manager and Supply Chain Manager	Weekly sales figures of new products, production schedule, forecasts
Revisit to observe how solution evolved	FoodCo	One group interview and three separate interviews with open-ended questions	Interviewers	Supply Chain Manager, Planning Manager, Planner	Weekly point-of sales figures of new products per market and product, from a period of 26 weeks during the product introduction

discussing the realized sales during the product introductions and the problems faced by the two case companies. Based on the product sales data it was observed that most products' sales volumes grew fairly smoothly until they settled at a steady sales level. However, identification of the point when a steady state of product sales has been reached is a key problem in S&OP. Many products in the categories of goods investigated in this study reach their steady demand level within 25–30 days of introduction, but some continue to grow even after 60 days or more. After the steady state has been reached, promotional activities may cause peaks in demand. The nature of the product affects the demand, as the sales of new products typically grow for a longer time than the sales of slightly altered versions of existing products. A further observation was that products bought less frequently by consumers tend to reach their steady sales level more slowly than products bought more frequently.

Fig. 2 presents the eight largest products (in terms of sales volume) introduced in one of ChemCo's categories. The products' sales are presented as seven-day rolling averages to eliminate the variation caused by sales on the different weekdays. The products' sales behave very differently. For example, Product 1, an extension of an existing product line, reaches its steady sales level in less than 25 days after its introduction. Product 2 is a true innovation and its sales continue to grow as late as 50 days after its introduction. Product 3 experiences a demand peak at 18–26 days after its introduction as a result of promotional activities.

The analyses of sales profiles revealed that the companies have an opportunity to benefit from accurate PoS information in the early stages of product introduction. In particular, miscalculating the steady state may result in misleading decisions. Premature judgments may result in a lack of production capacity and material, but a delay results in overproduction and excessive inventories of materials and finished goods. After having identified the problem and opportunity for improvement, the next step was the design of the collaborative process and testing it in the field.

4.2. Design of intervention

The question of how to use retail sales data was further explored as the initial analysis of the field problem pointed toward clear potential benefits. The case companies found the results of the initial data analysis very encouraging. On the basis of the different demand patterns and growth rates, the suppliers' key account managers were confident that they would be able to detect when forecasts and plans were in need of modification.

Our intervention (Denyer et al., 2008) — a pilot project on information sharing — was designed and implemented the same way in both case companies. The purpose of the information sharing project was to test in practice the value of access to PoS data in managing product introductions. The collaborative product introduction process was set up on the basis of an exchange of the latest retail sales information from the retailer, as follows:

1. At regular intervals, the retailer shared realized sales with the suppliers to be used for forecast updates of new products. In the intervention, every second week after the product introduction, the retailer shared daily chain-level PoS data with the suppliers for each of the new products.
2. The data were converted to graphical presentations, and decisions were made by supplier representatives whether forecast updates were warranted. In the project, sales profiles of each product introduction were evaluated to find out whether an adjustment of the forecasts was necessary.
3. Rules were decided about when an action based on the shared data was required. It was agreed that an update was to be made

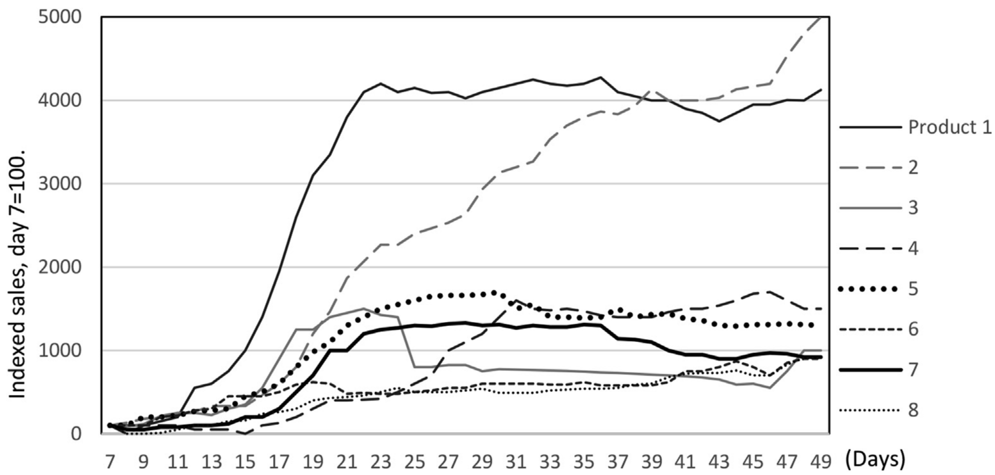


Fig. 2. Sales profiles of product introductions, 7-day rolling averages of the eight largest products in one product category. Days 7–49. Indexed sales, day 7 = 100.

when the product's sales were growing and had surpassed, or were about to surpass, the current forecast.

4. The duration of the intervention was determined. It was agreed that the collaborative process would be terminated for the product introduction when the product's forecast had stopped growing. The forecast was updated up to the planning horizon on the basis of the identified steady sales level.

4.3. Outcomes of the intervention

The outcomes of the intervention are corrective actions taken and the consequences of these actions (Denyer et al., 2008; van Aken, 2004). In FoodCo there were many such actions, while in ChemCo there were none.

Already early in the project, FoodCo realized tangible benefits from its access to retailer PoS data. The participating key account manager estimated that access to the PoS data was a key factor in securing availability for at least two products with a significant stock-out risk. Furthermore, the PoS data enabled the company to correct overly optimistic forecasts. FoodCo's key account manager commented that, by substituting retailer order data with the use of PoS data, the company forecasts were updated several weeks earlier and followed actual demand much more accurately. More important, when a forecast is updated, it can have an impact on production within as little as two weeks of the change. The company also found that benefits resulted from the forecast updates in its purchasing of materials. However, the long lead times of certain raw materials, especially packaging materials, was found to reduce the value of access to retailer data in product introductions.

It was not considered a problem by FoodCo that the shared PoS data reflect only the participating retailer's sales, whereas forecasts are developed for total demand. The key account manager explained: “Since we know the penetration of our products in the different retailers' chains, we can draw fairly accurate conclusions even on the basis of limited coverage of point-of-sales data.” Encouraged by the results, the participating retailer piloted sharing of PoS data on promotions. As promotions typically last one month or less, promotional products have to be manufactured in advance, leaving little room for FoodCo to react to realized demand, and thus, reducing the value of information sharing.

To summarize, FoodCo was extremely pleased with the results of the new collaborative process. Also, certain performance indicators pointed toward the situation having improved. FoodCo's forecast accuracy improved by 7%. This was studied by comparing the forecast accuracy for new product introductions in two eight-month periods (from January to August), a year before the information sharing pilot and during the piloting period. Furthermore, FoodCo's overall service level measured for all products toward the retailer improved by 2.6% when the same time periods were compared.

However, for ChemCo, the benefits stemming from the introduction of PoS data sharing in product introductions were not evident and the value of additional effort on forecasting was questioned. The explanation is in the company's forecasting and production processes. The key account manager concluded: “Production lead times are too long to be affected though access to early sales.” ChemCo's manufacturing plants are located far from the studied market and they serve the entire European market. Production planning lead times are long, between six and eight weeks, and products targeted at the studied market area are manufactured infrequently, typically six times a year. Access to early demand information for a new product allowed forecast updates, but influenced production only much later, and thus the effect on actual operations remained low. The company could not take advantage of shorter demand information lead times because of the long lead times in adapting the physical supply operations. An additional show-stopper for ChemCo was that it was difficult to scale up the sales information from the retailer to total demand, the reason being the retailer's low share of demand in production.

5. Evolution of collaborative product introduction in practice

We followed up on the first study eight years later. In FoodCo, we found that the process for collaborative product introductions was an established practice and had become an important part of S&OP. The collaborative process is based on timely access to PoS data in exceptional demand situations and is used to adjust forecasts and for operational decision making. On the basis of the experience from the pilot, FoodCo sought ways to combine the process for routine forecasting and collaborative product introductions. The key change was modifying the forecasting tool to combine sales profile graphs and comparisons of PoS data with forecasts.

5.1. The example of Red and Green

In 2012, FoodCo introduced two new products, here termed Red and Green. Both products were franchised goods of a global, very fast-growing toy brand. Because of the expected high demand for the new products, the strategic significance of them, the tight timetable, and the associated risks, the company wanted to manage their introduction as accurately as possible. The two new products are manufactured on the same production lines as many other products, resulting in a potential shortage of production capacity for the product introduction. Because of the strict schedule and long lead times for contract manufacturing and the purchase of packaging materials, there were few opportunities to hedge against future high demand. Production could not be moved to contract manufacturers, nor could the products already on the market be produced to inventory because of best-before constraints.

The company organized a dedicated planning team for the product introductions. The purpose of the team was to provide the best possible forecasts to ensure the availability of the new products without risking the availability of other products. The team met each week, right after the newest sales figures and updated forecasts became available. The meetings, which we call contextualized S&OP, were attended by experts from all the relevant functions. Top management and the collaborating customer representatives followed the work of the planning team closely and attended some planning meetings. Even several weeks before the product launch, it became obvious that it would not be possible to satisfy the demand for all products during the launch period. Therefore, the contextualized S&OP team had to make decisions regarding other products' inventory levels and availability. The solution was to reduce inventory levels for most products and thus accept a higher risk of out-of-stocks. For one product, a customer-specific tailored product, no new production batches were scheduled during the most critical period, grudgingly accepted by the customer.

One key question for the team was how the sales would be divided between the Red and Green products (Fig. 3). Before the launch in June 2012, the forecast for the product was created using historical data from product launches of similar products. In addition, as the product was launched in a smaller market four weeks before the main market, all the available sales data were collected to get indicators on the sales split. From this market, the first sales signals indicated that Red was outselling Green. This information was updated in forecasts and production plans and resulted in the decision to skip one planned production batch of Green, to improve the use of scarce production capacity.

When the retail sales started in the main market and the first retail PoS data were shared by the retailers, the split between the product variants was further adjusted in the sales forecast. As seen in Fig. 3, the split was, as expected, in favour of Red. As the product introduction proceeded, volume of sales was adjusted based on PoS data. The team was careful in interpreting the sales results, being aware that the retail sales data were not available from all retailers, but from only a quarter of the total market. After the second and third weeks, the observed split remained 60% for Red and 40% for Green. This information was used to set inventory target levels. Fig. 4 shows how the total volumes behaved and that, even after the peak deliveries in the beginning of the introduction, the company could deliver without stock-outs.

The last important task for the contextualized S&OP team was to identify the steady sales level after the launch and provide information for the production capacity investment decision. After the demand peak of the first weeks, the sales settled down to a lower level than initially expected. On the basis of the access to PoS data, the company could decide to delay investment in new production capacity or use contract manufacturing. Ten weeks after the product launch, the product introduction team had done its work, and the two products were included in the ordinary S&OP process using retailer order data.

5.2. The collaborative S&OP process

The collaborative S&OP process, and the way it was implemented at FoodCo, is illustrated in Fig. 5. The process is an evolved design that originated in the information sharing pilot and evolved in use to efficiently capture opportunities to benefit in the particular context of FoodCo.

After the initial piloting, FoodCo recognized that it needed a new type of process to identify those situations in which the extra effort involved in collaborative product introduction was likely to be beneficial. Most of the new products the company introduces to the market annually are modifications of existing products, the demand forecasts of which can be based on historical data from similar product introductions. Only a minority of the introductions involve truly new products, whose demand is exceptionally challenging to forecast and which can thus benefit from the collaborative process. The first step in the process is to analyse the context to identify the product introductions where this collaboration is likely to pay off.

Second, the exact design of the collaborative S&OP process needs to be decided according to the specific situation in question. This includes defining the planning resources to involve, identifying products that will be affected through shared capacity, and

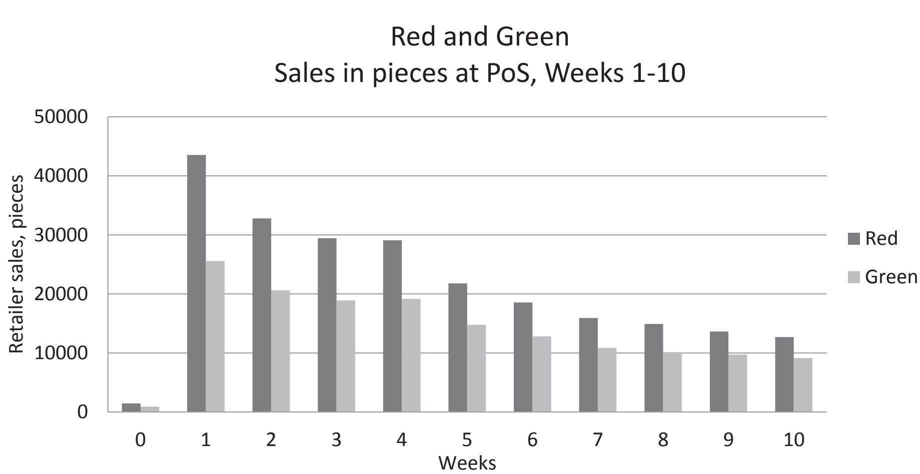


Fig. 3. Point-of-sales data for Red and Green.

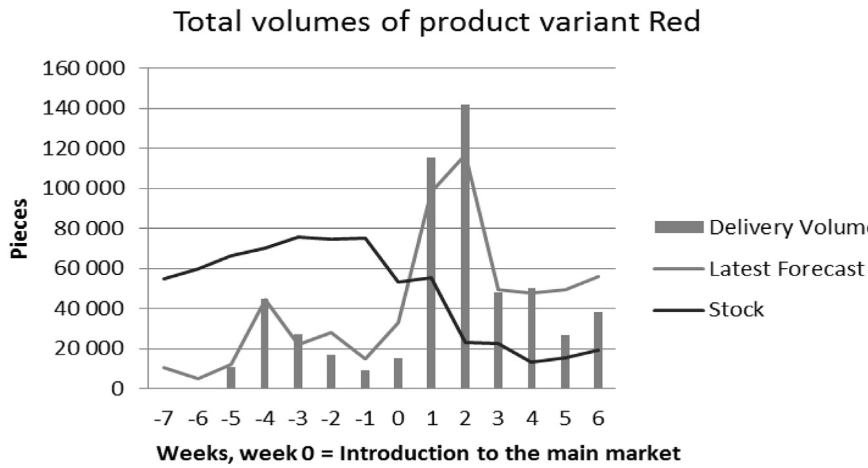


Fig. 4. Total volumes of the product Red.

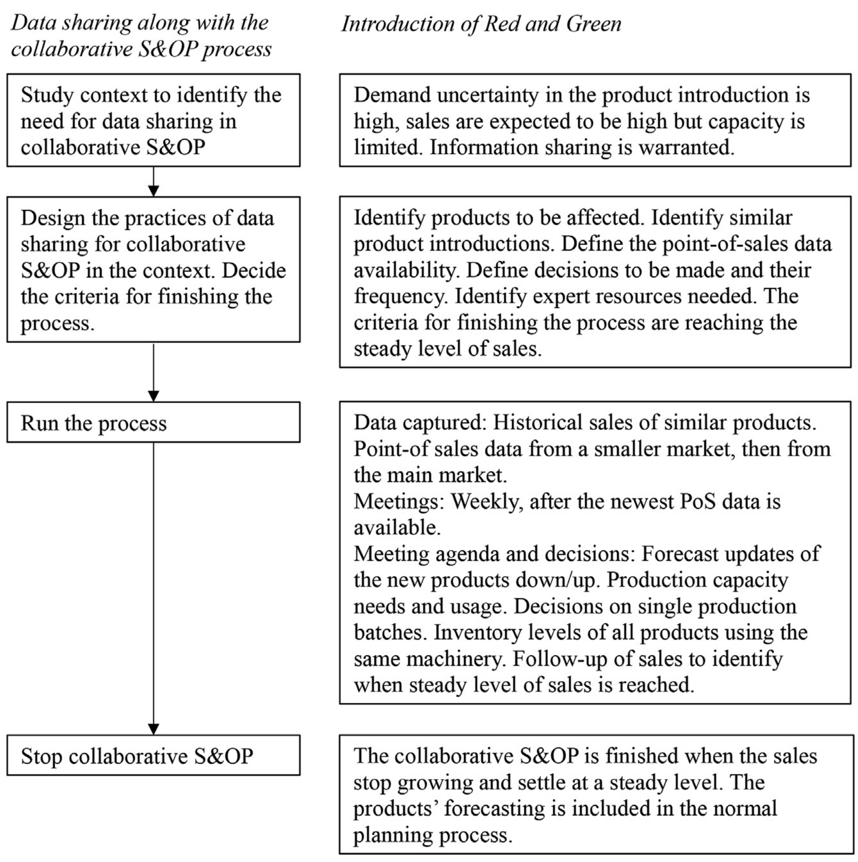


Fig. 5. The collaborative S&OP process and how it was applied in FoodCo.

the decisions to be made. Based on this information, the data needs for decision making are defined and access to data ensured. It is essential to determine how quickly the results of the analyses can be transformed into production and inventory-level changes. Last, the duration of the collaborative S&OP process as well as the criteria for when the process will be stopped are defined.

A product introduction requires the retail channel to be filled up, which causes a peak in deliveries. The first decision is to schedule production to reach a stock level to satisfy this high demand. The historical sales of a similar type of product can be used to estimate the first peak deliveries or, if such information is not available, the forecast for filling up the retail channel can be developed in collaboration with retailers. The second critical point is to estimate when retailers will need replenishments (i.e., when second retail orders can be anticipated) and how much stock is needed to respond to that demand. The third and final forecasting challenge is estimating at which level the sales will settle after the launch. The second and third decisions may benefit from the retailer sharing early PoS data during the product introduction.

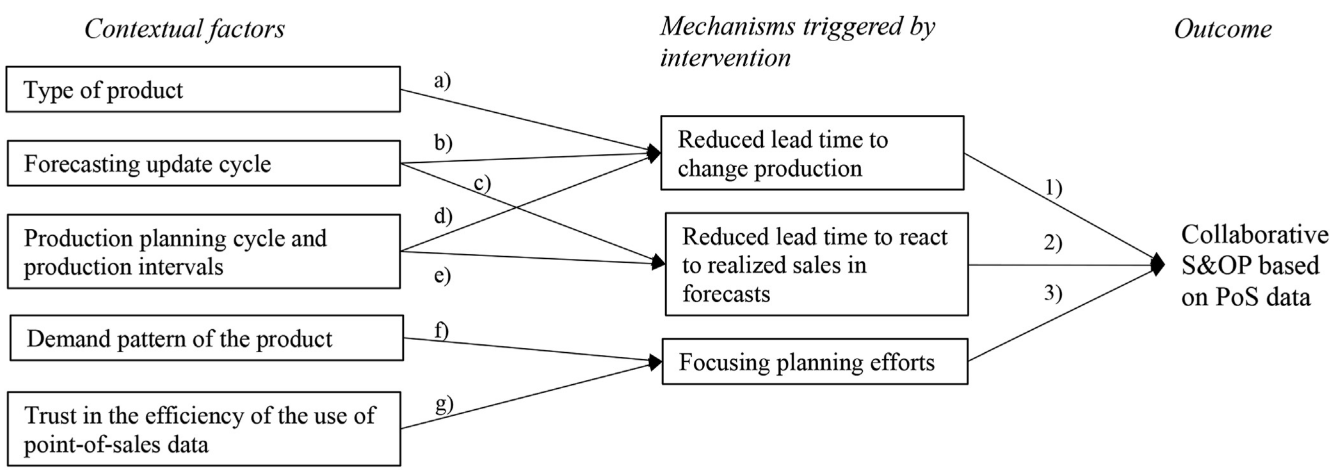
This collaborative S&OP design of FoodCo is similar to other S&OP processes for product introductions incorporating retail sales data, such as the S&OP process for the vertically integrated retail supply chain of Zara (Ghemawat, and Nueno, 2003). However, the convergent design evolution of the S&OP process for product introductions of FoodCo and Zara does not indicate that this is a best practice process design. In the following outcome evaluation, we will demonstrate how the process design likely triggers mechanisms to produce desirable outcomes only in contexts that share particular characteristics. Precisely because information sharing was extensively field tested in the contexts of the two manufacturers, we can investigate closely how outcomes are, or are not, produced and use this information to develop actionable design propositions.

6. Outcome evaluation and design propositions

The outcome evaluation of the intervention designed and the longitudinal follow up seeks understanding of the generative mechanisms that create business value through sharing of sales data. In the outcome analysis, the contingencies that affect information sharing and its outcomes in the supply chain were analysed. In the review of previous research, we noted that while the mostly conceptual and model-based research on data sharing in supply chains has studied the use of data to improve forecasts (Raghunathan, 2001; Ramanathan, 2012; Tokar et al., 2011) and the development of systems for new product sales forecasting (Bass, 2004; Ching-Chin et al., 2010; Kulkarni et al., 2012), little is known about the contingencies that affect data sharing efficiency in practice. We obey the process by Denyer and al. (2008) and critically evaluate the field problem in its context, design and observe an intervention introducing PoS data sharing in the S&OP process, and analyse the contextual factors and generative mechanisms through which sales data sharing creates business value in the supply chain. Our outcome evaluation uses CIMO logic to pinpoint the contextual differences and mechanisms that generated — or failed to generate — beneficial outcomes for the two case suppliers. Based on the identification of mechanisms in context, we then proceed to develop actionable design propositions for manufacturers considering the introduction of collaborative PoS data sharing in their S&OP.

6.1. Identifying the mechanisms in context

We found that neither the retailer nor the suppliers in the pilot had any interest in sharing or receiving PoS data on products with level demand. Only those products that were being introduced to the market, were affected by the seasons, or were on promotion had been considered potentially interesting from the information sharing point of view by the suppliers. However, FoodCo was significantly more interested in extending the pilot and making the new process a standard way of operating. The reason for this can be traced back to contextual factors, triggering, or not triggering generative mechanisms leading to beneficial outcomes. Figs. 6 and 7 summarize the outcome evaluation in relation to ways the PoS



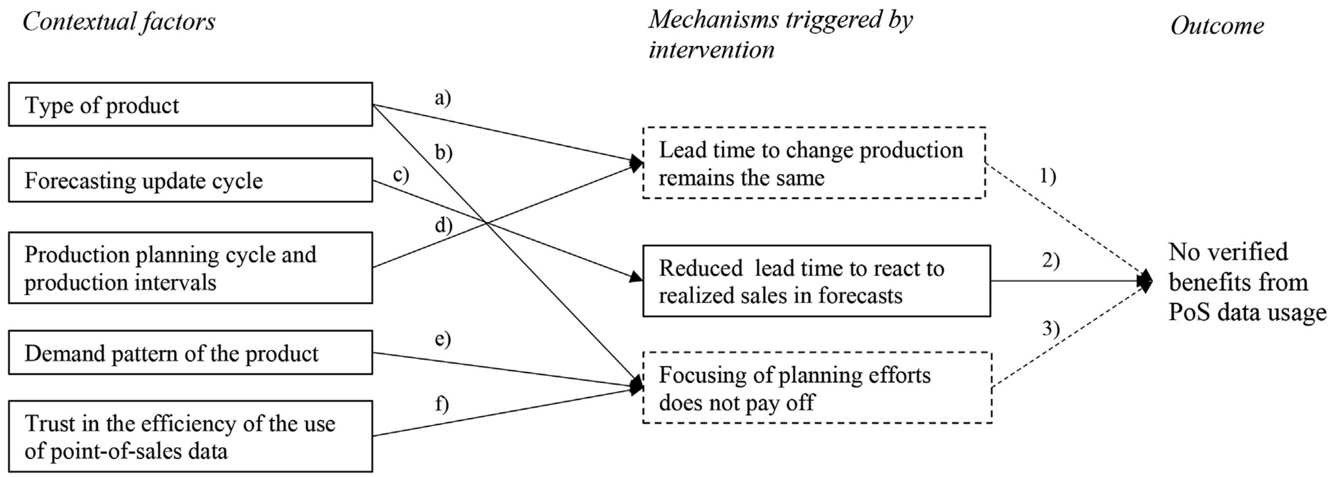
Contextual factors, rationale from case company FoodCo

a) FoodCo products have a limited shelf life of some months. The sooner the products are delivered to retailers, the fresher the products are offered to consumers.
b) In the pilot, bi-weekly point-of-sales data could be effectively used to correct overly optimistic or pessimistic forecasts.
c) In collaborative S&OP (described in the follow-up study) PoS figures were reviewed weekly. Forecast and production plan updates were made immediately.
d) Perishable products need to be produced relatively often. FoodCo production planning cycle was 2 weeks, and products are manufactured bi-weekly.
e) Production capacity at FoodCo was shared by several products
f) The early sales volumes of recently introduced products differed remarkably in growth rate and how quickly the steady state was reached.
g) FoodCo was able to observe immediate beneficial outcomes and focused on strengthening and further developing the S&OP collaboration with the retailer.

Mechanisms, rationale from case company FoodCo

1) Lead time to make changes in production was short. More specifically, it was sufficiently short to allow forecast updates be taken into account in production during the early sales of a new product. However, long lead times of product-specific package materials extended the lead time to change production.
2) Key stakeholders understood well the impact of reduced lead time on realized sales and the possibilities of taking advantage of the earlier forecast update in the S&OP process.
3) Products in steady state are predictable enough to be managed through historical sales and retailer orders. Products that have been recently introduced to the market, are affected by seasons, or are on promotion benefit most from the use of point-of-sales data.

Fig. 6. PoS information sharing — outcome evaluation for FoodCo.



Contextual factors: observations from case company ChemCo

a) The products have practically unlimited shelf life.
b) The long shelf life of products allow infrequent production intervals, producing in large batches and buffering for the target market.
c) The company received point-of-sales data bi-weekly and was able to update forecasts accordingly.
d) Production was performed six times a year, with a lead time to changes of several weeks.
e) The early sales of recently introduced products reached a steady state before buffers were depleted.
f) Key stakeholders concluded that earlier forecast updates impact production of products introduced with a long delay and were not motivated to continue investing time in analyzing PoS data.

Mechanisms: observations from case company ChemCo

1) Long production planning lead times, and infrequent production meant that more frequent forecast updates affected production plans and actual production with a long delay.
2) Key stakeholders did not see any impact from earlier and more frequent forecast updating, nor any advantage of the earlier forecast update for the S&OP process.
3) Instead of focusing planning efforts on collaborative S&OP, buffering was considered a satisfactory mechanism for long-shelf-life products to deal with forecast errors in product introductions.

Fig. 7. PoS information sharing — outcome evaluation for ChemCo.

information sharing resulted in a new collaborative S&OP for FoodCo. While the FoodCo case shows clear benefits of the developed process, ChemCo was unable to benefit from the same intervention.

The outcome evaluation indicates that the manufacturer's production planning frequency and production interval have a great impact on the perceived usefulness of the shared retailer sales data. Thus, the first identified mechanism of the outcome evaluation explaining why the case companies reaped very different benefits from the collaborative planning initiative is *reduced lead-time to change production*. The comparison of FoodCo and ChemCo pinpointed the context dependency of the outcome, and identified contextual factors — demand pattern of the product, production planning cycle and production intervals, as well as trust in the efficiency of the use — that lead to different outcomes of improved access to PoS data in product introductions. For product introductions, the benefit of PoS data depends on how quickly a forecast update is translated into a change of production. This is in accordance with the findings by Småros et al. (2003), who found that for stationary demand the value of customer sell-through data available through vendor-managed inventory arrangements depends on the order and replenishment frequency, and Småros (2007), who suggests that long production intervals affect the usability of demand data for manufacturers.

Also, we examined how the identified mechanism affected the verified outcomes in the case companies. ChemCo was not able to translate the bi-weekly reviews of PoS data into production change, which can be partly explained by their production planning cycle of six to eight weeks. This means that even at its shortest, the early sales signals can affect production that takes place 8–10 weeks after the product is launched and, in practice, even longer as products targeted to the studied market are manufactured infrequently. As the new products may reach the steady sales level only a couple of weeks after the introduction (see Fig. 2), this large international company decided to ensure availability by buffering. This was a viable solution because the products are chemical products with a long shelf life. FoodCo, instead, was able to change production within two weeks, during the early sales and well before a product reaching the steady sales phase.

The second identified mechanism is the *reduced lead time to react to realized sales in forecast updates*. In the collaborative S&OP of FoodCo, fast, accurate, and frequent following up of point-of-sales data improves the forecast accuracy, and as forecasts are used to update production plans, the operations are responsive to demand. The company are able to faster update forecasts and avoid stock-out risks and overproduction. This mechanism related to reducing the lead time to realized sales can be used to measure the time benefit (see Kaipia et al., 2002) in information flow that a supplier gains when introducing VMI with a customer.

Encouraged by the improvement, FoodCo further developed the way it used POS data in product introductions. Instead of bi-weekly, the demand data are reviewed weekly, right after the newest sales figures are available, reducing the lead time for reacting to realized sales. The case study indicates that through focused use of managerial resources for collaborative decision making and accurate weekly access to retail sales information (not forecasts), FoodCo was able to correct the initial forecasts of recently introduced products more rapidly and, at the same time, allocate the scarce production capacity towards those products that needed it most. On the other hand, ChemCo benefited less from reducing the lead time to realized sales as production responds slowly and relies more on buffering. For ChemCo, the planning cycle and production interval is long enough to wait for product introductions to reach a steady state before updating of production plans. This outcome evaluation explains why only FoodCo leveraged information sharing and responsive production to create a process that remarkably shortened the lead time to realized sales and the responsiveness to sales variations.

These findings are well in line with the research on accurate response to early sales (Fisher et al., 1994; Fisher and Raman, 1996). Response time should be such that it can reduce the demand uncertainty faced by the manufacturer. A manufacturer can reduce the demand uncertainty of product introductions either through faster response or buffering. The identified mechanism is consistent with the view that, for a responsive strategy, demand-related information should be shared as early as possible (Aviv, 2001) and that decision making should be based on the newest information from the sales and distribution channel (Kaipia et al., 2006). The accuracy and frequency of information sharing have also been previously emphasized in the literature (e.g., Kulp et al., 2004; Ramanathan, 2012), for example, concerning the extent to which companies share information about inventory and demand within the chain (Brandon-Jones et al., 2014), or that information sharing and planning efforts should be aligned to the flexibility in operations (Kaipia, 2009).

The third mechanism is *focused planning efforts*. For FoodCo, the beneficial outcome of collaborative S&OP is amplified by focusing planning resources on exceptional demand situations, such as the critical phase of product introductions. FoodCo collaborates selectively with retailers to use PoS data in its S&OP process while mostly relying on historical sales order data. Only in challenging product launches with demand uncertainty does the company use collaborative product introduction based on shared information from its sales channel outside its conventional planning process. Thus, we support the claim that increased collaboration intensity between suppliers and retailers increases forecast accuracy (Nagashima et al., 2015), but we still see that such an effort is not warranted in all situations.

The focusing mechanism requires that the company identify the situations and products where the use of a collaborative S&OP process is most likely to pay off. This ensures the efficient use of limited planning resources. Additional resources are needed as the effectiveness is based on the frequent review of early PoS data and fast decision making. This mechanism for generating beneficial outcomes for collaborative S&OP is a new contribution to the literature and complements the suggestion by Tokar et al. (2011) that human decision making is still central in the successful management of promotions and product introductions.

6.2. Actionable design propositions

The two manufacturers in this study experienced different outcomes from gaining access to timely PoS data during product introductions. The differentiating mechanism generating the observed case outcomes is the lead time to adjust production — not just plans — to changes in demand. When production planning lead times and intervals are long, the value of reducing the lead time to access high-quality information on realized demand is reduced. This result empirically supports the theoretical propositions on the contingent effect of supply chain collaboration presented in Holweg et al. (2005). In particular, the findings indicate that not all suppliers are in a position to benefit from access to PoS data in developing their S&OP. Based on the differentiating mechanism, we propose: *A supplier benefits from collaborative S&OP when the production interval and planning cycle are sufficiently short for forecast updates to change production during the early sales of product introduction.* Correspondingly, extending the proposition to promotions, the collaborative S&OP should be considered when production can respond during the early sales of the promotion.

Previous research suggests that collaborative S&OP can increase supply chain efficiency in production introductions, as well as in promotion management (Ramanathan and Muyldermans, 2010; Ramanathan, 2012). It has also been demonstrated that when demand is predictable, as in the case of stationary demand, or when sales history can replace access to PoS demand data, the payoff of collaboration may be small or even non-existent (Cachon and Fisher, 2000; Raghunathan, 2001; Tokar et al., 2011; Williams and Waller, 2011). These findings were supported in this study. Neither of the two manufacturers was interested in collaborating to access PoS data for situations in which demand can be deduced from order histories. They consider retailer order data or distributor sell-through data to be sufficiently accurate for managing products with stationary demand. Based on our contextualized understanding of the mechanism of reducing lead time to realized sales, the implication is that PoS data sharing and collaborative S&OP should not be considered for situations in which the supplier's transactional data can be used to assess actual sales with satisfactory lead times.

In collaborative S&OP, the decisions about production and purchase quantities to meet demand require the coordination of company functions and autonomous supply chain partners (Schneeweiss, 2003). The literature on collaborative planning in supply chains assumes that collaboration is beneficial without explaining how (Aviv, 2001; McCarthy and Golicic, 2002). For example, it argues that access to retailer demand information reduces variation in production plans or that demand visibility removes the supplier's inventory risk (e.g., Raghunathan, 1999). The results of this study challenge the plausibility of such claims. We find that not all product introductions are equally suited for collaborative S&OP and suppliers' efforts need to be focused on the outcomes of information sharing. Based on the contextualization mechanism, we propose: *A supplier develops the information sharing and S&OP procedures focused on the specific situation at hand. Over time, the developed S&OP designs become alternatives to be applied in upcoming non-standard demand situations.*

In the cases, the new products shared production capacity with several other products, which is a context not before studied in the information sharing research. Some views about capacity have been suggested, such as that information sharing is beneficial when the manufacturer has moderate to high capacity (Gavirneni et al., 1999) and that if production capacity is limited, then information is not very beneficial since the production quantity is determined by capacity, not the realized demand (Simchi-Levi and Zhao, 2003). In contrast to these studies, in the collaborative S&OP design presented in this paper, the value of reducing the lead time to realized demand was high when making decisions on how to allocate scarce production capacity between several products. This finding suggests that the specific planning context should always be considered for information sharing. In previous literature, the modelling-based studies have offered information sharing benefits in general (Aviv, 2001; Cachon and Fisher, 2000; Gavirneni et al., 1999; Simchi-Levi and Zhao, 2003).

Our study suggests that a variety of planning process designs are needed to configure the solution for a particular context, for example a particular demand situation. Hence, the general prescription that collaborative S&OP should be designed to reduce uncertainty and improve responsiveness to demand changes is, in this study, contextualized. In the studied context, we propose firstly that in new product introductions, the collaborative S&OP process should be used to shorten the lead time for production to react to sales volume change. Secondly, in product introductions where production capacity is scarce and shared between products, collaborative S&OP should be used in prioritizing between the newly introduced and steady state products.

7. Conclusions

The contribution of this paper is based on a design research that empirically investigates the mechanisms that determine whether there is value or not from introducing information sharing in S&OP. We identify three mechanisms that produce beneficial outcomes for a manufacturer when introducing collaboration and information sharing in the S&OP process. The identified mechanisms are fundamental operations management concepts related to responsiveness in production and the economizing of attention in the S&OP process. We pinpoint the contextual factors describing the situations where such mechanisms are likely to be active, and where not, to distinguish whether or not it makes sense for a manufacturer to consider collaborative S&OP processes in exceptional demand situations.

A number of articles have examined the practices and procedures of utilizing different information sources in S&OP, and have shown that the need for additional planning resources grows when the complexity of the planning situation increases. Showing the importance of the mechanism of contextualized planning efforts in collaborative S&OP is thus a contribution to this literature. Our design proposals emphasize how to adjust planning to achieve beneficial outcomes, in contrast to the literature where S&OP is treated as a formal planning process with strict schedules, practices, and meetings. Our study concurs more with Ivert et al. (2015) on the contingent nature of the S&OP process and provides empirical evidence on the need to adjust processes according to the planning situation. The results add to the findings about the need to add planning resource usage in demanding situations by Barratt and Oke (2007) and Kaipia and Holmström (2007), by identifying contextualization as a mechanism that brings benefits.

Previous research has suggested that the value of access to demand information is lower in cases where the production capacity is very high or very low (Gavirneni et al., 1999; Zhao and Simchi-Levi, 2002). In contrast to this view, the observations from our research suggest that in the context of managing a multi-product production process with capacity constraints, it is of high value to collaborate to access the PoS data to direct capacity usage to those products that most urgently need it.

The key managerial implication of this study is that reduced lead time to realized sales can be very valuable in managing product introductions. However, not all companies are equally equipped to benefit from such a practice. A key to leveraging the benefits of sales data sharing is that the information acquired is directed to improve the performance in operations, in our case study in production. A sufficient level of integration is required between sales and operations. Companies need to consider the expected outcomes before spending resources on accessing and analysing downstream demand data. If the customer's share in the supplier's overall volumes is low or if production planning cycles are long, the value of PoS sharing may be very small or even non-existent. In contrast, the value of reduced lead time to realized sales is likely to be significantly greater if data are available from more than a marginal share of the demand. However, in a product introduction where the challenge is to identify the steady state demand, not all customers and not even the majority of customers need to be involved in an information sharing arrangement for the supplier to benefit.

A key issue in design science research is whether an intervention produces the intended outcomes. We can contrast the in-depth examination of mechanisms in context with more conventional statistical analysis of the outcomes. There is a trade-off, in that increasing design orientation likely leads to practically more relevant knowledge on new ways of operating, but perhaps, at the expense of determining reliability based on statistical analysis. Whereas a properly designed quantitative evaluation can identify whether an intervention produces outcomes, a fine-grained design evaluation can shed light on exactly when and why an intervention produces specific outcomes.[1] In evaluating design-oriented case studies, relevance and pragmatic validity is emphasized as a primary criterion (Denyer et al., 2008; Näslund et al., 2010). The reliability of design-oriented case studies can be evaluated using several criteria that have been used to evaluate explorative case study research. In case studies focusing on design and action, one appropriate evaluation criteria is trustworthiness (Näslund et al., 2010). Lincoln and Guba (1985) suggest that the trustworthiness of a study can be discussed in terms of credibility (the veracity of particular findings), transferability (the applicability of the research findings to another setting or group), dependability (the consistency and reproducibility of the research results), and confirmability (the research findings being reflective of the inquiry and not of the researcher's biases).

The study reported in this paper was conducted over a long time period, and the research design was opportunistically further developed as we observed interesting developments in practice. This development allowed us to compare the outcomes in the case companies. Bearing the criteria for credibility and dependability in mind, we paid special attention to describing the specific reasons why sales data sharing in the product introduction process was more successful in FoodCo than ChemCo. In addition, we articulated the generative mechanisms of data sharing by linking our observations with the body of knowledge on the logistics and operations management research domains. However, full transferability of the findings requires further research and field testing with the established design propositions (van Aken, 2004). The confirmability of the results can be improved, for example, by investigating the views of different stakeholders on the S&OP process implemented in FoodCo.

In this regard, the design science study reported by Tanskanen et al. (2015) provides a potentially valuable template. Using the technique of 'technological framing' (Orlikowski and Gash, 1994), the alignment of stakeholder views on purpose and outcomes of a VMI-based solution in a construction industry setting was analysed. Conducting such an analysis of stakeholder alignment could reveal additional contextual factors and mechanisms that influence the outcome of introducing PoS data in S&OP. Opportunities for further research are also found in the design of collaborative and contextualized S&OP analysed in this study. The generative mechanisms associated with data sharing can be more fully exploited in design by linking the purposes of data sharing to the reduction in lead times and improved flexibility of the supply processes. The issues related to setting production planning cycles and production intervals, estimating customer share of demand, and interpreting sales profiles are pertinent to sales data sharing too. Hence, there is ample room for additional case studies using a design science approach on collaborative S&OP in different settings to further develop and test different aspects of the practices investigated in this study.

[1] For examples from introducing VMI information sharing, see e.g. Dong et al. (2014a) for a quantitative evaluation, and Kaipia et al. (2002) for a design-oriented outcome evaluation.

Acknowledgment

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