THE EFFECT OF SUPPLY CHAIN DECOUPLING POINTS ON DEMAND PLANNING. AN EMPIRICAL STUDY

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Abstract

The paper seeks to investigate the effect of the location of material and information decoupling points on the extent and role of demand planning in supply chains. In order to achieve this goal, the relationships between the location of two types of decoupling points are identified and necessary characteristics of demand planning process are recognized. The theoretical considerations are then evidenced by cross-sector findings obtained from an exploratory study carried out in European supply chains.

Keywords: material decoupling point, information decoupling point, demand, supply chain

INTRODUCTION

Supply chains possess two constituting flow pipelines – product transfer pipeline and information transfer pipeline. One may identify a material decoupling point in the product transfer pipeline, whilst an information decoupling point might be recognized in the information transfer pipeline. The reciprocal location of these two points is an issue of crucial importance determining the way supply chains plan, perform and control their operations. Thus, one may identify several zones and different concepts of supply chain management, depending on the location of these two points.

One of supply chain management concepts, strongly conditioned upon the location of material and information decoupling points, is demand planning encompassing a sequence of activities concerning the coordinated flow of demand through companies in supply chains. In some parts of supply chains, demand planning may have a profound impact on the efficiency of physical flow, whereas in other supply chain sections its role is far less significant, or even irrelevant.

The paper seeks to explore the effect of the location of material and information decoupling points on the extent and role of demand planning in supply chains. In order to achieve this goal, the following structure of the paper has been employed.

Following the introduction, the idea of an integrated framework of material and information decoupling point is explained. Based on these considerations, the nature of demand planning regarding derived decoupling zones is demonstrated. In the next part of the paper, the methodology of an empirical study conducted in the sample of European supply chains is revealed. The findings derived from the analysis are presented and discussed. Finally, the conclusions of the research are drawn and the implications for further empirical studies are indicated.

AN INTEGRATED FRAMEWORK OF MATERIAL AND INFORMATION DECOUPLING POINTS IN SUPPLY CHAINS

There are many theoretical considerations on the interpretation and the essence of material and information decoupling points as well as documented empirical studies on determinants of their location [30].

In general, material decoupling point is a position in the product axis to which the customers' order penetrates. In other words, it is a buffer between upstream and downstream partners in a supply chain separating its order driven and forecast driven activities [24]. It protects supply chains from fluctuating consumer buying behavior, enabling to establish smoother upstream material flow, while downstream consumer demand is still met via a product pull from the buffer stock [24].

The location of material decoupling point is reflected in the most popular classification of manufacturing types, namely: make-to-stock (MTS), assembly-to-order (ATO), make-to-order (MTO) and engineer-to-order (ETO).

In make-to-stock manufacturing products are standardized, but not necessarily allocated to specific locations; the demand is anticipated to be stable or readily forecasted at an aggregate level. In assemble-to-order system products can be customized within a range of possibilities, usually based upon a standard platform. Make-to-order is characterized by raw materials and components which are common, but can be configured into a wide variety of products. In the last manufacturing system engineer-to-order products are specially designed from engineering specifications. While the products might use some standard components, at least some of the components or arrangements of components are specifically designed by the customer or by the customer working with the producer [3] [14] [28].

When a demand for products is transmitted along a series of inventories using stock control orders then the demand variation will increase with each transfer. Market sales data are a catalyst for the whole supply chain, holding undistorted data describing the customer demand pattern. The point to which a marketplace order data penetrates without modification is called information decoupling point [23]. Consequently, information decoupling point is a position in supply chains at which information turns from the high value actual consumer demand data to the typical upstream distorted, magnified and delayed order data [15].

		Location of information decoupling point				
		First upstream link	Upstream link	Middle link	Downstream link	Last downstream link
Location of material decoupling point	First upstream link	1 zone	Mismatch	Mismatch	Mismatch	Mismatch
	Upstream link	3 zones	2 zones	Mismatch	Mismatch	Mismatch
	Middle link	3 zones	3 zones	2 zones	Mismatch	Mismatch
	Downstream link	3 zones	3 zones	3 zones	2 zones	Mismatch
	Last downstream link	3 zones	3 zones	3 zones	3 zones	1 zone

Figure 1. Number of zones regarding the relationships between the location of material and information decoupling points in supply chains

The appropriate position of both points is a critical issue in well-managed supply chains. The governing principle says that material decoupling point should be moved close to the final customer, thereby ensuring the shortest leadtime. On the other hand, information decoupling point ought to be positioned as far upstream in supply chains as possible in order to embrace a maximum number of companies with actual and on-line information on market demand. Apart from theory, each industry and a specific supply chain are different, and there are usually distinct operating conditions concerning technological, organizational and economic limitations which do not allow to fully apply a model location of material and information decoupling points. Nonetheless, the literature recommends to employ an integrated approach while considering the location of both decoupling points [2] [4] [24]. When combining the location of material decoupling point with the position of information decoupling point one may usually distinguish between one, two or three zones in supply chains - Figure 1.

As depicted in Figure 1, pull driven activities are based on the real market data, therefore information decoupling point cannot be positioned downstream from material decoupling point (the upper right-hand cells in a black color labeled as mismatch).

When considering the relationships between the location of material and information decoupling points, one may identify only one zone. In this situation, the points are located at either extreme upstream or extreme downstream position in supply chains. This combination suggests that all activities performed in supply chains are order driven or forecast driven, respectively. Consequently, it is rather theoretical concept, very rare and unusual in practice.

The remaining cells of the matrix represent 13 possible combinations of the location of material and information decoupling points. Consequently, if material and information decoupling points are both in the similar locations in supply chains (the middle three cells shaded in a bright gray color), two zones may be identified. It means that all companies in a supply chain having an access to the real customer data seize this opportunity and perform their operations in a pull driven system. The remaining 10 cells represent 3 zones obtained through the different location of material and information decoupling points in supply chains (the lower left-hand cells in a white color). This situation is very common in contemporary supply chains. It demonstrates an essence of the integrated framework and indicates that both material and information decoupling points are inextricably linked – Figure 2.

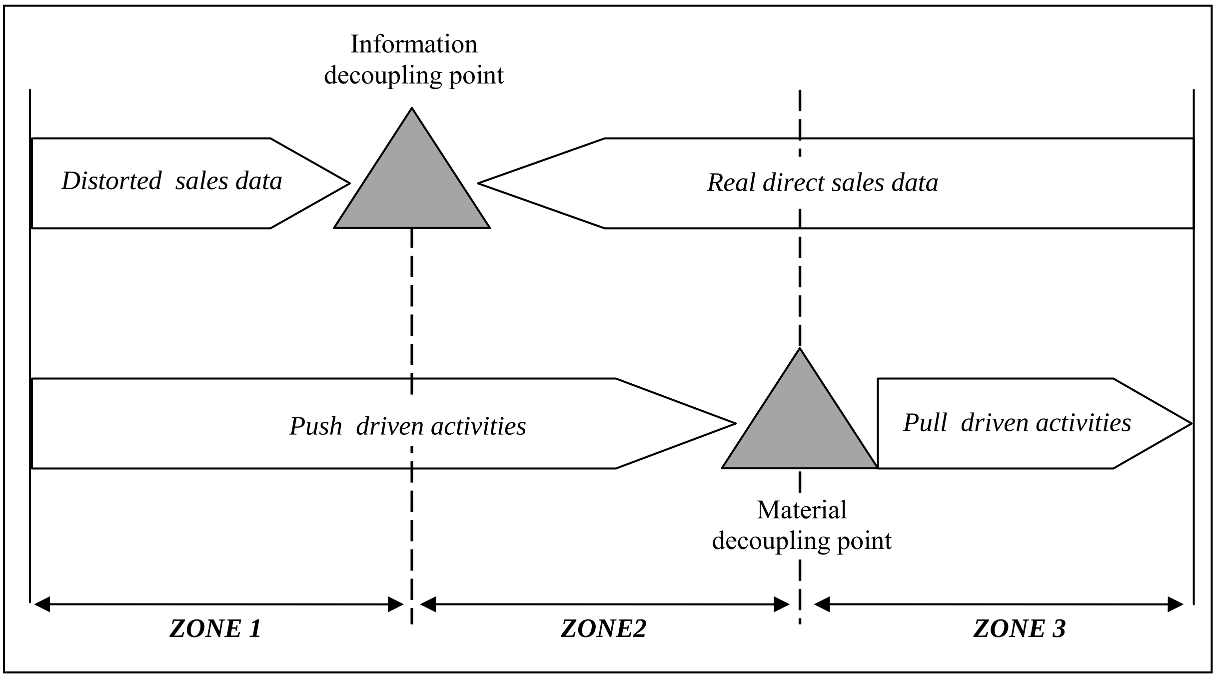

Figure 2. Three zones in supply chains obtained through the different locations of material and information decoupling points.

As depicted in Figure 2, the companies in zone 1 do not receive any demand information from the market. The activities are push driven which means they are based on forecasted demand and sales plans. Consequently, there is no inter-organizational collaboration in the zone. Each supply chain partner performs activities on its own. It receives an order from the subsequent link, initiates in-house activities and places an order to the preceding link in supply chains. Demand data is transmitted in the orders, in which customer demand data is magnified and delayed. This supremely illustrates the bullwhip effect in traditional supply chains where the partners do not have an access to the real customer demand data [13] [20].

In the middle zone 2, the companies receive the real customer data from the market. However, it is not available on time to perform pull driven operations in the physical flow. Market information is mostly used to improve demand forecasts and enhance the operating capabilities from the perspective of physical efficiency [29]. Therefore, the aim of the companies in zone 2 is to run replenishment process upstream the material decoupling point at low cost in order to provide a high service level for the links placed downstream from the material decoupling point. An access to the real customer data enables to identify the whole value stream in supply chains, treated as the sequence of activities from the first link to the final consumer, and eliminate or avoid non-value adding processes [31]. The firms in zone 3 have an access to the real customer data and perform their operations in accordance with a pull driven system. Instead of the physical efficiency, which is less important here, the market responsiveness is rising to prominence in the third zone. Therefore, the links in the zone pay attention to customer order variability, flexibility, greater use of IT and establishing virtual arrangements. M. Christopher highlights that an important prerequisite in the third zone is a high level of shared information. In particular, there has to be a clear visibility of downstream demand. It means that data on real demand has to be captured as far down the chain as possible and shared with upstream partners [7].

DEMAND PLANNING PROCESS IN SUPPLY CHAIN DECOUPLING ZONES

All activities performed in supply chains are organized on the basis of demand plans or customer orders. Therefore, the accuracy of demand plans plays a key role in organizing the activities of subsequent links. The importance of demand planning practices is discussed especially in process-oriented supply chain frameworks, such as SCOR or GSCF framework. The SCOR (Supply Chain Operation Reference-Model) framework consists of five operation-based processes (plan, source, make, deliver and return) but does not include processes related to sales, marketing and product development [35]. These aspects are examined by GSCF (Global Supply Chain Forum) framework, which is broader than SCOR framework. According to this approach supply chain model is built on eight business processes that are both cross-functional and cross-firm [9] [18] and consists primarily of demand management and order fulfillment [10] [11].

Demand management balances the customers' requirements with the capabilities of supply chains [11]. However, it is not limited to forecasting. The goal of the processes is to execute the plan with minimal disruptions, increase flexibility and reduce variability. When tactical and operational planning activities are taken into consideration, an adequate term reflecting this situation is demand planning process. Demand planning process is a systematic exploration and identification of a demand plan which may be implemented regarding the future environmental operating conditions. It is based on the prediction of future events and selection of certain options enabling to achieve the state recognized by managers as desired. Consequently, demand planning process is defined as a sequence of actions that can be divided into three stages [12] [22] [26], namely gathering information about the future demand of products, demand forecasting using the qualitative and/or quantitative methods, and checking the feasibility of the calculated demand plans through verification of resources, such as budget, planned marketing campaigns, capacity, storage space, availability of infrastructure etc.).

The scope of demand data used in demand planning process in supply chains is determined by the methods of gathering information [6] which, in turn, are conditioned upon the location of information decoupling point. Consequently, regarding the location of this point one may identify two distinct models. In the first model the companies do not share information about the demand [33]. The second one is information sharing model illustrating the collaboration between companies in supply chains [27].

The physical flow in the first model is driven by a demand plan which is based on historical data. Subsequent supply chain links do not have an access to the real sales data. In other words, the model illustrates the ‘bullwhip effect’, also known as the ‘Forester Effect’ [13] [20]. It denotes that the companies do not share demand data and operate independently which results in a transfer of forecast errors downstream in supply chains.

As the companies do not have an access to the real customer demand data, the plans are based on historical sales data and do not reflect the market conditions. Consequently, the processes determining demand plans usually leads to the fatal forecast errors. The material flow is driven by a push strategy in this model which means that demand plans are a key element in maintaining the efficiency of supply chains. As depicted in Figure 3 non-information sharing model is typical for zone 1.

Information sharing model represents another approach typical for the part of supply chains located downstream from information decoupling point which is represented by zone 2 and 3. There is an exchange of information between the companies enabling supply chain collaboration [6]. This concept strives to solve the problems raised in the first model. In information sharing model data is provided where and when it’s needed. This enables to determine demand plans based on the real customer demand information.

Demand planning process requires additional sources of information reflecting actual customers’ needs. They may be divided into internal, such as customer orders, completed sales, marketing campaigns, stocks, price changes etc. and external sources, e.g. market trends, customer needs, market analysis, competition, new technologies, new products on the market, technology [12].

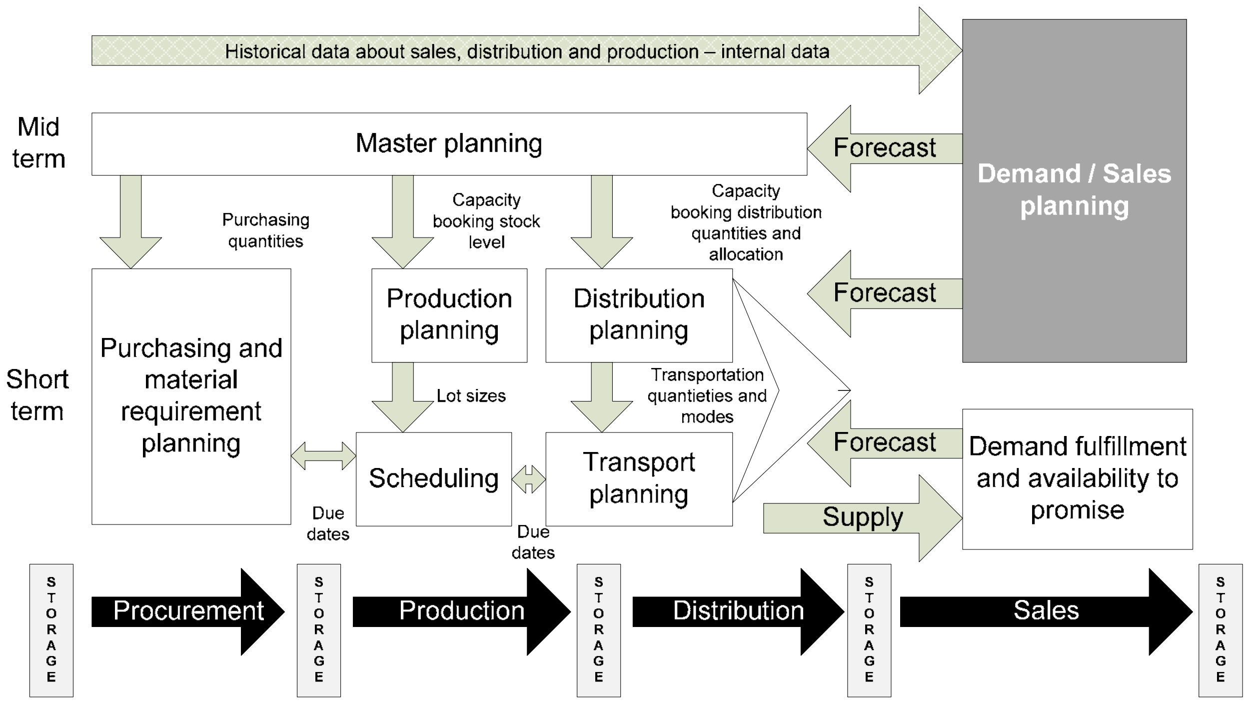

Figure 3. Demand planning in zone 1 in supply chains

Source: [33]

The obtained real customer demand information may be used in two different ways. First, it may serve to prepare the forecasts, making them more accurate, relevant, complete and timely with a small error. Consequently, although the material flow is still forecast-driven, an updated customer information in demand planning process enables to reduce the operational costs and shorten the lead time [17]. In order to control the physical flow, push strategy is applied and manufacturing is built to stock on the basis of pre-established demand plans. This situation is typical for zone 2, where updated customer demand data enables to conduct effective demand planning process, making the physical flow more smooth, efficient and lean – Figure 4.

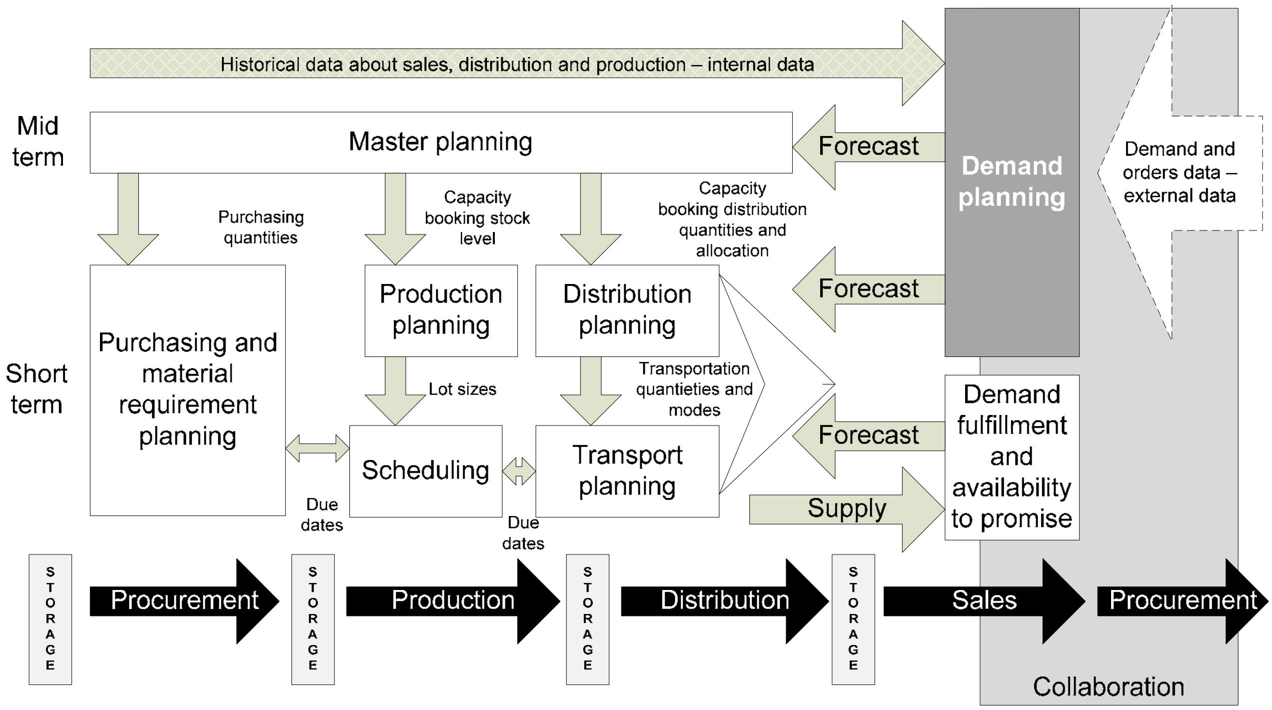

Figure 4. Demand planning in zone 2 in supply chains

Source: [27] [33]

The real customer demand information may also be used in demand planning process downstream from material decoupling point in zone 3 – Figure 5.

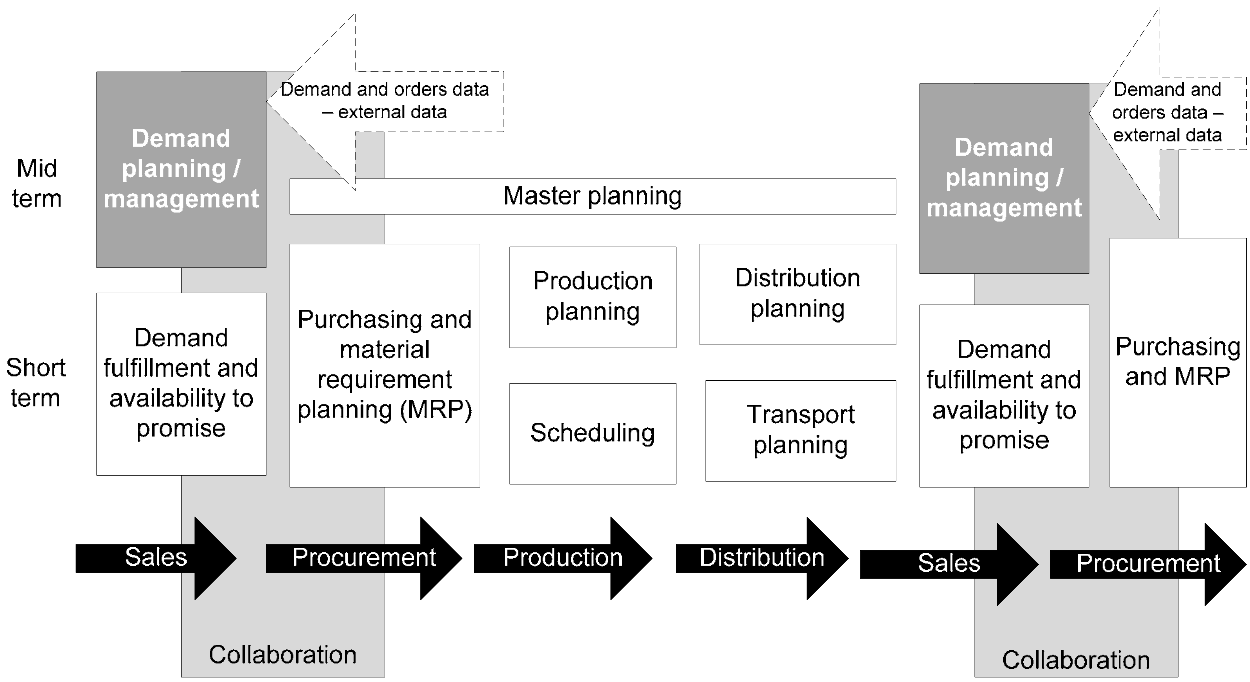

Figure 5. Demand planning in zone 3 in supply chains

Source: [27]

However, the application of the concept seems to be very limited in the zone as the physical flow is pull driven. Presumably, demand planning denotes only a collection of customer orders in advance. The real customer demand data is used to control the physical flow. Therefore, demand planning process does not play a pivotal role in zone 3, on contrary it serves rather as a supporting function. As depicted in Figure 4 and 5, information sharing enabling supply chain collaboration and demand planning typical for zones 2 and 3 are shaded in a gray color.

METHODOLOGY

Sample and data collection

In order to investigate the effect of the location of material and information decoupling points on the extent and role of demand planning in supply chains, an exploratory study using a quantitative survey as a method of data collection was conducted.

The main research instrument used for this study was a questionnaire consisting of several sections examining the nature of demand planning process from the perspective of material and information decoupling points. The set of data collected within the release of the survey was gathered in European supply chains in 2013. For the purpose of the research presented in this paper, a group of relevant variables has been selected.

Firstly, the number of 25 items, measured by a five-point Likert scale, constituted the list of initial variables concerning an intensity of the participation of suppliers and customers in demand planning process, drivers and significance of demand planning process, sources and quality of input data used in demand planning process. Moreover, two variables were applied to classify the supply chains into specific groups regarding a number of zones and the reciprocal location of material and information decoupling points in investigated supply chains.

The sample was compiled from the surveys of manufacturing and trading companies operating in supply chains, and consisted initially of 270 organizations. Those firms were leaders or major links located upstream, in the middle or downstream in their supply chains established by three subsequent major links and accompanying logistic and non-logistic service providers. As a result of initial data analysis, screening and elimination of observations with missing values 228 supply chain leaders remained as a subject of further analysis.

The majority of the surveyed firms (57 percent) are trade companies, remainder of the research sample includes manufacturers. The prevailing share of the companies operate in wholesale and retail grocery sector (18 percent), fabricated metal products, industrial and commercial machinery sector and manufacturing of motor vehicles (a total of 12 percent), followed by the companies from a mining industry (6 percent), trading companies (selling cross-industry products, mainly household goods – 4 percent, clothes – 6 percent, chemicals – 4 percent, electronic equipment – 4%).

Research outline and statistical analysis

In order to address the goal of the paper, a Principal Component Analysis (PCA) with Varimax Rotation was employed. It enabled to reduce many variables manifesting the nature of demand planning in supply chains and, hereby ease the interpretation process through highlighting the main underlying multi-item constructs.

The preliminary analysis conducted on the variables manifesting the role and extent of demand planning process in supply chains confirmed that in order to develop a strong structure of constructs, a group of 2 variables has to be dropped for low correlation indices with other variables. The Principal Component Analysis conducted in a space of the remaining variables showed a clean factor-loading pattern with minimal cross-loadings and high loading on the one construct factor.

The value of some factor loadings is below a nominal cut off point of 0.65, but better than 0.5 on all factors. Therefore, the original variables were kept in a model [34]. PCA conducted finally on 23 items revealed a solution consisting of 6 factors which explain almost 72 percent of total variance. The number of factors was determined by the analysis of the percentage of variance explained and the Kaiser criterion [1].

For each construct, Cronbach's alpha coefficients were used to assess the internal consistency of variables. Their values are above the nominal cut-off point of 0.7 and may thus be considered to be reliable suggesting a good internal consistency of the ten constructs (George and Mallery, 2003). The PCA resulted in producing the total number of 6 factors, used for the further research – Table 1:

- Factor 1: intensity of participation of supply chain partners in demand planning process;
- Factor 2: drivers of demand planning process;
- Factor 3: quality of input data used in demand planning process;
- Factor 4: significance of demand planning for other processes performed in supply chains;
- Factor 5: significance of demand planning process in achieving the goals of supply chains;
- Factor 6: sources of input data used in demand planning process.

Table 1. The structure of the constructs obtained through the Principal Component Analysis

Item	Constructs					
	1	2	3	4	5	6
Intensity of participation of suppliers in demand planning process	.754					
Intensity of participation of customers in demand planning process	.721					
Forecast driven plans of demand		.567				
Order driven plans of demand		.762				
Data accuracy in demand planning process			.634			
Data timeliness in demand planning process			.701			
Data completeness in demand planning process			.631			
Data relevance in demand planning process			.871			
Significance of demand planning for customer relationship mgmt.				.769		
Significance of demand planning for customer service				.713		
Significance of demand planning for complaints and product returns				.695		
Significance of demand planning for production scheduling				.709		
Significance of demand planning for supplier relationship mgmt.				.638		
Significance of demand planning for product/ service development				.764		
Contribution of demand planning in the vision of supply chains					.806	
Contribution of demand planning in the mission of supply chains					.761	
Contribution of demand planning in strategic goals					.601	
Historical sales data used in a demand planning process						.819
Customer orders used in a demand planning process						.504
Marketing actions used in a demand planning process						.511
Supply data (e.g. production capabilities, levels of inventory in a warehouse) used in a demand planning process						.834
Data on market environment used in a demand planning process						.724
Market research used in a demand planning process						.632

In the next stage of the study, supply chains were grouped into the classes regarding a number of zones obtained from the reciprocal relationships between the location of material and information decoupling points. First, each examined supply chain was analyzed in terms of its structure. The examined company and its partners were assigned to an appropriate group constituting an upstream, middle or downstream supply chain structure. As the sample consists of manufacturing and trade companies, the examined links were usually located in the middle or downstream in supply chains, respectively. It also determined a prevailing share of orders falling into the category of make-to-order, assembly-to-order, delivery-to-order and make-to-stock performed by investigated companies.

The first two categories are more typical for manufacturing companies whilst the latter two are more characteristic for trade companies. Then, depending on the mutual location of material and information decoupling points, supply chains with a specific number of zones were identified. The distribution of the sample regarding the potential location of material and information decoupling points is depicted in Figure 6.

Location of material decoupling point		Location of information decoupling point				
		First upstream link	Upstream link	Middle link	Downstream link	Last downstream link
	First upstream link	0%	Mismatch	Mismatch	Mismatch	Mismatch
	Upstream link	0%	14%	Mismatch	Mismatch	Mismatch
	Middle link	0%	16%	6%	Mismatch	Mismatch
	Downstream link	0%	14%	37%	13%	Mismatch
	Last downstream link	0%	0%	0%	0%	0%

Three-zoned supply chain   Two-zoned supply chain   One-zoned supply chain

Figure 6. The breakdown of the sample by the location of material and information decoupling points

In order to compare the nature of demand planning process, supply chains with two and three zones were a subject of further in-depth investigation. It enabled to determine the effect of the location of material and information decoupling points on the role and extent of demand planning in supply chains.

THE ANALYSIS OF THE EFFECT OF THE LOCATION OF MATERIAL AND INFORMATION DECOUPLING POINTS ON DEMAND PLANNING PROCESS. PRELIMINARY FINDINGS AND DISCUSSION

In order to analyze the effect of the location of material and information decoupling points on demand planning process, cluster means for particular zones were calculated. They were based on factor scores of the role and extent of demand planning. Table 2 shows the cross tabulation of companies in the zones and characteristics of demand planning process.

In order to determine if the companies in the zones are different regarding demand planning process ANOVA analysis has been performed. The three groups show significant differences (p<.01) in the six factors: intensity of participation of supply chain partners in demand planning process (F= 10.12), drivers of demand planning process (F= 27.84), quality of input data used in demand planning process (F= 13.42), significance of demand planning for other processes performed in supply chains (F= 21.94), contribution of demand planning process in achieving the goals of supply chains (F= 23.65), sources of input data used in demand planning process (F= 12.32).

Table 2. Cluster means in the zones based on factor scores of supply chain collaboration.

Factors of supply chain collaboration	Zone number			F-values*
	1	2	3	
intensity of participation of supply chain partners in demand planning process	-0.23	0.29	0.12	10.12
drivers of demand planning process	-0.59	0.48	0.08	27.84
quality of input data used in demand planning process	-0.91	0.19	0.42	13.42
significance of demand planning for other processes performed in supply chains	-0.35	0.29	0.27	21.94
contribution of demand planning process in achieving the goals of supply chains	-0.18	0.14	0.41	23.65
sources of input data used in demand planning process.	-0.22	0.46	0.52	12.32

* significant at p < .001

The findings demonstrate that the location of information decoupling point has a significant impact on demand planning process in supply chains. All factor scores in zone 1 gained the smallest negative values across all zones. It may suggest that the companies indicate the least positive attitude towards applying demand planning concept upstream from the information decoupling point.

The obtained results confirm that sharing data among supply chain partners enables to establish collaborative relationships which are essential to perform demand planning process in an efficient and effective way. If there is no data transfer, the role and extent of demand planning is scarce and very limited. This is evidenced by the study indicating the negative attitude of respondents concerning the multifaceted issues of demand planning process. Therefore, it is not possible to practically implement and take an advantage of the concept of demand planning further up the supply chains, upstream from information decoupling point.

On the other hand, the importance of demand planning process downstream from information decoupling point increases. However, the attitude of examined companies towards demand planning process varies in zone 2 and 3 regarding the location of material decoupling point. Among many investigated dimensions of demand planning process the drivers of demand planning process, the contribution of demand planning process in achieving the goals of supply chains and the importance of demand planning for other processes performed in supply chains strike out as the most powerfully differentiating characteristics with the highest *F* values. The drivers of demand planning process are the most important for the links located in zone 2, as the factor contains two basic mechanisms of initiating the physical flows in supply chains, namely demand forecasts and orders placed by customers. The finding confirms that both mechanisms are applied in the companies placed in zone 2 where demand planning process is an issue of crucial importance [35]. Consequently, in line with the study conducted by Christopher *et al.*, the companies in zone 3 report pretty neutral attitude to the drivers of demand planning process, as the physical flow in the zone is mostly driven only by customer's orders [7]. Interestingly, although demand planning is not a common practice of the companies located in zone 3, it still has a profound impact on achieving the goals at the corporate level of supply chains. It stems from the fact that the links in zone 3 are more market oriented, which means enriching customers by providing added value. This is consistent with the opinion of Rigby *et al.* who allege that employing market orientation requires the organizations to adapt the solution-based approach in order to satisfy individual customers' expectations [32]. This may evidence the importance of the factor in zone 3. On the other hand, the links located in zone 2 apply demand planning concept, however it does not contribute, to a large extent, to gain the strategic goals of supply chains. Contrary, the finding may suggest that demand planning practices applied by the companies in zone 2 contribute to achieve the operational and tactical goals as the efficiency and cost reduction play a pivotal role in this part of supply chains. This result is in line with concept of leanness and establishing lean supply chains [8] [38]. Similar opinion is highlighted by Mentzer *et al.* who mention that demand planning affects the operational goals of supply chains. These goals are manifested, in performing everyday management activities, mainly through the cost reduction and elimination of surplus stock in subsequent links [25].

Another factor manifesting the significance of demand planning for other processes performed in supply chains seems to be equally important in zone 2 and 3. The finding is not very surprising when considering the factor and its structure. There are practices characteristic for zone 2, such as production scheduling, suppliers relationship management and product or service development. On the other hand, the factor consists of the activities typical for the links located in zone 3, namely customers relationship management, customer service or complaints and product returns. This may partially explain a relative equal importance of the factor in two zones. For instance, production scheduling is conditioned upon demand planning process [5] [36]. Production adjusted to demand plan has a positive impact on costs, resource requirements, customer service and financial performance etc. [12] [37]. On the other hand, demand planning also plays a significant role for supplier relationships management [10]. With the right process in place, it is crucial to match supply with demand proactively and execute the plan with minimal disruptions [19] [37]. Finally, demand planning process is also a vital ingredient of a product or service development [16]. It is important to recognize the key link between new product launches and demand planning in order to specify the effect of a new product on new demand and supply procedures [37].

The other factors of demand planning process differentiate a research sample to a lesser extent. The quality of input data used in demand planning process are more important for zone 3. It probably stems from the fact that pull driven activities performed by the links in this zone require more reliable, actual, complete and relevant data in order to establish responsive, flexible and market sensitive physical flow. On the other hand, the links in zone 2 use similar data in demand planning process, however the management of material flow in the zone is also enhanced by previous sales plans and demand forecasts which may support decisions made in demand planning process. Furthermore, the highest quality data is not directly used in the management process, as the material flow is forecast driven in zone 2. Consequently, data is rather used to modify and update demand forecasts so its quality is not an issue of crucial importance. These arguments may explain the lesser role of the quality of input data in demand planning process in zone 2.

Apart from the quality of data, also its sources seem to be important for demand planning process. However, the findings show that the factor is almost equally relevant in zone 2 and 3. The similar significance of different data sources for both demand planning process in zone 2 and pull driven activities performed in zone 3 may stem from the structure of the factor. For instance, it contains historical sales data which is, in particular, important for demand planning in zone 2 and customer orders mostly used to initiate pull driven activities in zone 3. Furthermore, there are also other data sources such as marketing actions or market research extensively used by the links located in both zones.

The last extracted construct deals with the intensity of participation of supply chain partners in demand planning process. First of all, judging on F values, the factor strikes out to be the least differentiating construct which may suggest that its significance is relatively low. Moreover, the largest factor scores are reported by the companies in zone 2. The finding demonstrates that the intensity of cooperation between suppliers and customers is important for demand planning process in a supply chain. In other words, supply chain collaboration seems to be a vital ingredient of effective demand planning. It is in accordance with the opinion of Mentzer *et al.* who argue that there is a need of consistency between demand planning and inter-organizational collaboration in supply chains [25]. Furthermore, one should notice that the companies located in zone 3 also report a positive attitude toward the intensity of participation of supply chain partners in demand planning process. Although, demand planning does not play a key role in zone 3, an access to the real customer data enables the links to establish collaborative relationships and perform pull driven activities in this part of a supply chain. Lewis maintains that it is not just an exchange of information on demand and inventory but also multiple collaborative working relationships across supply chain links on all levels. The companies tend to establish partner development cross functional teams intended to interface with the equivalent customers management team [21].

DELIVERABLES AND FURTHER RESEARCH

The study shows the effect of the location of material and information decoupling points on demand planning process in supply chains. There are theoretical and practical deliverables of an empirical research. First, the study provides a necessary theoretical background for the concept of demand planning striving to overcome the recognized deficiencies and complement the current theory on demand planning process with a contextual view. It highlights that the concept is embedded in a wider environmental context. Thus, it gives an opportunity to recognize the external conditions as well as to reveal the internal constraints determining the application of demand planning concept in specific supply chains. Consequently, the study also provides the practical guidelines for managers implementing supply chain concept. The paper demonstrates the significance of specific steps and activities undertaken in the whole process of demand planning regarding environmental conditions and supply chain context. The findings of the study highlights the nature of demand planning practices in terms of the zones derived from the reciprocal location of material and information decoupling points. Specifically, an empirical part of the paper validates the importance of demand planning practices in supply chain links placed in zone 2.

Apart from indicated deliverables, the study also highlights the potential areas of future research. First of all, one should be aware that demand planning is an ingredient of demand management. It raises a question concerning the role and mutual relationships between these two concepts. Furthermore, demand management should be analyzed in a different way, not limited to the links located in zone 2, but also taking into account pull driven activities performed in zone 3. Demand planning may also be extended to the service sector, such as the real estate industry or finance sector. Finally, as demand planning is mostly focused on lean practices prevailing in zone 2, it would be interesting to investigate and measure the efficiency of demand planning practices from the standpoint of the whole supply chains. Consequently, the future study may indicate the collaboration patterns, allowing the companies to increase the efficiency of demand planning in supply chains.

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