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COMPARATIVE ANALYSIS OF SELECTED CONCEPTS OF MANAGING MATERIAL FLOWS IN DISTRIBUTION LOGISTICS

Łukasz Hadaś, Piotr Cyplik, Roman Domański, Marek Fertsch

Poznań School of Logistics, Poznań, Poland

ABSTRACT. Article presents a comparative analysis of selected concepts of managing material flows in the distribution logistics. This is an analysis of the similarities and differences according to selected criteria, such as: the degree of integration, focus on stocks, buffer form, the form of safety stocks and the concentration of stock in the distribution network. Subject to comparative analysis were the concepts of: ROP (Re-order point), ROC (Re-order Cycle) which belong to the classical inventory management, the concepts of MRP (Material Requirements Planning) and DRP (Distribution Requirement Planning) which are examples of aggregated planning, as well as concepts based on extensive collaboration of partners in the supply chain such as CPFR (Collaborative Planning, Forecasting & Replenishment), VMI (Vendor Managed Inventory).

Key words: distribution logistics, supply chain, DRP, CPFR, VMI.

INTRODUCTION TO THE CONCEPT

In the traditional approach most companies see themselves as organizations acting independent of one another and competing with one another on the market. Such an approach does not support "cooperation on equal terms" in the process of generating values (of goods and services) delivered to end customers. Companies operating on the market according to the rule "only the strongest will survive" use their market power to offload costs onto weaker subcontractors. Such a "market game" limits the possibility of cooperation within the supply chain and determines the original direction of integration.

The first stage of integration of companies is internal integration aimed at establishing closer cross-functional links within an organization. The need to integrate manifests itself in the rationalization of activities related to supplies and production sphere (in historical terms the earliest) or distribution and management of finished products stock. The directions of integration and its intensity are also related to the industry a given company is active in and increased customer service requirements. Internal integration is focused on optimizing internal workflows within the company. Optimization of workflows makes it possible to develop more efficient processes. In the classical approach, balancing workflow levels and their better synchronization makes it possible to make better use of the potential at hand and to reduce the time and costs needed to implement these processes. Further development of internal integration is the means of establishing comprehensive process planning and control in the whole organization as another stage in the process of developing internal effectiveness of the organization.

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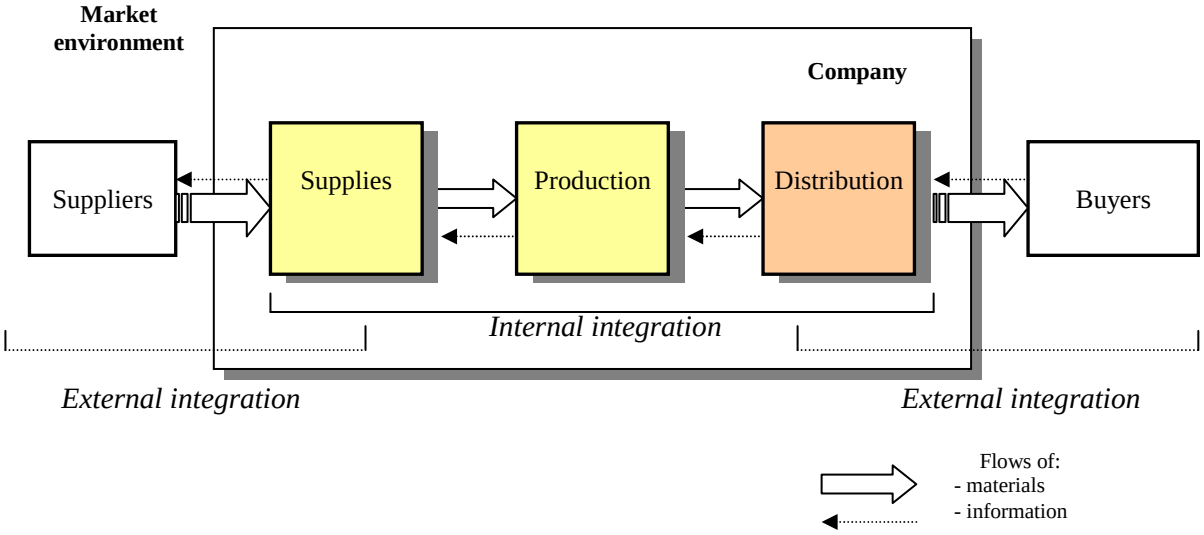
The other direction of integration is external integration aimed at building close relations with supply chain partners and at supply chain management. In historical terms, previously internal integration took the form similar to vertical integration. These two, however, are not identical, since vertical integration is connected with taking over the ownership of suppliers and distributors.



Source: Own study on the basis of [Christopher 2000]

Fig. 1. Directions of integration and special place occupied by distribution logistics in this process
Rys. 1. Kierunki integracji oraz umiejscowienie logistyki dystrybucji w procesie

At present, the strategy of vertical integration is abandoned by the companies in favour of concentrating on their core competence, i.e. fields of activity which they are best at and which make them stand out among the competition thanks to their knowledge and know how. The remaining activities are outsourced to specialist companies with which they engage in close cooperation in order to achieve an appropriate level of integration. Outsourcing is not a complete departure from the concept of internal integration within auxiliary processes. The scope of integration among specialist entities performing outsourced processes and the company may become so advanced that we rather speak here of a modified concept of integration. External "outsourcing partners", while competing with one another, strive to cater for the needs of their customers in the best possible way by adjusting to the relevant requirements. Outsourcing some functions enables the company to increase its flexibility, introduce a stimulating competition element and eliminate fixed costs of these processes in favour of costs related to the current demand for such processes.

Contemporary integration of the area of supplies and production as such goes beyond the framework of internal and external integration. Close integration within companies is accompanied by external integration with suppliers who create "an integrated supply network". The range of cooperation among suppliers and the company within such a network is not limited to co-managed inventory (CMI) solely, but also involves the process of concurrent engineering as well as quality development and protection.

Summing up the stages of integration, a conclusion must be drawn that distribution logistics becomes part of both phases of integration. Internal integration involves establishing connections between supplies and production logistics, whereas external integration comprises the connections

between distribution logistics of a company and customer supplies logistics within the supply chain. Understanding distribution as an integrator of the supply chain changes the way we perceive the selection of the leading concept and development of a system of distribution logistics.

The aim of the study is a comparative analysis of selected concepts of managing material flows in the production logistics. The comparison is to serve both as a proposed taxonomy of methods from the point of view of specific criteria relevant for distribution logistics management and a decision-making tool for practitioners. Such a comparative analysis may be helpful in the decision-making process of selecting a management concept to match specific market conditions.

IDENTIFYING DIFFERENCES AND SIMILARITIES BETWEEN SELECTED CONCEPTS OF MANAGING DISTRIBUTION LOGISTICS

It is not easy to analyse differences and similarities among individual concepts of distribution logistics. The reason is the fact that these concepts as such are very complex.

Many detailed solutions which make up specific concepts may be applied to differing degrees, optionally or in specific sets. Also the degree of their implementation understood as the level of acceptance and understanding by users may also be different. On the other hand, there are various conditions in which specific concepts function. Of importance here is the industry a given company is active in, the level of competitiveness, characteristics of demand, the way the distribution network is organized, target customers, characteristics of the supplier network, etc. Without classifying these factors into groups or hierarchy level, one can notice that such a "set" of factors is a sheer "mosaic of variables". It is also worth noting that many concepts of distribution logistics, despite their practical implementations, have not developed specific functioning standards. Lack of generally acceptable reference models which would define both the nature of the solution and the operational level of its functioning, causes many solutions under one label to be very different from each other.

Given the above situations, the comparative analyses proposed by the authors are "open" in nature. Many categories are questionable and certainly their characteristics are bound to evolve. However, a debate on these issues is an attempt at their classification aimed at creating a reference model which would make it possible for companies to select optimum concepts of development of their own distribution network.

Subject to comparative analysis [Fertsch, Cyplik, Hadaś and Domański 2007] were the concepts of ROP (Re-order Point) ROC (Re-order Cycle) which belong to the classic inventory management [Krzyżaniak 2005], the concepts of MRP (Material Requirements Planning) [Fertsch 2003] and DRP (Distribution Requirement Planning) which are an example of aggregated planning and the concepts based on advanced cooperation of entities within the supply chain such as [Mierzyńska 2003][Taking It One Step at a Time][Vendor Managed Inventory][The Vendor Managed Inventory Solution from i2] CPFR (Collaborative Planning, Forecasting & Replenishment), VMI (Vendor Managed Inventory).

The first analysed category was the main activity implemented in a given concept. The concepts of ROP and ROC focus on the replenishment system. Critical is the inventory replenishment ability understood as response time to a change in stock level. The response time is clearly mainly affected by the cycle of inventory replenishment. The main action in the concept of ROP and ROC is therefore based on stock replenishment and the signal to replenish stock in the network links depends on the monitoring of this information status. The system in a way reacts to the size of demand by requesting more or less frequent replenishment. The key issue is "only" the ability to form the inventory in such a way that is changeability is prevented during the replenishment cycle. The main activity in the MRP concept is aggregated hierarchical planning which integrates flow in the supply chain around the product complexity structure. Generated dependent demand for components may be addressed both to the company internally as well as to its partners in the supply chain. Thus integration of internal and external supplies is obtained. At the level of finished products, information on demand includes forecasts and/or specific market orders. A similar idea of the main activity is presented by the DRP

concept which is often designated as "reverse MRP". In this case, aggregation mainly takes placed at the level of main links in the distribution network. The main activity in the CPFR concept is collaboration in the field of forecasting, planning and stock replenishment functions. Collaboration means both clarity of information and standardization of the decision-making process. The VMI concept on the other hand, uses the idea of collaboration to a more limited degree in order to take advantage of the economies of scale. These benefits are related to maintaining central inventory, i.e. buffering the global supply chain and facilitating forecasts where the demand flows are concentrated.

Each concept is characterized by different levels of integration (see Table 1). For example, the concepts of ROP and ROC present a low degree of integration restricted only to individual stock-keeping units and, specifically, to aggregated demand for them in a given link of the distribution network. MRP and DRP represent integrations both for SKUs and different levels of growing demand for them. The VMI concept concentrates integration in specific sections of the distribution network chain, whereas the CPFR concept is most extensive and least formalized at the same time.

Table 1. Comparative analysis of selected concepts of managing material flows in the distribution logistics
Tabela 1. Analiza porównawcza wybranych koncepcji zarządzania przepływem materiałów w logistyce dystrybucji

Comparison criteria	Concepts of managing material flows in distribution logistics					
	ROP *Re-order Point*	ROC *Re-order Cycle*	MRP *Material Requirements Planning*	DRP *Distribution Requirement Planning*	*CPFR* Collaborative Planning, Forecasting & Replenishment	VMI *Vendor Managed Inventory*
Main activity	Inventory replenishment	Inventory replenishment	Aggregate hierarchical planning	Aggregate hierarchical planning	Collaboration in the field of functions	Using economies of scale
Integration level	As part of a SKU	As part of a SKU	Internal at the level of goods and components	External - in distribution network links	As agreed - dispersed integration	Where inventory is concentrated
Focus on inventory	Optimization	Optimization	Elimination on intermediate levels	Elimination on intermediate levels	Optimization	Concentration and optimization
Buffer form	Physical stock	Physical stock	Temporal and physical stock	Temporal and physical stock	Physical stock	Physical stock
Form of safety stock	Physical	Physical	Temporal and physical	Temporal and physical	Physical	Physical
Inventory concentration in distribution logistics	Lack – dispersion	Lack – dispersion	At the distribution point	In the nodes of distribution network	As agreed	At the manufacturer's

Source: Own study

The concepts also have another characteristic orientation on cyclical stocks and the manner in which safety stock is formed. These factors also affect the form of inventory concentration in the distribution network. The concepts of ROP and ROC, in the classical perspective, do not implement the idea of inventory concentration, instead they create a system of communicating vessels of different

capacities and different cross-sections of their inlet and outlet pipes. The MRP concept, if used correctly, concentrates inventory at the distribution point. Practice shows, however, that it is often deformed and concentration is subject to decomposition into many links. DRP on the other hand, concentrates inventory in key links of the distribution network, i.e. the so-called nodes. VMI is based on the concentration of inventory in the manufacturer's warehouse and the CPFR concept does it depending on the features of the network and the possibilities of engaging into cooperation between individual links.

CONCLUSION

The above comparative analysis of selected concepts of managing material flows in the distribution logistics is undoubtedly subjective for many adopted criteria. The main reasons are that such concepts, in practice, rarely occur in their "pure" form. Usually, they involve minor or major modifications of initial solutions or hybrids thereof. Also different is the degree to which a given concept is implemented both from the perspective of a single link in the supply chain as well as the whole distribution network. Hence, it is not an easy task to determine the standard (reference model) for the selected concept which is the starting point for comparative analyses. Nevertheless, to sum up, three groups of concepts can be distinguished:

- classic concepts, with no significant features of integration and based on local optimization of the inventory level,
- concepts of aggregate planning, based on multi-level structure of product (MRP) or levels in the distribution network (DRP),
- concepts based on collaboration with different levels of advancement (VMI, CPFR).

Analyses as such serve to better explore the nature and be able to assess which of the concepts would be the most appropriate in specific market conditions. Such an assessment, however, needs a deeper analysis of existing conditions of company operation in the supply chain. These conditions apply both to the degree of possible functional integration, the degree of delegation and responsibility being borne by business partners, as well as the features of logistics networks and, finally, characteristics of business entities and end customers.

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ANALIZA PORÓWNAWCZA WYBRANYCH KONCEPCJI ZARZĄDZANIA PRZEPŁYWEM STRUMIENI MATERIAŁOWYCH W LOGISTYCE DYSTRYBUCJI

STRESZCZENIE. Artykuł przestawia analizę porównawczą wybranych koncepcji zarządzania przepływem strumieni materiałowych w logistyce dystrybucji. Jest to analiza podobieństw i różnic według wybranych kryteriów takich jak między innymi: stopień integracji, orientacja na zapasy, forma zapasów, postać zapasu zabezpieczającego czy koncentracja zapasów w sieci dystrybucji. Analizie porównawczej poddane zostały koncepcje ROP (Re-order Point), ROC (Re-order Cycle) należące do klasycznego zarządzania zapasami, koncepcje MRP (Material Requirements Planning) oraz DRP (Distribution Requirement Planning) będące realizacją zagregowanego planowania oraz koncepcje oparte na zaawansowanej współpracy podmiotów w łańcuchu dostaw jak: CPFR (Collaborative Planning, Forecasting & Replenishment), VMI (Vendor Managed Inventory).

Słowa kluczowe: logistyka dystrybucji, łańcuch dostaw, DRP, CPFR, VMI.

VERGLEICHSANALYSE DER AUSGEWÄHLTEN KONZEPTIONEN DES MATERIALFLUSSES IN DER DISTRIBUTIONSLOGISTIK

ZUSAMMENFASSUNG. Im Beitrag wurde eine Vergleichsanalyse der ausgewählten Konzeptionen des Materialflusses in der Distributionslogistik dargestellt. Es handelt sich um die Analyse der Ähnlichkeiten und Differenzen nach den ausgewählten Kriterien, u.a. die Stufe der Integration, Orientierung auf das Bestandsmanagement, Form der Bestände, Form des Sicherheitsbestands oder Konzentration der Bestände im Distributionsnetz. Die Vergleichsanalyse umfasst die klassischen Konzeptionen des Bestandsmanagement, wie ROP (Re-order Point), ROC (Re-order Cycle), weiterhin die MRP (Material Requirements Planning) und DRP (Distribution Requirement Planning) Konzeptionen als die Realisierung der aggregierten Planung sowie Konzeptionen, die auf einer engen Kooperation der Partner in der Lieferkette basieren: CPFR (Collaborative Planning, Forecasting & Replenishment) und VMI (Vendor Managed Inventory).

Codewörter: Distributionslogistik, Lieferkette, DRP, CPFR, VMI.

Łukasz HADAŚ Ph. D., Eng.
e-mail: lukasz.hadas@wsl.com.pl
Piotr CYPLIK Ph. D., Eng.
e-mail: piotr.cyplik@wsl.com.pl
Roman DOMAŃSKI, M.Sc., Eng.
e-mail: roman.domanski@wsl.com.pl
Marek FERTSCH Professor of the Poznań School of Logistics
e-mail: marek.fertsch@wsl.com.pl
Poznań School of Logistics
ul. Estkowskiego 6
61-755 Poznań