

LOGISTICS NETWORK AS A BASIS FOR NETWORK SUPPLY CHAINS’ EMERGENCE THE SURVEY OF COMPANIES IN POLAND

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Abstract: One evolutionary type of supply chain is the network supply chain. It is perceived as a network organization formed with and by a group of independent firms called network, which are experts in replenishment, production and distribution and which have both logistical and non-logistical relations, working on optimization of material and information flow. Since the mechanism of creating of the network supply chain is rather complicated and not deeply researched, it is essential to introduce its relevance and conduct further necessary research on these issues. This article presents the role of logistics network and basic foundations of the network supply chain concept.

Key words: logistics network, network supply chain.

1. INTRODUCTION

The supply chain, which in the last few years has been a subject of intense research both in theoretical and practical fields, is currently one of the most dynamically developing concepts. Its emergence was connected with changes occurring in the late eighties of the last century in economical and technological environment: the creation of the global market and worldwide economy, a necessity to gain control over new markets with the purpose of having better effect on customers as well as a need for challenging the growing pressure from competition, the dynamic development of information technologies, the increasing pressure from customers connected with their newly discovered, more refined needs, the necessity to lower the costs of activity, the development of new techniques and methods of managing, the cost of investments as well as scientific technical and development research, whose high level exceeds the financial capabilities of individual companies.

These circumstances have led directly to form one of the evolutionary types of the supply chain concept – the network supply chain. Fundamental role in the emergence of the network supply chain is played by logistics network. From the theoretical point of view it can be treated as a basis for network supply chains’ construction and functioning.

2. THE ROLE OF LOGISTICS NETWORK IN SUPPLY CHAIN’S EMERGENCE

A number of approaches have been developed to study the phenomena of networks. In general, a network is understood to be a set of nodes related to each other by certain links. However, besides this abstract structural description, the appearance of networks is amazingly diverse. One can look at networks of railways and electricity lines connecting power stations, food webs and networks of neuronal cells, semantic webs and networks of trade relationships [1].

The scientific interest in network approach has a long tradition. It is concerned with the graph theory in

mathematics and the appearance of social networks analysis as a research field in sociology.

The adoption of the network theory in logistics is connected with the trend of a huge number of companies towards development of their replenishment systems, production and distribution, increasing the level of agility and the benefits of synergy [2]. As a result, organizationally and legally independent companies are becoming members of logistics networks. In order to specify the relevance of logistics network a graph theory can be used.

Logistics network in a mathematical perspective one can define as a directed graph $G = (V, E)$, where V is a set of nodes and E is a set of edges – Fig. 1.

From the perspective of graph theory logistics network is a set of interconnected nodes, joint lines, which symbolize logistical relations. All directed edges in a logistics network can be perceived as pipelines (channel) of product flow. Each channel has its own capacity and the nodes of network are the points where channels meet. There are many different material and information flows in the logistics network from the point of source to the point of destination.

Therefore logistics network can be defined as a set of directly connected business relationships that “creates” interdependences between firms and constitutes the context of focal business relationship which gives each firm roles and means to develop and survive within the structure. Through networks firms ‘know how’ and ‘know who’ [3]. The quoted definition refers to the industrial network, but it can be easily adopted to logistical field.

According to the definition presented above logistics network includes nodes (particular firms) and logistical ties between them, which are foundation on which emerges a structure much better organized than a network

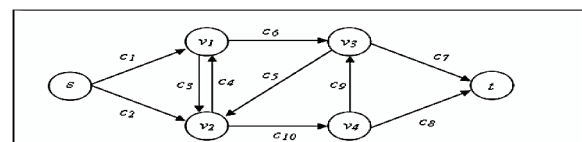


Fig. 1. Graphical representation of the network.

itself. An example of such an organization is a supply chain.

3. FROM LINEAR SUPPLY CHAINS TO NETWORK SUPPLY CHAINS

The dual way of dealing with logistics network and supply chain issues is a result of observation of practical economic activity. In practice the appearance of material and information relations between particular firms in a network does not mean that they are optimal (appropriately planned, organized, implemented) from the holistic perspective.

3.1. Linear supply chain concept

There are many, often very different opinions about the supply chain concept. Authors argue for their definitions analyzing different aspects of its functioning. According to J. Mentzer, for example, a supply chain includes suppliers of the immediate supplier and customers of the immediate customer, all linked by one or more of the upstream and downstream flows of products, services, finances, and information from the initial supplier to the ultimate customer [4]. In other opinion supply chain involves all activities associated with the flow and transformation of goods from the raw material stage, through to the end user, as well as the associated information flows [5].

In the definitions above authors consider only dyadic (peer-to-peer) relations that guide the flow of material among companies, which belong to the supply chain. It can be defined as inter-organizational optimization in external chains. Such organization are often described as a linear supply chain.

There are two fundamental features of such supply chains: linear and sequential logistical relations between companies.

The essence of linearity is the existence of individual, bilateral ties (peer-to-peer relations) between firms.

Sequential relations refer to an ordered group of activities achieved systematically through following companies of supply chain. The linear and sequential relations indicate that there is exactly one firm on each stage of material flow, which achieve particular functions of replenishment, production and distribution. Therefore in such a supply chain the logistical relations are exemplified by peer-to-peer relations.

Linear supply chains are currently more often substituted by organizations, in which the material flow is much more complicated.

Each new step in the evolution of logistics corresponds to a change in ‘the whole’ to be optimized. Now

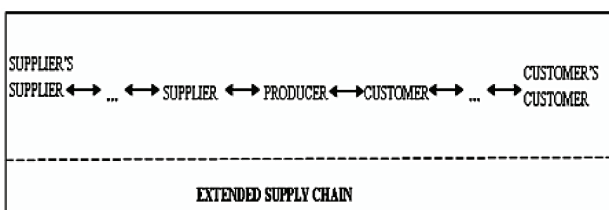


Fig. 2. Peer-to-peer relations in the supply chain [4].

the evolution moves forward from linear supply chains to network supply chains. It is a very advanced, complex structure, where a huge number of conditions must be fulfilled to call such an organization a network supply chain.

3.2. NETWORK SUPPLY CHAIN CONCEPT

The emergence of network supply chains is strictly connected with the technological development of communication and data transformation process. For example Murphy [6] argues that with the development of Internet the old ways of operating supply chains – in a linear, sequential fashion – are no longer appropriate due to the lack of speed and responsiveness to customer pull signals. Rather, “intelligent-webs” that use high speed and real-time communications to link partners in a networked structure are evolving to satisfy consumer demand in a highly responsive manner. In the opinion of Kahl and Berquist the Internet is a robust platform that allows companies for transition from simply connected linear supply chains to electronic business communities that are coordinated [7].

From the organizational point of view the supply chain can be defined as a set of different firms so connected or related as to perform a unique function not performable by firms alone. It means that a supply chain can be treated as a system, which emerges in a logistics network.

The network supply chain can be defined as a set of companies involved in all the upstream and downstream flows of products, services, finances and information from the initial supplier to the ultimate customer [4]. In such an organization, there are multiple layers, and in each layer there are multiple nodes. This confirms an exemplary definition presented by M. Christopher, who proposed that a supply chain is a network of organizations that are involved, through upstream and downstream linkages, in different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer. In other words, a supply chains consists of multiple firms, both upstream and downstream [8].

Fig. 3 illustrates the graphical complexity of the network supply chain. In this example, a third-party financial provider may be providing financing, assuming some of the risk, and offering financial advice; a third party logistics (3PL) provider is performing logistical activities between two of the companies; and a market research firm is providing information about the ultimate customer to a company well back up the supply chain. [4]. This briefly illustrates some of many functions that a network supply chains can do and perform.

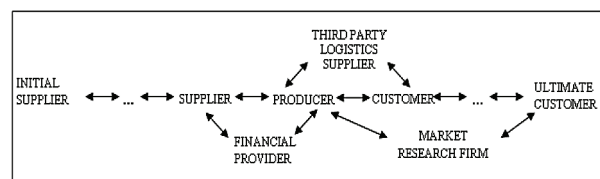


Fig. 3. Multiple relations in the supply chain [4].

In literature, the network supply chain is very often presented as a pipeline. There are many companies at each stage of material flow in such a pipeline – Fig. 4.

There are group of suppliers $D = \{D_1, D_2, D_3\}$, producers $P = \{P_1, P_2\}$, wholesalers $H = \{H_1, H_2, H_3\}$, retailers $DE = \{DE_1, DE_2, DE_3, DE_4\}$ and clients $K = \{K_1, K_2, K_3, K_4, K_5, K_6\}$, which represent following stages of material flow: replenishment, production and distribution. The group of companies in a network supply chain is connected with material and information relations.

There is a necessity to reach the holistic optimum of material flow in a network supply chain. Therefore multiple relations in such a supply chain should be treated as one chain of material flow.

4. DEVELOPMENT OF NETWORK RELATIONS – INITIAL EMPIRICAL STUDY

4.1. Research problem identification

The main objective of the research conducted in 2005 was identification and analysis of material ties between companies in a southern Poland. Two detailed research purposes were then subordinated to this objective :

- the examination of the level of complexity of relations among companies,
- the examination of qualitative aspects of relations among companies.

On the basis of the objectives the following research problems were derived:

- the complexity of interorganisational relations in southern Poland is high,
- the relations between companies are not sufficiently organized and demand further efforts to be holistically planned, organized and implemented in part or in the entire logistics network.

4.2. Research methodology

Having profoundly studied literature referring to the concept of the network supply chain the author has defined the research methodology, whose results were to prove the rightness of the hypotheses. Statistical methods are used in carrying out research.

The statistical methods allow to identify and analyze the main features of the network supply chains in Poland. The author has decided to carry out the initial survey among a sample of Polish companies, which are mostly operating in the south of Poland, mainly in the Silesian Region. The research tool is a detailed questionnaire, which consists of a number of items, the respondents are supposed to answer.

4.3. The initial results of survey

The initial research was carried out among 104 companies in Poland. The response rate is 80%. Most of the sample (36%) were companies which offer many different services. Next group (18%) were producers and 30% were sales companies. The companies represented following industry divisions: fabricated metal products, chemical, petroleum, miscellaneous manufacturing, basic metal products, food and beverages, transport, clothing and footwear, textiles, etc.

The initial survey revealed that most (about 85%) of the examined companies in southern Poland have at least 5 business partners. Fig. 5 presents more detailed information about the structure of business partners.

The business partners of the examined companies can be divided into three groups:

- customers: two groups – one group: individual customers (79%) and firms (21%), second group: unstable group of customers (70%) and permanent group (30%),

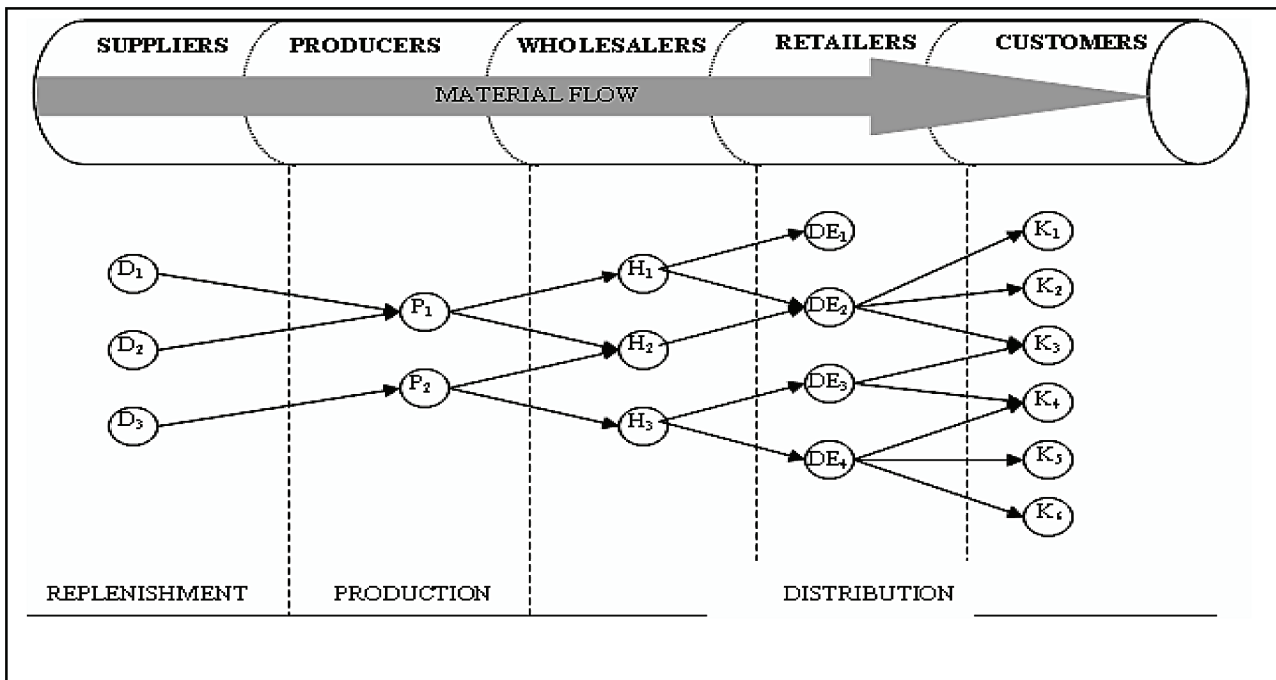


Fig. 4. The example of network supply chain.

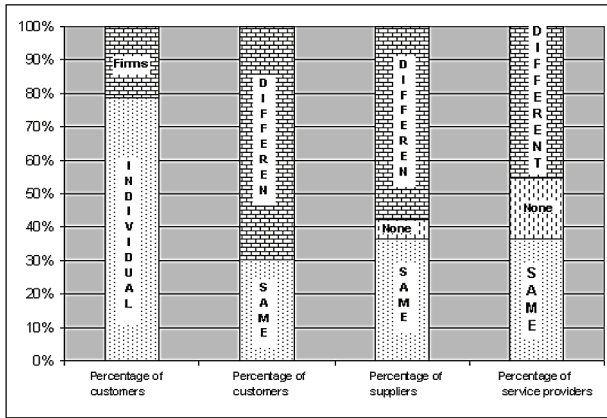


Fig. 5. Detailed information about partners.

- suppliers: unstable group of suppliers (58%) and permanent group (36%),
- service providers: unstable group of service providers (45%), permanent group of service providers (36%).

Fig. 6 briefly presents the analyzed indicators of the quality of relations among companies.

In the initial survey three indicators were examined:

- replenishment control. This indicator analyzed if the examined company decided to take over the responsibility on the client’s replenishment process,
- vendor managed inventory. This indicator analyzed if the examined company decided to transfer the responsibility on the inventory to its suppliers,
- aggregated data on the quantity of demand. This indicator examined if the company is able to transfer data about its demand to suppliers.

The gathered information revealed that 67% of the examined companies have no opinion about taking over the responsibility on the client’s replenishment process. Less than a half of the companies would decide to transfer the responsibility on the inventory and transfer data about its demand to the suppliers.

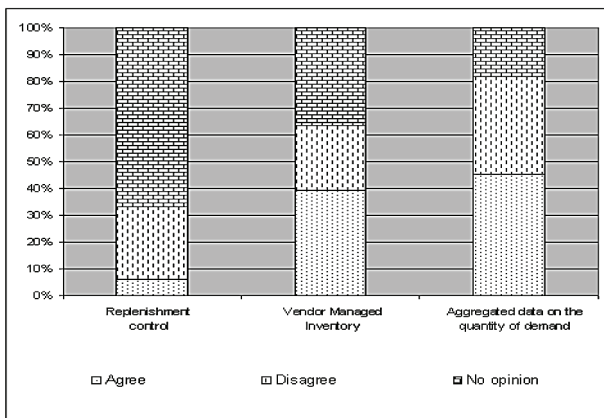


Fig. 6. Qualitative aspects of relations.

A preliminary analysis of the network relations and their quality among Polish companies suggests that the complexity is quite high, but simultaneously the relations are not yet sufficiently managed – planned, organized and implemented. This allows to confirm the initial hypotheses – the complexity of interorganisational relations in southern Poland is high and the relations between companies are not sufficiently organized and demand further efforts to be holistically planned, organized and implemented in the part or in the entire logistics network.

5. CONCLUDING REMARKS

The particular logistics network can be a basis for the emergence of many supply chains, including network supply chains. In course of time independent supply chains in a logistics network will tend to optimize the material flow among them. This interesting tendency is now perceived as a main power which leads to the changing future relations between organizations in a field of logistics. In line with this, Gadde et al. suggested that a network view may complement the more common chain approach in the logistics literature [9]. The preliminary analysis of the relations of polish companies revealed that the their quality is still not sufficient and there is still a lot of effort to make them more efficient from the holistic perspective.

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