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## The Concept of Industry Supply Chains – A Pilot Study

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Ewa Kulińska<sup>1</sup>, Dariusz Masłowski<sup>2</sup>, Małgorzata Dendera-Gruszka<sup>3</sup>

### **Abstract:**

**Purpose:** The paper presents an analysis of supply chain concepts and research on the industry supply chain. The aim of the paper was to present the industry supply chain for the heavy industry.

**Approach/Methodology/Design:** The literature analysis conducted emerged supply chain concepts on theoretical grounds, which enabled the development of a supply chain concept dedicated to the heavy industry. The research methodology was also based on a 2016-2019 analysis of the heavy industry industry, an interview and a literature analysis of previously known supply chain concepts. The study group consists of nine business entities.

**Findings:** The main conclusion of the article is that industrial supply chains operate without spatial constraints and use every possible mode of transport, depending on demand. The flow of goods is strongly dependent on energy prices, raw material prices and labour costs. Skilful stock control is an important factor.

**Practical Implications:** It is safe to say that supply chains have existed since the beginning of entrepreneurship. The article helps to understand this phenomenon, as well as shows a practical look at a specific area of research through an extended research sample from heavy industry. A certain limitation may be that the industry is too dynamically changing. Consequently, the study of supply chain flows requires continuous improvement.

**Originality/Value:** The analysis of the heavy industry sector enabled the development of interdependencies between the entities involved in the flow of goods. The article provides a basis for improving supply chains in the heavy industry sector.

**Keywords:** supply chain, heavy industry, supply chain concepts, industry supply chain

**JEL classification:** O14, P42, P51.

**Paper Type:** Research study.

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<sup>1</sup>Faculty of Production Engineering and Logistics, Opole University of Technology, Opole, Poland, 0000-0002-3227-057X, [e.kulinska@po.edu.pl](mailto:e.kulinska@po.edu.pl)

<sup>2</sup>Faculty of Production Engineering and Logistics, Opole University of Technology, Opole, Poland, 0000-0002-3964-540X, [d.maslowski@po.edu.pl](mailto:d.maslowski@po.edu.pl)

<sup>3</sup>Faculty of Production Engineering and Logistics, Opole University of Technology, Opole, Poland, 0000-0002-3683-5160, [m.dendera-gruszka@po.edu.pl](mailto:m.dendera-gruszka@po.edu.pl)

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## **1. Introduction**

The concentration of population around urban centres contributes to the centralisation of logistics services within major conurbations. Due to the rapid development of globalisation processes, consumers have become accustomed to a situation where they can obtain any item from anywhere in the world in a very short time (Babek *et al.*, 2019). An important factor in the functioning of supply chains is the consolidation of markets. Supply chain management, on the other hand, depends on the type of decisions taken and the choice of supply chain management strategy (Vaillancourt, 2017).

Contemporary economic conditions and globalisation processes influence the way a company is managed and its development (Kontrimienė and Melnikas, 2017). Different regional, cultural and social factors and structures determine the choice of an appropriate decision-making strategy to keep a company competitive in a given market. The dynamics of change in both cultural and economic issues determine the determinants of change in organisational management (Stajniak and Zwoliński, 2016). Nowadays, the most important elements to gain a competitive advantage are quick reactions to changes, speed of decision-making and flexibility of action (Kaleka and Morgan, 2017). Mass production along with the flow of goods is a certain threat to companies, but it also forces organisations to continuously improve their products or services (Rajesh and Saravanan, 2018). A dynamic response to change must be supported by adequate organisational and information resources within the company (Stajniak, 2015). Therefore, the logistics system is primarily oriented towards the integrated flow of materials, goods and information. The organisation of the flow and movement of goods together with information involves the development of a logistics network (Jacyna-Golda, 2015).

The supply chain is inextricably linked with the current world picture. The awareness of the advantages of the supply chain has contributed to the creation of methods supporting its management (Yang *et al.*, 2017). Globalisation forces companies to expand their market activities on a macroeconomic scale (Zwolińska, 2011; Grad *et al.*, 2013; Stajniak 2015). Cultural and economic changes also affect the role and functioning of supply chains (Babu and Mohan, 2018). Speed and flexibility are very important in this area. The need for companies to continuously improve their processes in order to remain in the market in the age of globalisation has forced organisations to cooperate. Cooperation between economic entities has undergone a significant evolution over the last few decades. It is safe to say that supply chains have existed since the beginning of entrepreneurship. Over time, economic actors have come to appreciate the properties of the supply chain and have achieved competitive advantage through it. They have started to create conscious business networks in order to move goods more efficiently, easily and effectively (Ozkan-Pir and Karaduman, 2017). A dynamic response to change is not the only criterion for maintaining leadership in a given market (Dendera-Gruszka *et al.*, 2017; Kulińska and Dendera-Gruszka, 2019).

## 2. Types of Supply Chains

Supply chain management was initially defined as the integration of logistics processes of suppliers with the final customer. The concept of supply chain management was developed in the manufacturing industry. One of the first concepts was Just in Time (JIT) for Toyota Production Systems. The concept was based on minimising inventory and effectively regulating the interaction of suppliers with production lines. The evolution of industry, technology and engineering has led to the development of supply chain management as a network of relationships within a company and between interdependent economic actors, organisations, business units, which includes purchasing, production, logistics, marketing, data and information flows, financial resources and distribution (Pettit *et al.*, 2019). The key task of the supply chain is to maximise profitability through process efficiency and end customer satisfaction (Hasim *et al.*, 2018; Kulińska and Dendera-Gruszka, 2019).

Despite the development and use of many logistics, business and management tools, there remain numerous issues that impede the flow of materials, raw materials, services and information. Today's supply chain issues differ from the complications or obstacles characterised ten or more years ago (Ghadimi *et al.*, 2019). Every year, every month, new challenges appear, increasing the complexity of problems to be solved in the perspective of supply chain management. Despite many logistical tools, the flow of materials, raw materials or services within the supply chain is in each case different and unique, which is associated with the uncertainty of the adopted strategy or elements of action. It becomes necessary to carry out an analysis between the relationship of supply chain links, logistics processes and tools with management concepts. It should also be noted that not every management concept will work in supply chain management. The problem arises of choosing the most appropriate concept, corresponding to the most effective supply chain management. Table 1 shows the known concepts of supply chains (Ciesielski 2009; Ciesielski and Długosz, 2010; Kulińska and Dendera-Gruszka, 2019).

**Table 1.** Characteristics of supply chains

Types of supply chains	Definition (Kulińska and Dendera-Gruszka, 2019, p. 174-186)
<b>Rigid supply chains</b>	Structures based on the vertical construction of the logistics network, which aim to ensure continuity of production by maintaining, among other things, high stock levels. They are characterised by the production of large product series, all components of which are purchased, which may involve a high risk of data leakage. In rigid supply chains, there is a negligible risk associated with possible production downtime (Wang <i>et al.</i> , 2020).
<b>Lean supply chains</b>	Supply chains associated with continuous cost and price reduction. They are characterised by the elimination of waste in terms of material, product, process, time and data and information flow. They are characterised by an increase in the efficiency and effectiveness of production processes, a reduction in errors and inventory costs. The key to lean manufacturing effectiveness is skilled employees and their

	increased responsibility for assigned tasks and duties. The concept is strongly influenced by unpredictable market fluctuations, as production is based on high volumes and low variety of products and close cooperation between actors within the supply chain. Therefore, the system cannot operate under pressure (Tortorella et al., 2017).
<b>Continuous replenishment supply chains</b>	A continuous replenishment supply chain is characterised by decreasing inventory levels with increasing stock turns, improved customer service, increased warehousing efficiency and increased perceived value from business partners. The fundamental values in the chain are reliability, trust and loyalty. Businesses are keen to exchange information and carry out projects together (Freitas et al., 2019).
<b>A lean and agile supply chain</b>	The lean and agile supply chain is also referred to as the 'triple A' supply chain (agility, adaptability, alignment). Its essence is resilience, adaptability and serial alignment. The chain is characterised by immediate response to change and rapid adaptation to long-term market, political or business changes, and by shortening product, technology and IT cycles. The concept is based primarily on the close integration of information systems, which are responsible for the flow of information and the speed of response (Kuupiel et al., 2017).
<b>Flexible supply chains</b>	The concept is mainly characterised by the ability to adapt to changing conditions affecting the organisation and the supply chain as a whole. Flexible supply chains are defined as an operational capability that allows business entities to change effectively under the influence of external conditions, within the organisation and between supply chain links (Zirngast et al., 2018).
<b>Resilient supply chains</b>	The most important element of a resilient concept is speed of response by maintaining spare capacity. Maintaining a resilient supply chain is costly and involves fast decision cycles and the right organisational sub-culture throughout the supply chain. At the heart of a resilient supply chain is speed of decision and response, proper planning with consideration of process interruptions, short product runs, short lead times, production schedule flexibility and production of specific/one-off orders (Treiblmaier 2018).
<b>Agile supply chains</b>	The most important elements of an agile approach to supply chain management are flexibility and time compression. To this should also be added qualities such as innovation and creativity. Projects of complex technological complexity are characteristic of agile supply chains. Therefore, their success is determined by the finalisation of the project together with an appropriate functional structure. Agile means reacting quickly to changes in the external environment. Agile supply chains place great emphasis on taking care of the environment by using advanced information technologies and developing network organisations. The concept of agility is also based on the use and management of knowledge and information about markets (Kawa and Maryniak, 2018).
<b>Hybrid supply chains</b>	Hybrid supply chains refer to the transfer of product sales into the virtual sphere and the initiation of multi-channel product sales. These chains become the basis for managing sales of fast-moving products, where order picking is associated with a small amount of time and high flexibility of operation, which results from the irregularity and unpredictability of orders. There are large variations in the volume of demand, which is highly unpredictable (Nakandala and Lau, 2019).
<b>Multidimensional supply chains</b>	They consist of several supply chain management concepts (e.g. Just in Time, Six Sigma and Business Process Reengineering). The

	functioning of the supply chain is based on well-defined and assumed concepts of personnel management and the creation of an appropriate organisational culture. Multidimensional supply chains include elements such as personnel management, integration of logistics and business processes, integration of IT systems, quality of information data flow, unification of supply chain management concepts, appropriate allocation of responsibilities in the supply chain, measuring the effectiveness and quality of processes (Davis and Hyndman, 2019).
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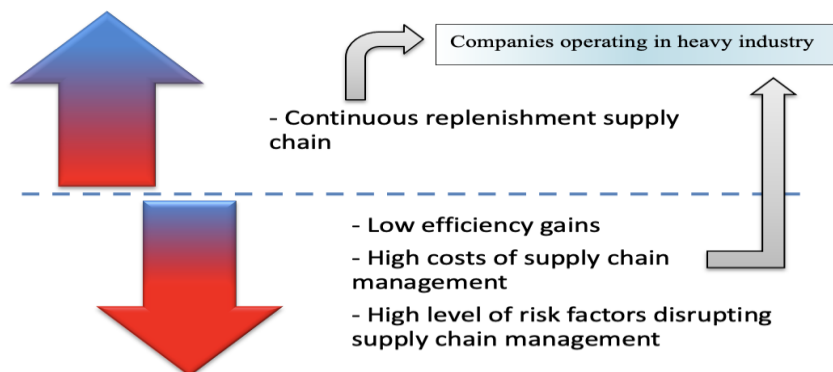
*Source: Own study.*

Each of the supply chains shown in Table 1 is based on a pattern of relationships and the nature of production. It does not refer to a specific industry where the implementation of the assumed supply chain model would maximise efficiency and reduce the risk of disruption.

### 3. Industry Supply Chains

The research was conducted with reference to enterprises operating in the heavy metal industry in 2016-2019 in Poland and Germany. The specificity and nature of relations occurring within the supply chain were taken into account and risk elements affecting the surveyed enterprises were analysed. During the preliminary analysis, the studied entities were divided into three groups (Kulińska and Dendera-Gruszka, 2019). Due to the difficult subject of the study, which is the identification of a new phenomenon in supply chain management, it was necessary to first analyse the supply chain concepts known so far, to examine the structures of companies operating in a given industry and to determine their mutual relations.

**Figure 1.** Factors influencing the industry under study



*Source: Kulińska and Dendera-Gruszka, 2019, pp. 205.*

A preliminary analysis of the economic actors from the perspective of their relationships with companies in the supply chain revealed shortcomings in terms of efficiency resulting from cooperation (Figure 1). Another negative aspect associated with supply chain co-operation relates to high management costs and high levels of risk factors. In steel processing, manufacturing and trading companies, it can be

observed that there is continuous complementarity within the supply chain. In the companies surveyed, cooperation is based on specific conditions. Partnerships and a high degree of trust and loyalty are also observed. Cooperation within the supply chain in the sector under review is long-term oriented. In the companies surveyed, the following are noted in particular:

- low efficiency gains,
- high costs of supply chain management,
- a high level of risk factors for supply chain disruption.

Relations in the supply chain are a key factor in strengthening the links of its links and relations with the external environment. A characteristic feature of enterprises operating in the heavy industry sector is the high degree of differentiation and complexity of supply chain link relations. An important element is the formation of appropriate links within the supply chain to reduce disruptions and the impact of risks within the structure and to increase the efficiency of operations (Kulińska and Dendera-Gruszka, 2019).

The study group consists of nine business entities. The research sample presented was divided into three groups, each containing three business entities. The common features and differences between the organisations are presented in Table 2.

**Table 2. Characteristics of the research sample**

		Adopted name of the entity									
		A	B	C	D	E	F	G	H	I	
Number of employees	of	1–49									
		50–99	X	X				X			
		100–499				X	X				
		> 500			X				X	X	
Nature of operations	of	steel trading	X	X	X	X	X	X	X	X	
		steel production							X	X	
		steel processing	X	X		X	X	X	X	X	
Number of suppliers	of all	1–9	X	X	X					X	
		10–19							X		
		20–39				X					
		> 40					X	X			
Location of economic operators	Poland	voivodeships	Opolskie			X	X	X	X		X
			Silesia	X	X	X				X	X
			Małopolskie			X				X	X
			Lower Silesia			X					
			Podkarpackie			X					
			Lubelskie			X					
			Podlaskie								
			Warmińsko-mazurskie								
			Pomeranian			X					



	World	X							X	X
The most important elements for working with suppliers	loyalty						X			
	trust					X				
	financial probity					X		X		X
	high quality products and services	X	X		X					
	an impeccable corporate image	X	X							
	positive opinions about the entity in the environment								X	
	business credibility	X						X	X	X
	speed of response to requests for quotations/orders submitted			X	X					
	low prices		X	X	X	X	X	X		
	supplier location			X			X			
care for the environment								X	X	

Source: Own study.

The analysed supply chains of the selected economic entities are characterised by interconnectedness. Each analysed enterprise cooperates with each other directly or indirectly. The links with all the entities are shared by company. Due to the strong integration of the economic entities in the industry under study, the impact of risk factors on the operation of each of the economic entities affects the entire supply chain. The analysis of the heavy industry sector made it possible to work out the interdependencies between the entities involved in the flow of goods. The most salient elements that emerged from the analysis of supply chains in the heavy industry and at the same time characterise the flow of goods in the industry under study are:

- organisational culture,
- import and export opportunities, no spatial restrictions on the movement of goods,
- the dependence of the flow of goods on pricing policies for energy, raw materials and labour costs,
- oversupply of steel,
- level and ability to control stocks,
- business relationships and degree of customer connectedness,
- the quality of information flow between links in the supply chain and a high degree of business loyalty and trust,
- concentration on strategic areas of activity and selection of key assortments from the product offer,
- high quality of raw materials, materials, goods and merchandise.



The supply chain in heavy industry requires a highly developed organisational culture - hiring employees with high qualifications, appropriate experience and skills and, above all, taking care of their interests. The analysed business entities assume that the satisfied interest of the employee translates into the interest of the business entity. Personnel management in the studied businesses is based on thorough discussion of projects with lower-level employees. Communicating the relevance and purpose of a given project to employees is an extremely important issue, determining the success or failure of a given assignment.

#### **4. Conclusion**

Industrial supply chains operate without spatial constraints and use every possible mode of transport, depending on demand. The flow of goods is strongly dependent on the prices of energy, raw materials and labour costs. Skilful stock control is an important factor. However, the biggest risk for the supply chain in the heavy industry sector is not allowing an oversupply of steel. Production of goods takes place with moderate stock levels. There is a close relationship between the actors involved in the flow of goods in the heavy industry. Cooperation mainly takes place on the basis of partnership and mutual loyalty and trust. The economic actors in the supply chain are both buyers and suppliers. There is a mutual division of labour. The quality of the manufactured products and services is at the highest level and is continuously improved.

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