

## **SUPPLY PROCESSES IN A MACHINE-BUILDING ENTERPRISE CONCERNING METALLURGICAL PRODUCTS – CASE STUDY**

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### **Abstract**

The article presents applied solutions in the range of supply chain structure of metallurgical products required in machinery and equipment manufacturing taking into account the realisation of contracts to order in selected machine-building enterprises. The study undertakes issues concerning different types of inter-organisational relationships and determinants for the effective implementation of supply processes in a selected company. The study indicates the complexity of an analysed supply chain combining features of both flexible and narrow supply chains.

**Keywords:** machine-building company, metallurgical products, supply chain structure

### **1. INTRODUCTION**

Effective management of supply processes in machine-building enterprises is still the challenge for managers and researchers. High level of the complexity of phenomena occurring in supply processes makes this phase essential in the whole process of a contract realisation and particularly sensitive to disturbances. Supply processes determine the efficiency of a production process. That situation is mainly determined by dynamic changes which take place in a market environment, and above all the change in the service of the final client for which a highly specialized product is developed and manufactured. And this is why there is the necessity of changes in the organisation of a supply chain, in the structure and the type of a production process, and in the organisation of distribution. Many companies, facing these changes, are focused on transforming the way of a manufacturing process from mass production into unitary production.

The article refers to the problems concerning a supply chain of metallurgical products applied in the production of machinery and equipment in Kopex Machinery, which is the comprehensive supplier of machines and equipment for underground coal mining. The study includes the analysis of source materials and a direct interview with engineering and technical staff of an analysed company. The research has indicated the benefits brought in by the reconfiguration of a supply chain, mainly by strengthening the supply of steel products by Kopex Machinery subsidiaries.

### **2. SPECIFICITY OF POLISH MACHINE-BUILDING ENTERPRISES**

Machine-building industry can be characterised by the great diversity of products and is essential for the national economy. Its main role is the supply of machinery and equipment which are the production means in other industrial branches and sectors in an economy. The development level of machine-building industry affects the general level of products' production and products' quality. The location of machine-building plants is determined by, inter alia, the access to qualified engineering and technical staff, research facilities, the resource base (mainly steel products) and markets.

Engineering industry in Poland can be divided into the production of: general-purpose machines, special-purpose machines, machinery for agriculture and forestry, and machinery and mechanical appliance. Engineering industry is one of the strongest in Poland, especially in the context of the share of finished products in the export. The location of machine-building plants in Central and Eastern Europe made a positive effect on the scale of investment in the branch and the level of orders. In the year 2014 there is a 3% increase in comparison to the previous year in the number of entities involved in manufacturing of various kinds of machines. Presently, there are approximately 8 000 enterprises in the Polish engineering industry, of which more than 80% employ up to 10 people (microenterprises). A large share belongs to small enterprises, which employ 11-49 people (1 015 entities). Less than 5% of enterprises employ up to 250 people, and there are 79 large enterprises which employ more than 250 persons.

The main factors determining the competitiveness level in machine-building sector are: technological advancement level, access to markets, industry knowledge, labour costs, innovation potential. Innovative activities are mainly product and process innovations, i.e. the implementation of new or significantly improved designs, production methods and distribution of products. The key issue is acquiring new knowledge, changes in infrastructure, human resources, working methods or the combination of different solutions [5].

### **3. SUPPLY CHAIN STRUCTURE OF METALLURGICAL PRODUCTS**

The complexity of relations in present supply chains derives from dynamic changes in a market environment and depends upon changing needs of recipients [7]. The key fact is that the presence of enterprises in competitive market and the necessity of searching new demand requires enterprises' reorientation [3]. J. Brzóska [2], in his study emphasizes the need for more flexible and innovative business models treated as contemporary form of model capture of concept of the strategy and organization system or even company management.

The structure of particular supply chains is given by industrial branch character (e.g. automotive, food or pharmaceutical industry). They are usually consisted of hundreds or thousands of companies and institutions which are connected through huge material, information and financial flows [6]. Operational managers must consider many factors in the processes of designing, developing, and restructuring their supply chains as markets evolve. The studies undertaken by A. Awaysheh i R. D. Klassen prove that the location of suppliers and the forms of interaction between supply chain members have important social implications, and cannot be ignored [1].

A different approach to the structure of a supply chain is presented by M. Kruczek [9]. He suggests, first of all, that the analysis of a supply chain should be conducted at the formal structure level. For that type of focus, it is recommended to conduct the field research comprising e.g. the surveillance method, the survey study and the analysis of source materials. The information gathered in such a way is then supplemented with opinions of experts in a given field who point out the influence creation of supply chains among various companies. That stage of the analysis leads to identifying the companies that become particular links of the supply chain. Such an analysis is necessary in a simple supplier – receiver relationship which has evolved with many additional indirect links. Moreover, the number and scope of activities of those middlemen companies perform constantly changes and such a structure is very difficult to identify and, even more, to be managed.

The management process of the whole supplies chain is not an easy task. In Fig. 1 the complexity of the supply chain structure is presented.

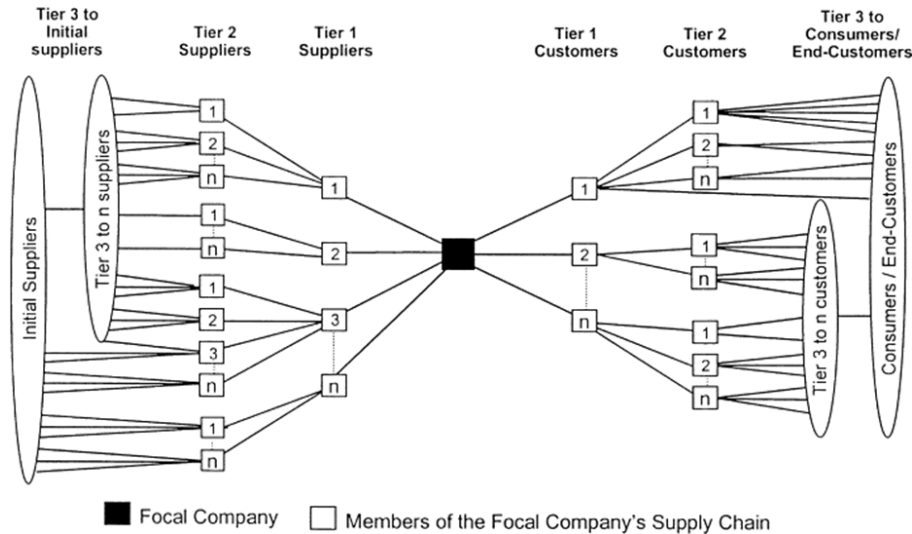


Fig. 1 Supply chain network structure [11]

All firms participate in a supply chain, from raw materials to the ultimate consumer. The question is how much of this supply chain needs to be managed depending on several factors including the complexity of the product, the number of available suppliers, and the availability of raw materials [10]. Dimensions to consider include the length of the supply chain and the number of suppliers and customers at each level. It would be rare for a firm to participate in only one supply chain. For most manufacturers, the supply chain looks less like a pipeline or chain than an uprooted tree, where the branches and roots are the extensive network of customers and suppliers [4].

The Polish metallurgy gradually changes its own production offer towards deep-converted products. The specialization of metallurgical enterprises becomes a market necessity. Such tendencies concern both the production side of the supply chain and the distributional part. Supply networks of metallurgic products consist of numerous cooperating nodes connected by different formal and informal relationships. Such a structure enables the network configuration to match current market needs [8].

Metallurgical supply chains are specific, especially thanks to the nature of production systems. In comparison with the assembly types of productions, they are based on highly material and energy demanding physical and chemical processes taking place in technically and technologically complicated apparatus devices. The character of products is different as well, since they are not composed of components, but they represent treated material of certain shape, size, and structure, with physical, chemical and other properties that make their use value [12].

#### 4. SUPPLY PROCESSES IN A SELECTED MACHINE-BUILDING ENTERPRISE

The analysis of supply processes, especially concerning the supplies of metallurgical products and to the production of machines and equipment dedicated to different industrial branches were carried out in an enterprise which is the largest producer of mechanical engineering industry in Poland. Kopex Machinery offers complete solutions for machinery and equipment for coal companies, for all longwalls' heights and the power adjusted to customers' requirements. Processes carried out by the company result from the primary purpose of its activities, namely, meeting the demand of customers, mainly in the field of machinery and equipment for coal mining (longwall shearers, heading machines, haulage longwall complexes, transport

equipment, equipment for mechanical processing of minerals). Despite the strong influence of technique and technology, it is the customers' needs which determine the size and the subject of production.

Restructuring changes, which took place the last years in the capital group Kopex, mainly in the field of employment and organization, led to the changes in the structure of the supply chain from the distracted structure into the compact one, based on subsidiaries. Steel products are of great importance for the final product. Their share in total purchases is about 30%. Supplies of steel products, up to 55% are realized as internal supplies by subsidiaries. Other deliveries are supplied by external contractors which are not connected with Kopex Machinery.

The largest subsidiaries of Machinery Kopex are: Miilux Poland Ltd, Tagor, Poland Investments 7 Ltd and HSW Odlewnia Ltd. Miilux Poland Ltd is a major supplier of hard wearing steel sheet used in the production of longwall scraper conveyors. Tagor is a supplier of sheet metal and alloy construction, which are components of shearers. Poland Investments 7 provides processed steel structures and the complex of heading machines, and products designed for vertical transport of excavated material and people, horizontal transport (conveyors), machines for enrichment and classification of coal. HSW Odlewnia Ltd is the main supplier of steel and iron castings. Deliveries of HSW Odlewnia Ltd cover almost the entire demand for castings in Kopex Machinery.

The production of Kopex Machinery is the unitary production. Parameters of final products complies with the customers' requirements. In case it is necessary consultations are held with the producers of materials for the optimum selection of materials. The internal supplies in Kopex Machinery have a significant impact on the quality of supplies, their timelines and pricing. The creation of consignment warehouses resulted in a significant decrease in inventories in the assortment of metallurgical products.

The configuration of a supply chain enables more efficient after-sales service. The customer service, including maintenance services and the supply of spare parts, is a strategic activity of the company which makes it more competitive. Her character is dependent on the activity of a given market and covers all activities through their own subsidiaries. The company participates in both the selection of equipment, their implementation, supervision, and maintenance management.

In Fig. 2 the structure of a steel goods supply chain is presented. The structure is adjusted to processes realised in the analysed enterprise.

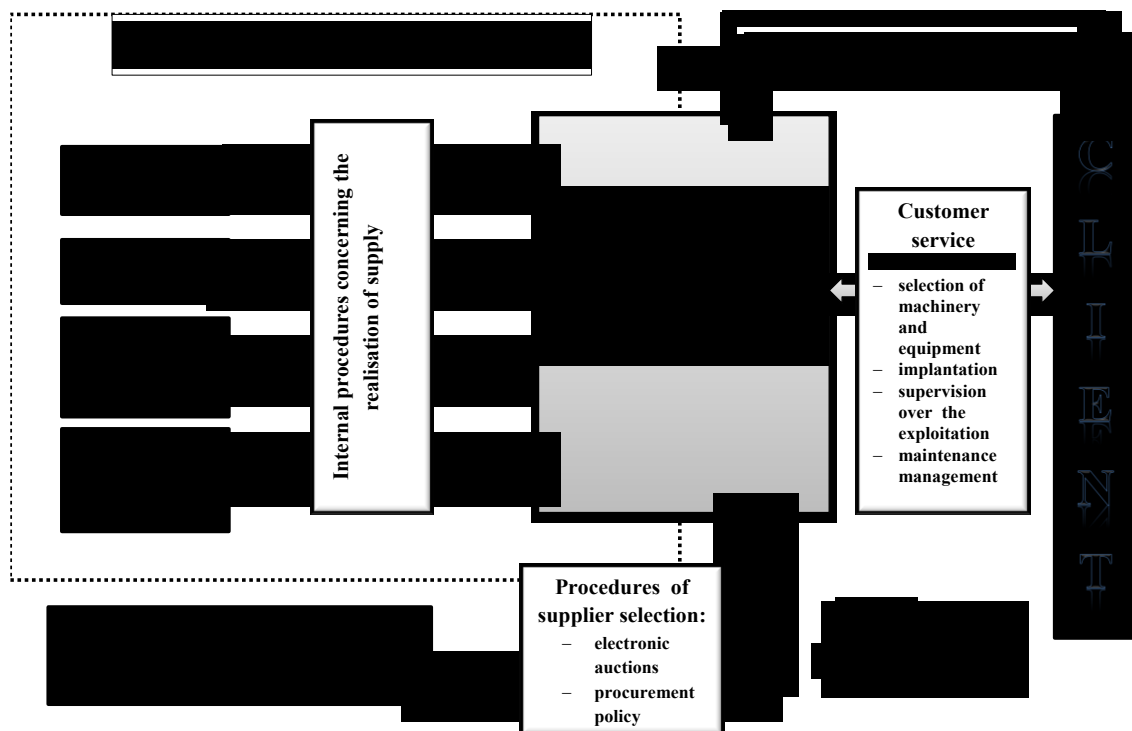


Fig. 2. The structure of a steel goods supply chain (own preparation)

Taking into consideration restructuring changes realised in the last few years in the group of Kopex Plc , it should be emphasized that there has been the significant improvement in the indicators characterizing the supplies of metallurgical products mainly by subsidiaries, which can be regarded as internal supplies.

Table 1. Data concerning the supplies of defective materials for Kopex Machinery in the years 2010-2014.

No.	Year	The cost of the supplies of defective materials [PLN]	The number of the protocols of defects	The number of defects	Defects in castings	
					Total	Supplied by HSW
1	2010	201.798,85	183	478	174	145
2	2011	575.760,90	174	532	122	98
3	2012	377.291,76	158	532	119	84
4	2013	398.122,08	105	295	48	39
5	2014	129.800,40	68	238	-----	36

The analysis of the protocols of defects shows the scale of the need to replace materials or products in Kopex Machinery arising from the delivery of defects. The analysis indicates the decline in quantity and the value of qualitative indicators of defective deliveries as a result of the consolidation policy of the internal supply chain. The effect was achieved both by acquisition of companies such as HSW Odlewnia Ltd, and by creating new entities such as Millux Ltd.

## 5. CONCLUSION

Kopex Machinery is going to continue the solutions in the range of consolidation and optimization of an internal supply chain mainly by the development of existing assets and by the improvement of internal logistics systems.

In a mid-term horizon, the future of Kopex Machinery, given in the development strategy of the company, will focus on the diversification of final products due to the difficult situation on the domestic and international hard coal market, and the further reconfiguration of the business model, mainly in response to external circumstances.

In the area of improving the supply chain Kopex Machinery intends to undertake active actions in subsidiaries, which should bring in:

- strengthening the production potential of HSW Odlewnia Ltd in the range of large-scale steel and iron castings (over 4 tonnes),
- changes, in Miilux Poland Ltd, in the infrastructure and production processes for improving the quality and the further cost reduction of the production of hard wearing steel sheet.

Kopex Machinery considers actions related to the implementation of the concept of Just in Time, mainly for internal deliveries carried out by the company's subsidiaries, which should bring beneficial effects in the range of logistic customer service and the optimization of the costs Kopex Machinery activity.

The reconfiguration of the supply chain, which took place in Kopex Machinery is a good example that shows how essential are flexible supply chains in machine-building enterprise for the effective implementation of products for individual customers' order. They bring benefits in reducing the number of defective materials in the process of completing the product, and on the other hand they enable to obtain the improvement of the quality of the product for the final consumer.

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