

MANAGEMENT AND CONTROLLING OF STOCKS IN THE SUPPLY CHAIN OF METALLURGICAL INDUSTRY

SAŁEK Robert, KLIMECKA-TATAR Dorota

Czestochowa University of Technology, Poland, EU,
robertsalek203@gmail.com, klimt@wip.pcz.pl

Abstract

One of the most important branches of Polish and worldwide industry is metallurgical industry. The economic slowdown observed in the world in recent years had a negative impact on the metallurgical industry in Poland and throughout Europe. Steel industry recorded a decrease due to the limitation of individual consumption and reduced demand for manufacturing industry. Therefore, it is important through the use of available resources and tools, strive to improve processes, also logistic and thereby to influence on the shape of the whole industry.

An important element supporting the functioning of metallurgical enterprises is efficient supply chain management. The basis of functionality is synchronization of supply system with physical distribution of materials. Individual solution for enterprises is the use of appropriate methods to increase the effectiveness of this synchronization. The article presents solutions for the use of methods of inventory and order control in logistics chain of metallurgical enterprises. The steel market analysis in Poland through several years has been made, to show the market trends, as a justification for the use of appropriate management methods.

Keywords: SCM, logistics, management, metallurgy

1. INTRODUCTION

The issue of the supply chain is extensively discussed and has many definitions since its functioning depends on a wide range of activities of the participating enterprises. Depending on the level of the economic development of the specific country also the level of the development of supply chains is different. Simultaneously, the form of supply chains has changed over the years along with an increase in globalization. The systems of cooperation between enterprises in the supply chain have been improved and widely distributed. Therefore, it is necessary to consider a number of definitions of the supply chain in terms of both the subject and the object. [1]

One of the most significant characteristics of logistics is the supply chain. It defines the activity and procurement lead time from obtaining the raw material to its storage. It can be defined as "the sequence of events in the flow of goods increasing the value of specific goods" [2], which should be understood as specifying the scope of the acquisition of goods or raw materials to obtain the continuity of the appropriate amount of the purchased goods in the enterprise. The problem of procurement in the supply chain particularly concentrates on maintaining appropriate warehouse stocks, which is combined with the optimization of stocks and deliveries. The flexibility of the flow between the related activities of the supply chain particularly depends on appropriate supply management, which translates into maintaining the appropriate level of the product quality and reducing the risk of overproduction. Defining the issue of the supply chain by B.J. LaLonde and T.L. Pohlen as "a business process which is orientated towards the external relations of the enterprise and providing the final purchaser with the maximum value" [3] allows to claim that the supply chain is built on the basis of the relationships between the purchaser and the seller taking into account intermediate links, transfer of goods and services, maintaining appropriate procedures, actions and factors.

In order to properly understand the essence of the logistics chain, it is also necessary to refer to the issue of supply chain management. In terms of widely perceived chain, additional activities are seen as an element of

work necessary to get the customer's satisfaction. Supply chain management focuses on the functioning of the supply chain and its environment as a whole. Due to the systemic perception of the supply chain it is easier to understand and manage individual actions coordinating flows and services to provide the highest quality of customer service. [4]

The discussed problem is closely related to SCM, which was defined by Christopher as "*Management of relationships with suppliers and consignees and customers to provide the customer with the highest value at lower costs for the whole supply chain*" [5]. He emphasizes that SCM should not be identified with "vertical integration" (Vertical integration can be seen as an alternative for supply chain management in the sense that, by ownership, it makes an attempt to control the effectiveness of the flow channels) since we do not deal with the phenomenon of taking over suppliers or distributors. It should be seen in terms of cooperation of a group of partners in the supply chain removing the barriers between them, enabling coordination and management of the flows of goods from producers to consumers.

Creating the cooperation between enterprises in the supply chain aims at the achievement of high performance of individual links and their networks due to the value added by all the enterprises, its integration, coordination and optimization.

Taking into account the above considerations, one can claim that the supply chain with the integrated approach to management of supplies, production and distribution of goods and services to customers takes the form orientated towards processes. On the other hand, the benefits coming from such a concept of supply chain management can efficiently replace "possible" revenues from typical market competition.

Satisfying the demand for specific products is associated with the integration of activities of the participants of the supply chain, therefore, they are often called the integrated logistics supply chains. This concept is the development of the notion of logistics and does not apply only to the optimization of internal flows but also the flows between institutions and organizations. The integrated supply chain requires the cooperation of enterprises and their partners in the key logistics processes: planning and product development, demand planning and order fulfillment. Such an approach allows for new perception of enterprises in the supply chain, significantly wider, taking into account the needs of the end customer and all the partners - the links. Building the strategy based on the integrated supply chain must take into account understanding the needs of customers and capabilities of suppliers. [6]

2. THE THEORY OF INVENTORY MANAGEMENT IN THE ENTERPRISE

The proper functioning of trading and production companies is significantly dependent on appropriate inventory management. Another situation is observed in service companies where the concept of inventory is not so common. The problem of inventory management mainly focuses on providing its appropriate level to maintain the continuity of production and sales. [7]

High levels of inventory have both favorable and unfavorable impact on the activity of the enterprise. The direction of the adopted activities of inventory management must be assessed by management groups. If the balance is successful, i.e. the costs associated with inventory management are lower than the costs of e.g. supply logistics in order to balance warehouse stocks, it is worth considering the decision on the continuation of the specific strategy. Maintaining a high level of inventory also allows for: reducing the risk of loss of liquidity, providing safety of functioning, enabling high readiness of supplies, gaining competitive advantage.

Shortages of stocks are associated with the costs of slowdown or suspension of sales/production and can result in the loss of customers. To solve or prevent such a situation there are applied different methods and techniques of optimization of inventory management. Any optimizing activities must be preceded by the detailed analysis of the inventory costs. [8]

Possessing and maintaining stocks are often the condition for the functioning of enterprises. The inventory of materials or raw materials for the maintenance of the continuity of production, production stocks in the course of processes, inventory of goods to satisfy customers' needs, all these types of stocks determine the proper functioning of specific enterprises. A great challenge for entrepreneurs is to determine the level of inventory properly. The problem of forecasting stocks is complex since they mostly depend on the level of sales and inventory precedes sales. Therefore, their size should be adjusted to the planned sales. Enterprises, depending on the specificity of their sales strategy can solve this problem traditionally, i.e. possessing the inventory of finished goods or products (trading companies providing goods in stores etc.) or the lack of the possessed goods in the case of production on order or e-commerce.

It should be remembered that maintaining the appropriate level of stocks is associated with incurring costs but it also brings some specific benefits. Removing stocks in production or trading companies does not seem to be either possible or favorable, therefore, it is necessary to aim at more effective or optimal economy of inventory management, particularly due to its relationship with sales or inflating costs. [9]

Effectiveness of management of inventory is built using appropriate methods which allow to plan and control its level. Most of the well-known methods are applied in management of materials, raw materials or goods and are often used simultaneously. The main methods of management of inventory of the company include: ABC/XYZ, CVA, Critical Value Analysis, EOQ model, economic order quantity, the ROP, ROC models, the model of optimal production batch. [10]

2.1. The ABC, XYZ method

It is one of the simplest methods which consists in the classification of stocks into three groups. This division is made on the basis of the assumption that a smaller part of stocks has a larger value share in the whole of stocks and the ones which are more numerous in terms of quantity have a smaller share in the value of all of them. [11, 12] As a supplement of the ABC analysis, there is often applied the XYZ analysis, taking into account additional criteria such as regularity of supplies or accuracy of forecasting. The combination of these methods provides the opportunity to create the matrix of stocks which allows to direct specific activities to specific groups of goods or materials. This results in greater effectiveness in inventory management. [13]

2.2. The CVA analysis

This method requires the development of the detailed criteria of the classification of stocks on the basis of the main criterion (e.g. sales). Its nature is more subjective in contrast to the quantitative analysis of ABC. In accordance with the principle of CVA and the division of assortment, there should be identified individual groups of resources in relation to their significance for the enterprise: top priority (goods that are always in stock), significant products (for which low levels of shortages in stock are allowed), medium priority (for which periodic shortages are allowed), low priority (necessary products but their shortages are allowed in the warehouse). The classification of individual products into the above groups translates into the size of stocks and production planning. [14]

2.3. The EOQ model

This model is based on the optimal size of supplies, which allows to provide the minimization of the total costs to maintain inventory. [15] This concept is the most widespread and used in inventory management. An increase in the order influences the amount of inventory, which, in turn, is associated with reduction in costs of replenishing stock but an increase in stock maintenance costs. While increasing the frequency of supplies there is reduction in the level of stocks, which will result in reduction in stock maintenance costs and an increase in costs of stock replenishment. [16]

2.4. The models of stock control - ROP, ROC

Stock control is associated with movement, transport and all the associated operations. There can be identified two models of stock control in the enterprise: [17]

- ROP- Re-Order Point, the model of the ordering level, i.e. fixed size of supplies
- ROC- Re-Order Cycle, the model of order lead time, i.e. fixed supplier's lead time.

The basis for the functionality of ROP is the economical size of the order and the minimum level of all the stocks (buffer, reserve stocks etc.). The main assumption is the constant series of the ordered materials or goods essential for maintenance of the continuity of production or sales. The time left to the placement of another order is specified by warehouse stocks, i.e. minimum stock level. In the case of the ROC model, there should be identified two parameters: optimal order lead time and maximum stock level. To determine optimal supplier's lead time it is necessary to determine the demand and optimal supply batch. Consequently, there is no need to constantly control warehouse stocks. [18]

2.5. The model of optimal production batch

The application of this solution is reflected in successive supplies of production batch. The supplied finished goods from production to the warehouse are systematically currently acquired by consignees. It is the situation which is the most frequently observed in the case of enterprises of the SME sector. They increase their value by maximizing cash transfers dependent on: sales revenues (dependent on the availability of assortment), fixed and variable costs and an increase in net working capital (dependent on the size of inventory and the level of sales - an increase in operational risk). [19]

3. THE ANALYSIS OF THE POLISH METALLURGICAL SECTOR

The metal sector in the world provides components and finished goods practically to all the other production sectors, including most of all the automotive industry, the aerospace industry, the transport and machine-building industries. According to the commonly applied criteria, the metal sector is divided into: [20]

- steel production,
- distribution of steel and steel products,
- metalworking.

In turn, the metalworking sector can be divided into the subsequent four sectors:

- metalworking (casting, forging, plating) - usually associated with small enterprises,
- metal constructions (used in the building industry),
- boilers, metal containers and packaging - the enterprises of this sector are usually larger due to economies of scale coming from production,
- metal products - great diversity with reference to the size and type of enterprises.

The metallurgical industry is one of more important branches of the processing industry, it deals with the preparation of the mined ores to release pure metal, metal refining, heat treatment, thermochemical treatment (hardening etc.) and casting to produce some specific shapes and production of alloys. The metallurgical industry is divided into ferrous metallurgy and non-ferrous metallurgy. In Polish conditions, the vast majority of metallurgical production falls for steel (91%), copper production is also noticeable (7%). The share of other metals in the industry amounts to less than 1%. Poland has not had an aluminum plant since 2009 when the aluminum plant in Konin was closed. [21]

The metallurgical industry is one of the most significant parts of the Polish economy. According to the obtained data, sold production of the metallurgical industry by divisions of PKD (Polish Classification of Activity) - 24 and 25 with reference to the whole industry on average amounted to PLN 115361.15 million, which is 10.27% of the value. The detailed data are presented in **Table 1**.

Table 1 Sold production of industry by sections and divisions of PKD in [PLN million]

Sections and divisions of PKD	2010	2011	2012	2013	2014
INDUSTRY - TOTAL	985715.9	1137372.8	1178303.6	1182963.9	1139192.5
Manufacture of metals (PKD C 24)	35628.6	46412.2	45195.3	41630.5	43161.9
Manufacture of metal products (PKD C 25)	61081.4	75215.0	78404.9	77876.7	74260.4
SUM (PKD C24,C25)	96710.0	121627.2	123600.2	119507.2	117422.3
% of the share of the metallurgical industry	9.81	10.69	10.49	10.10	10.31

Source: Author's own study based on Local Data Bank, www.bdl.stat.gov.pl, www.swaid.stat.gov.pl

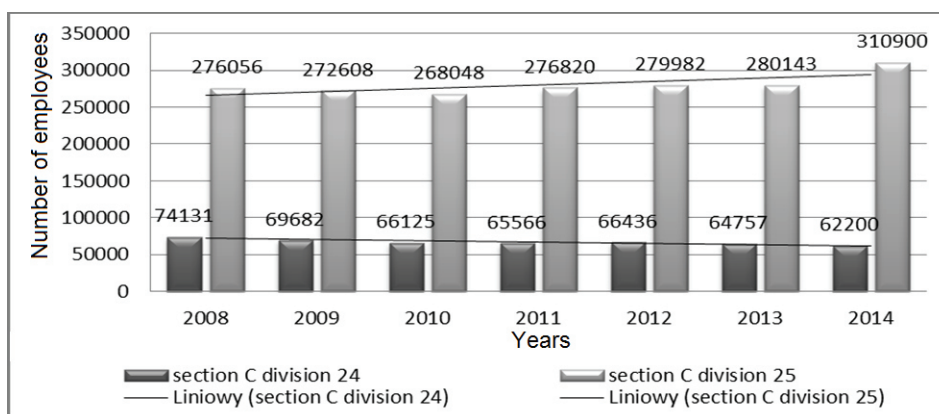
While analyzing the data from the above table, there can be observed a systematic increase in sold production for the metallurgical industry and the whole industry. In 2010 these values respectively amounted to - for manufacture of metals - PLN 35628.6 [million] and for manufacture of metal products - PLN 61081.4 [million], whereas in 2014 they respectively amounted to PLN 43161.9 [million] and PLN 74260.4 [million], which means an increase in production by 17.45% for PKD C24 and 17.75% for PKD C25 with 13.47% growth for the whole industry. An important economic indicator for each branch of industry is employment. The data concerning the employment in the metal sector is shown in **Table 2**.

Table 2 The number of people employed in the metallurgical industry

	2008	2009	2010	2011	2012	2013	2014
Manufacture of metals (PKD C 24)	74131	69682	66125	65566	66436	64757	62200
Manufacture of metal products (PKD C 25)	276056	272608	268048	276820	279982	280143	310900
Total	350187	342290	334173	342386	346418	344900	373100

Source: Author's own study based on Local Data Bank, www.bdl.stat.gov.pl, www.swaid.stat.gov.pl

The above table indicates that also the employment in the metal industry was characterized by the fall by 2010 and then it went up by 2014. There should be pinpointed different trends with reference to manufacture of metals and metal products. Manufacture of metals is characterized by a downward trend whereas manufacture of metal products - by an upward trend, which is presented in **Figure 1**.


Figure 1 The number of employees in the metallurgical industry

Source: Author's own study based on the data of Central Statistical Office

The total number of people employed in the metallurgical industry is heavily dependent on the number of people working with manufacture of metal products (PKD C25) since they amount to as much as 81% of all the employed in the industry. It is also closely related to the number of economic entities operating in the metallurgical industry. The data concerning the number of entities are presented in **Figure 2**.

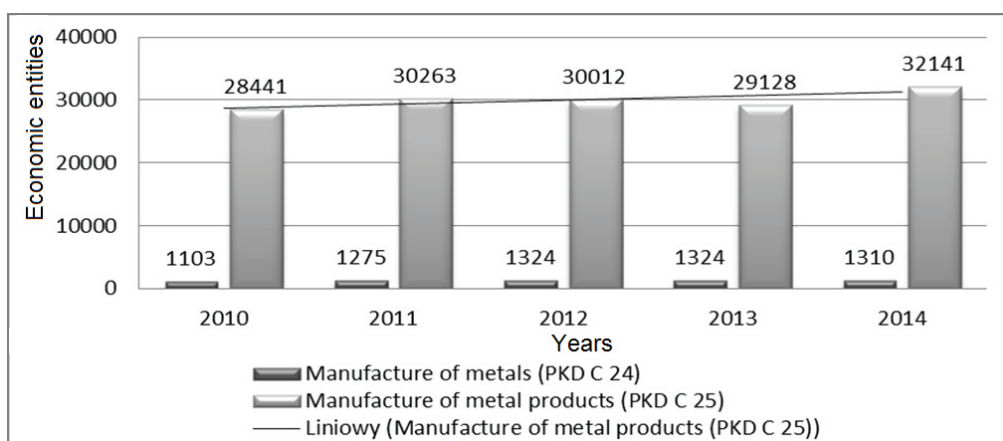


Figure 2 The number of economic entities in the metallurgical industry with the division into sections of PKD 2007

Source: Author's own study based on the data of Central Statistical Office

The above figure allows for the observation that the number of economic entities significantly increased over the analyzed years. For enterprises manufacturing metals the increase amounted to 15.8% whereas the number of enterprises manufacturing metal products grew by 11.5%. This is reflected in the general economic data and upward trends of the metallurgical industry.

4. THE STRATEGY OF SCM IN THE ENTERPRISE OF THE METALLURGICAL INDUSTRY

The analysis of the metallurgical industry allowed for the observations concerning an upward trend of the market and more than the 63% share of manufacture of metal products (PKD C 25) in the whole industry. Therefore, the analysis of inventory management in the supply chain will be based on the enterprises manufacturing metal products.

Each enterprise, in its activity, is driven by a few most important values which constitute the basis for specifying the strategic nature of logistics operations. There can be identified the following objectives:

- minimization of order processing time - efficient order processing for a customer translates into acquiring funds from manufactured goods,
- optimization of the production process - an increase in revenues by optimization of inventory,
- an efficient flow of information in the supply chain - an increase in rapidity of response to changes in procurement and distribution processes,
- partnership cooperation in the supply chain - possibility of planning activities and identification of cooperators' expectations,
- creating an attractive image - maintaining or increasing the competitive position by exposing the greatest qualities to investors and contractors.

The adjustment of the activity of the enterprise to changing expectations of customers is conditioned by the effective cooperation between suppliers, i.e. efficient flow of information. Efficient customer service depends on the level of exchange of information between customers and distributors. Rapidity in placing orders affects the planning of the production process and supplies, also due to the feedback from customers.

The control of own activity is the main objective of each supplier but they know that the planned flows of raw materials, goods, materials or finished products are performed in the whole supply chain. Therefore, enterprises should focus on the following areas of the activity in the logistics supply chain: rapidity of response in order fulfillment, flexibility of other links in the supply chain, providing efficient flows of information, knowledge and understanding of the expected results of cooperation.

The enterprise manufactures products and provides services on its own, by agreement with suppliers, contractors, entrepreneurs and customers. In the area of its operation, it commissions activities to competent professionals or managers. Everything is done for the enterprise and in the framework of its operation while taking into account all subsystems.

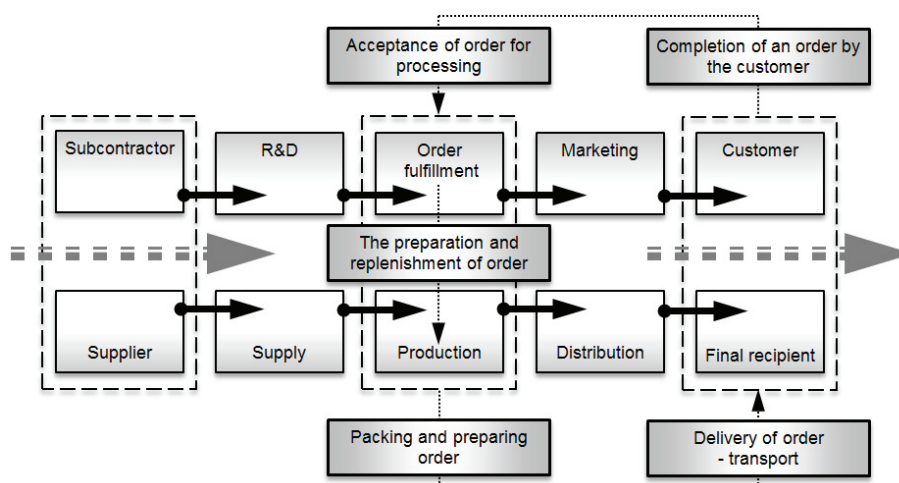


Figure 3 The process of ordering in terms of the integrated supply chain

Source: Author's own study based on [22]

The application of Just in Time method, which is determined as the method of organization of production and decrease in inventory, allowed for significant improvement in the process of manufacture of the specific batch of products for the specific customer. This improvement consists in monitoring the counters located with consignees due to which the enterprise does not have inventory. Additional activities, undertaken in order to increase the performance of the JIT system, concentrate on the optimization of deliveries, regularity of production at properly prepared work places and the use of information systems for the compliance and cooperation of all positions participating in the processing of information.

5. CONCLUSIONS

The strategic approach to the functioning of enterprises of the supply chain allows to observe the significance of cooperation between economic entities and its impact on the economy of the whole country. Building solid networks of economic ties allows for being surrounded by reliable partners who will be able to guarantee reliable and cheap supplies provided at high level. Discussing the problem of inventory management in enterprises of the metallurgical industry was aimed at analyzing the supply chain in the industry and paying attention to the ties and dependencies forming these chains.

The metallurgical industry is an important branch of the national industry, its share amounts to more than 10%, therefore, it is necessary to discuss the problem of its functioning in every aspect. The Polish metallurgical industry should be considered in respect to two economic classifications: manufacture of metals - PKD 2007 section C division 24 and manufacture of metal products - PKD 2007 section C division 25. The analysis presented in the paper allows for the presentation of the quantitative variation occurring both in sold production of industry and employment and the number of enterprises in the selected years. While comparing the two identified divisions, one can notice that manufacture of metal products significantly exceeds manufacture of metals themselves with reference to sold production and it amounts to more than 63% of the whole metallurgical industry.

Like an increase in employment this is undoubtedly closely related to the number of economic entities in the industry. The enterprises manufacturing metal products are also more varied in respect to products, which

brings about that their supply chain is significantly more complicated and requires the detailed analysis at its every stage.

REFERENCES

- [1] CHRISTOPHER, M. *Logistyka i zarządzanie łańcuchem dostaw*. PCDL. Warszawa, 2000. p. 16.
- [2] TWARÓG, J. *Koszty logistyki przedsiębiorstw*. Wydawnictwo Instytut logistyki i magazynowania. Poznań, 2003. p. 133.
- [3] SKOWRON-GRABOWSKA, B. *Zarządzanie łańcuchem dostaw w teorii i praktyce*. WZPCzęst. Częstochowa 2010. p. 123.
- [4] KOT, S. STAROSTKA-PATYK, M. KRZYWDA, D. *Zarządzanie łańcuchami dostaw*, SW WZ PCz, Częstochowa 2009. pp. 8-9.
- [5] CHRISTOPHER, M. *Logistics and supply chain management: Strategies for reducing costs and improving service*. Financial Times - Prentice Hall, London 1998.
- [6] WIŚNIEWSKA-SAŁEK, A. Future Supply Chain - Cluster Supply Chain, *Advanced Logistic Systems. Theory and Practice*, 2011, Vol. 5 pp. 112-118.
- [7] CZEKAJ, J., DRESLER, Z. *Zarządzanie finansami przedsiębiorstw. Podstawy teorii*. Wydawnictwo Naukowe PWN, Warszawa, 2005.
- [8] ZIMON, G. *Wpływ strategii zarządzania zapasami na wyniki finansowe przedsiębiorstw*, In NOWAK, E., BEDNAREK, P. (sc. Eds.), *Research Papers Of Wrocław University of Economics*, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Rachunkowość a Controlling, No. 399, 2015.
- [9] SZYMAŃSKI, P. *Zarządzanie majątkiem obrotowym w procesie kreowania wartości przedsiębiorstwa*, Wydawnictwo Petros, Łódź, 2007, p. 85.
- [10] SZYMAŃSKI, P. *Zarządzanie majątkiem...*, op. cit., p. 96.
- [11] SZYMAŃSKI, P. *Zarządzanie majątkiem...*, op. cit., p. 97.
- [12] MICHAŁSKI, G. *Zarządzanie zapasami w małym przedsiębiorstwie (Inventory Management in Small Firm, in Polish)*, *Finanse, Bankowość, Rachunkowość* No. 2, *Prace Naukowe Akademii Ekonomicznej we Wrocławiu* nr 1059, Wydawnictwo AE, Wrocław, 2005. pp. 190-197.
- [13] SZYMAŃSKI, P. *Zarządzanie majątkiem...* op. cit., p.97.
- [14] CYPLIK, P. *Zastosowanie klasycznych metod zarządzania zapasami do optymalizacji zapasów magazynowych - case study*, *LOG FORUM* 2005, Vol.1., Issue 3, No 4, p. 8.
- [15] MICHAŁSKI, G. *Zarządzanie zapasami ...*, op. cit., pp. 190-197.
- [16] SZYMAŃSKI, P. *Zarządzanie majątkiem...*, op. cit., p. 98.
- [17] RYDZKOWSKI, W. *Usługi logistyczne*. Instytut Logistyki i Magazynowania. Poznań 2007. p. 26.
- [18] DOBRZYŃSKI, M. *Logistyka*. Politechnika Białostocka. Białystok, 1999. p. 22.
- [19] MICHAŁSKI, G. *Zarządzanie zapasami ...*, op. cit., pp. 190-197.
- [20] EU-Consult Sp. z o.o., *Analiza potencjału rozwoju sektora metalowego w powiecie bytowskim*, Opracowanie zrealizowane w ramach projektu „Strategia i kwalifikacje - nasze narzędzia na zmiany w gospodarce” współfinansowanego ze środków Unii Europejskiej, Gdańsk, 2011, p. 4.
- [21] Polska Agencja Informacji i Inwestycji Zagranicznych S.A., *Sektor metalurgiczny w Polsce*, Warszawa, 2011, p. 2.
- [22] POKUSA, T. *Uwarunkowania i poziomy kształtowania procesu integracji łańcucha dostaw*, In SOŁTYSIK, M. (ed.) *Kierunki rozwoju logistyki w Polsce w świetle tendencji światowych*, Katowice, 2004, p. 82.