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ECOLOGICAL ASPECTS OF SUPPLY CHAIN MANAGEMENT IN MANUFACTURING ENTERPRISES

5.1 INTRODUCTION

Contemporary enterprises, in view of their market image, look for pro-ecological solutions which would evoke positive associations among their customers, bearing in mind that their future depends primarily on sustainable development. The basic assumptions include forms of reducing emission of pollution at the stages of production and transport, or lower energy consumption in the process of manufacturing goods. Additionally, enterprises take into account the fact the not only production, but also the entire life cycle of products, from the moment of acquisition of raw materials to recycling, exert impact on the environment.

Background literature identifies company management as the key element supporting integration of economic and ecological goals in the process of supply chain management in manufacturing enterprises. Pro-ecological activity of companies combines environment protection with lower production and transport costs of manufactured goods. Hence the hereby paper discusses issues related to ecological aspects of supply chain management in manufacturing enterprises.

5.2 SUPPLY CHAIN STRUCTURE AND MANAGEMENT IN CONTEMOPRARY MANUFACTURING ENTERPRISES

Supply chain constitutes an important element of functioning of manufacturing enterprises. Numerous definitions can be found in background literature. According to M. Christopher „supply chain is a network of organizations involved, by means of links with suppliers and buyers, in various processes and actions, which create value in the form of products and services supplied to end users” [6], whereas P.K. Bagchi observes that ‘the supply chain consists of a network of companies and contractors, which supply raw materials and components and subsequently transform them into semi-finished products or subassemblies, next manufacture final product and enable their consumption by end users’. Professor Jarosław Witkowski, while analyzing the issue of the supply chain, defines it as „mining, manufacturing, trade service provision enterprises and their customers cooperating in various functional spheres, connected by the flow of strings of products, information and financial means” [17].

The following factors exert influence on the functioning of the supply chain in a given enterprise [11]:

- production – applies to the capability to manufacture and store products,
- reserves – apply to raw materials, semi-finished products and final products in the entire supply chain,
- location – applies to the distribution of particular elements of the chain,
- transport – applies to the transfer of raw materials and final products between particular links of the chain,
- information – binds all actions in the supply chain and constitutes the essential element in the decision making process combining all remaining factors influencing the functioning of the enterprise.

In the supply chain between the suppliers and buyers, there occurs flow of information, products and financial means, which is presented in the Fig. below.

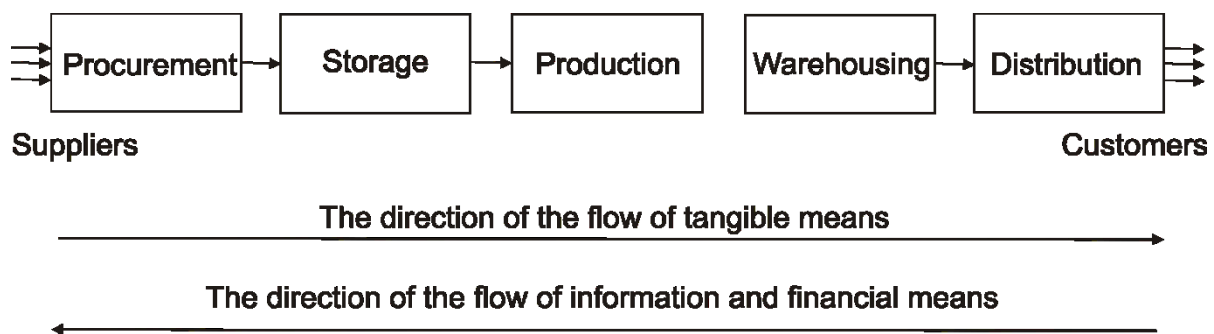


Fig. 5.1 Supply chain diagram

Source: [13]

„Efficient management of the supply chain requires simultaneous improvement of the level of service provision to customers and internal operational efficiency of enterprises within the supply chain.” [7]. The following are the key elements conditioning efficient supply chain management [10]:

- determination of the subjects responsible for the correct functioning of the chain;
- application of the basic systems of the information flow (bar codes, electronic circulation of documents);
- determination of actions in respect of improvement of the flow of goods and circulation of documents;
- providing participants of the chain with access to information about sale, orders.

The elements of the organization of supply chain management presented above allow defining its goals. One of them consists in the reduction of the cost of the flow of products and information and simultaneous observation of customer requirements. Another goal, at which the supply chain should aim, applies to efficiency understood as guaranteeing the shortest delivery lead times and simultaneous high frequency and flexibility of supplies [16]. Supply chain management allows both suppliers and buyers to obtain numerous benefits. These include: lower costs, long term contracts, higher competitiveness on the market and shorter delivery lead times [4].

5.3 ECOLOGICAL ASPECTS OF SUPPLY CHAIN MANAGEMENT IN MANUFACTURING ENTERPRISES

Financial factors constitute the principle problem and barrier limiting the implementation of ecological elements in the supply chain. The basic aim of enterprises is to maximize profit in the possibly longest term [2]. Companies may also have other goals; yet neglecting the above mentioned aim affects the very existence of business entities. The aspect of environment protection is appreciated by entrepreneurs, yet usually it does not result in notable profits. Pro-ecological solutions are more often used for the purpose of promoting companies among customers rather as a real aspect of competitiveness. While discussing environment protection in the 21st century it is impossible to neglect the concept of sustainable development which influences broadly understood issues of logistics, including supply chain management [2].

H. Brdulak defines sustainable (ecological, green) supply chain as „the process of using environment friendly resources and transforming them in the way which improves their side properties or enables recycling in the existing environment without disturbing it” [5].

The very idea of most efficient use of resources is frequently implemented by entrepreneurs, since it leads to lowering production costs. There are other issues which pose problems such as e.g. emission of pollution. Most entrepreneurs apply minimum ecological standards which meet legal requirements. Thus they treat the issue as a „necessary evil” and unwanted cost and do not invest more means than they have to. Sometimes they lack appropriate knowledge in order to organize ecological supply chain. The American Environmental Protection Agency prepared a special practical guide, with the intention of helping entrepreneurs, in which four actions supporting the development of sustainable supply chain are identified (Fig. 5.2) [9].

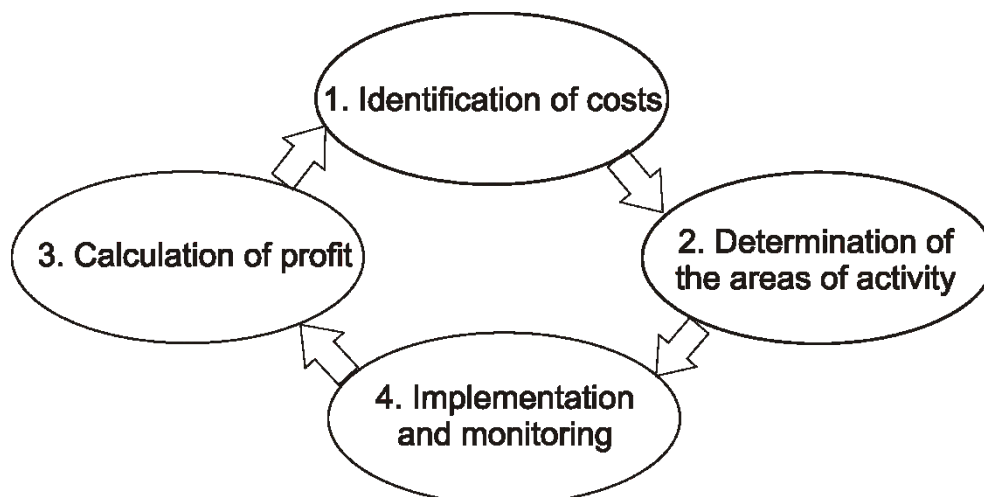


Fig. 5.2 Model of sustainable supply chain

Source: [9]

Management of the ecological supply chain is a permanent process which can be run infinitely. Its first point consists in the identification of environmental costs arising in the enterprise. The costs include losses borne by the company in result of the imple-

mentation of non-ecological solutions as well as environmental damage. The next point concerns the identification of the areas of activity in which environmental costs could be reduced. In other words the places in which the company exerts pressure on the natural environment should be determined. The subsequent step consists in the calculation of profit which can be made, once the supply chain becomes pro-ecological. The profit can be understood both as financial means as well as contribution to environment protection. At the final stage designed changes are introduced and their functioning in accordance with project assumptions is monitored. Correction of changes or even their complete abandonment is advised if necessary [9].

5.4 TYPOLOGY OF THE IMPACT OF MANUFACTURING ENTERPRISES ON THE ENVIRONMENT

The global crisis, IT revolution as well as globalization are prime movers which significantly change the image of the economic and social world. The economy of highly developed countries was particularly strongly affected by the decrease in the value of industrial production. The most significant fall, by as much as 21.3%, was observed in Japan, a member state of G20, in the years 2008-2011. On the other hand in 2010, after 115 years of the domination of the United States, China became the biggest economy in the world. These phenomena result from global de-industrialization, which means the reduction of the share of industry in direct formation of domestic product, which in turn determines the structure and the potential of economies. Manufacturing sectors should not be neglected in economic policy, both in view of their function in economy as well as because of the development of the sector of modern business services on which they are based. Production and industry are the most significant components of technological progress. Many highly developed economies made the mistake of underestimating manufacturing. Among others, such mistakes are at present corrected in the United States where, according to the report of 2013 prepared the consulting firm Accenture, every third concern in the USA started new production activities in the years 2001-2013 [3].

Dynamic changes in enterprises, occurring among others in manufacturing companies, significantly influence the functioning of the social and economic systems as well as the natural environment. Sudden increase in the amount of waste, in particular electronic waste, constitutes one of the most negative forms of impact of manufacturing firms on the environment. In Europe, the total of six million tons of e-waste was generated in 1998, which constitutes 6% of all communal waste generated at the same time. According to the European Report, 27 EU member states generated between 8.3 and 9.1 million tons of electronic waste in 2007. The forecasts included in the report indicate at growth in subsequent years up to 12.3 million tons. Approximately 40% of larger appliances and only 25% of smaller electronic or electrical items were collected for recycling. Technological progress resulted in the production of enormous amounts of such appliances as mobile phones, computers or tablets, which as electronic equipment; contain numerous harmful and dangerous elements which are potentially hazardous both for people and the environment. Mercury, cadmium or lead, all kinds of solvents and plastics

must be securely stored in order to reduce their negative impact. A significant amount of such products was sometimes burnt, which resulted in soil contamination as well as water and air pollution. The Directive of the Council of Europe 2002/96/EC on electronic and electrical waste, accepted by the European Union in 2003, obliged producers to organize and finance recovery and recycling of electronic and electrical waste, as well as reduce the use of substances which are dangerous for the natural environment [15].

Waste does not constitute the only negative impact on the environment. Air pollution has become a universal problem. Mariusz Kudełko PhD from the Mineral and Energy Economy Research Institute of the Polish Academy of Science observes, on the basis of the analysis of the decision model in an enterprise manufacturing rock raw materials, that dust and gas pollution is directly related to processing of limestone and rock shooting. Such work results in the formation of the cloud of dust pollution (mostly mineral), hanging at the height of 200-300 m, depending on the atmospheric conditions, above the excavation point for the period of 10-20 minutes. In view of its short duration, the hazard is not considered to be significant. Dust pollution emitted from the sorting and grinding stations or in the area of dumping or loading points, estimated in 2003 for 23 Mg, is particularly dangerous for the environment. Emissions are also generated by fuel combustion, which is reflected in gas pollution (NO_2 – 1 Mg, SO_2 – 16 Mg, CO – 7 Mg, CO_2 – 3460 Mg)[12].

Hydrosphere constitutes another element of the environment which is directly at risk of being affected by negative aspects of functioning of manufacturing enterprises. In order to illustrate the damage, the analysis of the contamination of water containing fertilizer components was performed on the areas of concentration of greenhouse production. Mineral wool is often used as growth medium in production of vegetables in greenhouses. It is characterized by very good chemical and physical properties which guarantee good and high quality crop. In case of non-soil cultivation and use of mineral wool, it is necessary to use nutrients in order to rinse cultivation mats and assure appropriate conditions of the growth of plants. The amounts used reach almost 40%. Excessive amounts are disposed to the ground, which results in the penetration of fertilizer components to underground water. Consequently the components reach water in rivers or wells and pollute water and soil. It is estimated that on the area of 1 ha, approximately 5 tons of fertilizers penetrate soil, including 1000 kg of nitrogen annually. The contamination of ground water results in the risk of consumption of water containing large amounts of nitrates [8].

In the past, manufacturing enterprises focused on satisfying the consumer needs of the society, treated natural environment as a secondary issue. At present the protection of eco-systems is given more priority. A gradual shift can be observed in industry, expressed by the fact that not only production processes and products are significant, but also the extent to which business activity serves the environment and people [15].

CONCLUSIONS

Supply chain constitutes an important element of functioning of manufacturing enterprises. It offers benefits to both producers as well consumers of goods. At present, environmental aspects are imposed upon enterprises in the form of production requirements. Yet financial factors and the need to maximize profit constitute a barrier which limits the implementation of ecological elements in business activity. Firms are favorably inclined towards the idea of efficient use of resources, however considering the cost of implementation of the ecological supply chain; entrepreneurs invest only minimum necessary resources. It has to be noticed that some companies still lack information on efficient use of the pro-ecological supply chain.

Production and industry are the most important components of technological progress. This results in abrupt increase in the volume of waste, and in particular electronic waste. The negative aspects of the business activity of manufacturing enterprises endanger both atmosphere and hydrosphere.

Until recently, manufacturing enterprises prioritized consumer needs and neglected environment. In view of the present awareness of what consequences arise from such approach, it is likely that the negative impact on ecosystems will decrease, so that future generations could take advantage of them in the way that is possible now.

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Abstract: *The paper discusses issues related to ecological aspects of supply chain management in manufacturing enterprises. It presents the functioning of the supply chain in companies and discusses the minimum pro-ecological standards implemented by entrepreneurs. The article specifies the typology of forms of the impact manufacturing enterprises exert on the environment.*

Key words: *supply chain, supply chain management, manufacturing enterprises*

EKOLOGICZNE ASPEKTY ZARZĄDZANIA ŁAŃCUCHEM DOSTAW W PRZEDSIĘBIORSTWIE PRODUKCYJNYM

Streszczenie: *Artykuł podejmuje problematykę ekologicznych aspektów zarządzania łańcuchem dostaw w przedsiębiorstwach produkcyjnych. Przedstawiono w nim funkcjonowanie łańcucha dostaw w przedsiębiorstwie, a także poruszono kwestie minimalnych standardów proekologicznych stosowanych przez przedsiębiorców. W artykule określona została również typologia oddziaływań na środowisko przedsiębiorstwa produkcyjnego.*

Słowa kluczowe: *łańcuch dostaw, zarządzanie łańcuchem dostaw, przedsiębiorstwo produkcyjne*

Elżbieta CELIŃSKA
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Elaa.Celinska@gmail.com

Ewelina GAWEŁ
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: E.Gawel@onet.pl

Bartosz KLUCZYŃSKI
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: BartoszKluczynski1@gmail.com

Karolina MATERNE
Universität Potsdam
Am Neuen Palais 10, 14469 Potsdam, Niemcy
e-mail: Karo.Materne@yahoo.de

Mateusz ORŁOWSKI
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Mateusz_93@vp.pl

Joanna POŹNIAK
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra
e-mail: Pozniak.Asia@gmail.com

Patrycja ŚWISTAK
University of Zielona Góra
Scientific Association Eco-Management
Faculty of Economics and Management
ul. Licealna 9, 65-417 Zielona Góra