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Assessment of Factors Affecting the Implementation of Projects in the Field of Green Logistics in Poland in the Perspective of the Sustainable Development Concept

Abstract: The aim of the article is to assess the essential factors determining the implementation of Green Logistics projects for the sustainable development of the logistics potential of Polish enterprises. The article discusses the strategic role of business in achieving goals in the field of sustainable development of logistics processes. It is the result of international conventions and the obligations imposed on the state and enterprises arising from these conventions. Based on literature studies and analysis of existing data, five basic categories of factors determining the development of Green Logistics projects were identified. Within these areas, specific actions were identified as important for entrepreneurs. They were then assessed as a result of an in-depth questionnaire interview. Special attention was paid to the need for implementing technological solutions, which is crucial for the development of Green Logistics. It was emphasised that Green Logistics can be an important element of the global economic balance.

Keywords: sustainable development, green logistics, green supply chains

JEL: Q01, Q56, O11

1. Introduction

Green Logistics and Green Supply Chain are increasingly gaining in importance and practical application in the economy. The awareness of the existence of a barrier to socio-economic development and its global character resulted in the modification of entrepreneurs' behaviour and the attitude of societies to the use of natural resources. The change in the conditions of conducting business activity has triggered actions aimed at developing universal rules for using natural environment resources. The principles of sustainable development are widely accepted, indicating the need to maintain a balance between the implementation of economic, environmental, social and spatial order objectives. Obeying these rules in the supply chain becomes extremely important under the conditions of the ongoing process of globalisation, transformation and integration of logistics activities. In the case of Green Logistics, key areas of interest include: green design, green transport, green production, green inventory management or reverse logistics. The European Union (EU) is particularly active in the field of activities supporting sustainable development. The development of Green Logistics is the EU's contribution to the implementation of the sustainable development strategy in the global dimension. Enterprises are becoming more and more aware that ecological behaviour leads to business success. At the same time, it is more and more visible that enterprises operating in the global market face the necessity of obtaining social acceptance for their operations.

The aim of the article is to identify the factors affecting the implementation of logistics projects in the field of Green Logistics and the scope of activities undertaken by economic entities for the sustainable development of the Polish enterprises' logistics potential.

2. The idea of sustainable development as the basis for shaping the concept of Green Logistics

Degradation of the natural environment is currently a serious civilisational problem. At the beginning of the 1940s, human activity in the natural environment began to take on a global character. And its impact, mainly indirect, covered almost the entire globe (Pawłowska, 2013: 78). The human-environment relations were increasingly "expanded", which led to an exacerbation of the conflict. Lack of commensurability between the scale and pace of human interference in ecosystems and the mechanism of environmental systems balance (shaped in the evolution) resulted in depletion and destruction of the living world. As a consequence of the violation of this balance, limitations in the access to resources and environment assets have appeared. These restrictions have led to a deterioration of the conditions and

quality of human life, resulting in a social well-being decline. Starting from the end of the 1960s, the global dimension of human-related threats and devastation is becoming increasingly common. In the report "Man and His Environment" (November 1969), the Secretary-General of the United Nations (UN) U Thant compared the then state of social-environmental relations to a crisis of a global scope, encompassing both developed and developing countries (Zieliński, 1971: 234).

Negative effects of the dynamic development of national economies dominated the directions of further research on socio-economic growth and development. The concept of sustainable development has become one of these directions. Despite its holistic character, it is undoubtedly an important macroeconomic theory and has already gained a significant position in economic sciences. Sustainable development is a widely used concept. Although this concept is commonly used, it is not unambiguously interpreted. The durability is crucial to the essence of sustainable development, and in particular the ethical aspects of this durability. These premises include intra-generation and intergenerational justice, as well as assumptions regarding the scope of substitution between services provided by natural capital and other forms of social capital and the problem of irreversibility of processes (Jeżowski). From an economic point of view, problems may arise by reaching a kind of intergenerational Pareto efficiency. The assessment of any optimum is associated with serious methodological challenges, and in practice also with issues related to the information gap. However, this does not diminish the role of sustainable development in shaping the integrated order. This order is conditioned by the existence of direct relations between the four spheres of socio-economic life, i.e. the economic, social, environmental and spatial sphere (Borys, 2011: 78).

The term "sustainable development" appeared for the first time in the 1970s. It referred to ecological problems revealed during this period. They became commonly known thanks to publications and reports, prepared e.g. by UN and the Club of Rome, describing the state of the natural environment and warning against its crisis. According to the UN definition of 1975, the society of sustainable development was defined as "a society that recognises the supremacy of ecological requirements that cannot be disturbed by the growth of civilisation and cultural and economic development, capable of self-steering by its development, respecting economical production and consumption, and the use of waste, caring about the future consequences of the actions undertaken, and thus also about the needs and health of future generations" (Kiełczewski, 2010: 10–11). Sustainable development is nowadays an inseparable element of not only ecological policy and socio-economic policy but also various strategies for socio-economic development. The ability to generate long-term development of EU regions, resulting from the EU Sustainable Development Strategy and the EU Treaty, assumes reconciling economic, social and environmental goals. The concept of sustainable development was the basis for determining the priorities for creating the most competitive economy in the world in Europe. This is an outcome

of strong emphasis on the need to build a knowledge-based economy and the need to ensure the sustainability of development, put by the creators of the concept of EU Lisbon Strategy and its continuators – the Europe 2020 strategy.

The indication of economic arguments confirming the importance of natural resources in socio-economic development began the process of changing thinking regarding the perception of the essence of these resources. This process lasts for this day. The new global programme of actions for sustainable development adopted by the UN in September 2015 (UNGA, 2015) is the first manifestation of international consensus that the goals of sustainable development should be achieved individually, but at the same time they must be mutually reinforcing. The programme shows that the pursuit of sustainable economic development will include the patterns of sustainable production and consumption within the circular economy, effective resource management and the transition to low-carbon and climate-resilient methods.

Current competition in the use of available environmental resources for the purposes of production, consumption and transport leads to pollution and exceeding the natural capacity of the environment, to lack of free space and degradation of the landscape, and above all to the rapid emergence of the problem of limited natural resources. Management under conditions of limited natural resources and environmental pollution requires, therefore, searching for new directions of development, taking into account the protection of the environment and prevention of adverse effects of human activities on the environment (EEA, 2015: 152). The proper direction may be the development of the so-called green economy that combines economic needs with protection of the natural environment and climate. According to the OECD definition (OECD, 2011: 9), this economy supports growth and economic development, maintaining at the same time access to natural capital and ecosystem services on which human well-being depends. However, green economy does not replace the idea of sustainable development, because it has a narrower scope. In the case of green economy, the social aspect is included only in the part which is directly related to the environment or the economy (Wyszkowska, Rogalewska, 2016: 56).

The concept of "greening", in which the attention is paid mostly to the natural environment, encompassing the ecological system of production of goods and provision of services is found in almost all fields of science as well as economic and social processes. It is also the main point of interest of Green Logistics, Green Supply Chain and Green Transport. The issue of Green Economy and Green Logistics, closely related to the idea of sustainable development, is understood as a new path of socio-economic development that allows us access to a sustainable economy (Figure 1).

Environmentally friendly "green" initiatives related to various aspects of logistics are an important direction for the development of modern logistic systems.

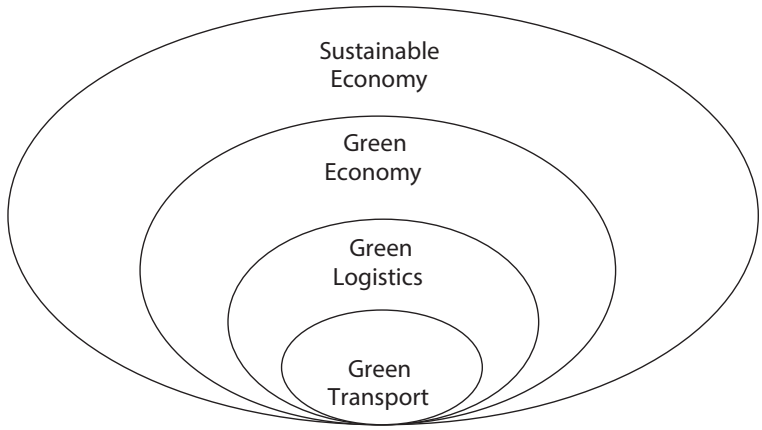

Figure 1. Green Logistics as an element of a sustainable economy
Source: own elaboration

3. The essence and concept of Green Logistics

Green Logistics and Green Supply Chain have been widely discussed in public for almost thirty years, but are still being redefined. Many conceptual and strategic documents have been published that indicate the desired directions of logistics development on a global, European and Polish scale (Figure 2). Their development should support the implementation of the principles of sustainable socio-economic development, assuming that all logistic activities are carried out so as not to cause irreversible changes in the natural environment. This objective has become even more important in recent years, and one of the key instruments for its implementation is to accelerate the implementation of the concept of Green Logistics and Green Supply Chain. Unfortunately, these concepts are too often simplified and narrowed down.

In many policy documents (Figure 2) and business strategies, the idea of Green Logistics is identified with sustainable development of society and economy. It is a natural-centric interpretation that treats Green Logistics as a concept of greening economics. Meanwhile, the literature analysis of the subject (Lee, Klassen, 2008; Lyon, Maxwell, 2008; Sbihi, Eglese, 2009; Jedliński, 2014; Rajeev et al., 2017; Tundys, 2018) indicates a much broader understanding of the concept of greening in logistics.

At the theoretical level, researchers predict that the functioning of Green Logistics and Green Supply Chain will take into account not only ecological but also economic, technological and social challenges. The implementation of the Green Logistics concept is aimed at a more effective, from the point of view of the entire

logistics system, use of limited environmental resources. These resources are necessary to achieve other goals co-determining the level of social well-being. In this way, this concept limits the opportunity cost of environmental protection, i.e. depletion of resources and deterioration of the quality of the natural environment. The first research in this area was carried out by scientists from the Manufacturing Research Consortium of Michigan State University in the USA in 1996 (Witkowski, Pisarek, 2017: 14). They proposed a methodology for a comprehensive approach to the relationship between the natural environment and the optimisation of production in the supply chain. The subject of the assessment was the reduction of environmental costs by tracking the product throughout its entire life cycle, as well as monitoring products withdrawn from circulation. B.M. Beamon is considered as the precursor of the use of the term "Green Supply Chain" in scientific debates. He developed a general procedure for transforming the traditional supply chain into the green one (Beamon, 1999: 332–342). The thesis, which was the starting point in the research conducted by Zhu, Sarkis and Geng (2015: 450), was also important for understanding the nature of the functioning of green chains. Recognising the need to reconcile the highly complex logistics goals with the reduction of pressure on the environment, these researchers considered the green supply chain as a kind of "art of interaction" between managers, consumer needs and the natural environment. They pointed out that the green supply chain is a new archetype of creating common value. Enterprises operating under different supply chains can increase their profitability by reducing the negative impact of processes on the natural environment, while improving the environmental effectiveness of entities. The scope of integration of environmental thinking within the supply chain with the superior goals of logistics is reflected in the definition proposed by Srivastava (2007: 54). According to the author, Green Supply Chain concerns the integration of all activities related to the product's life cycle, i.e. from product design to product management of the items which were withdrawn from service, and therefore whose life cycle ended.

The model of the Green Supply Chain presented in Figure 3 allows for creating a new value and increasing the efficiency of resource management through their repeated use. Increasing international responsibility for the growth of environmental costs of enterprises, as a result of, among others, the implementation of the provisions of the Kyoto Protocol, added value to understanding the nature of Green Logistics and Green Supply Chain and the emergence of new approaches in defining them. In these relatively new definitions, greening in logistics is related to the values that characterise the concepts of: circular economy (Tundys, 2015), sharing economy (Large, Kramer, Hartmann, 2013), smart city (Jedliński, 2014) or industry 4.0 (Attaran, 2017: 189–206). Recognising the numerous interdependencies, all the quoted authors agree that a systemic approach, the implementation of technological innovations, the use of appropriate financial and legal instruments, and an increase in public awareness is required for the development of Green Logistics.

Essential EU documents on sustainable development	Essential Polish documents on sustainable development
– The Europe 2020 strategy (2010) – The Resource Efficient Europe (2011) – The climate and energy package (2008) – The EU strategy on adaptation to climate change (2013) – The Low Carbon Economy Action Plan 2050 (2011) – The Energy Efficiency Directive (2012) – The EU Transport White Paper (2011) – The Energy Action Plan 2050 (2011) – The Directive on cost effective reductions and low-carbon investments (2018) – Towards a circular economy: "a zero waste programme for Europe" (2014) – Clean energy for all Europeans (2016) – Communication on the next steps for a sustainable European Future (2016) – Trade for All (2015)	– The long-term growth scenarios for Poland till 2030 (2013) – The National Development Strategy 2020 (2012) – The Energy Efficiency Directive (2016) – The Renewable Energy directive (2015) – The act on electromobility and alternative fuels (2018) – The human capital development strategy 2020 (2013) – The Sustainable Growth Strategy 2020 (2017) – The Energy and Environment Safety Strategy (2014) – Environmental protection law (amendment) (2014) – The Strategy for Innovation and Efficiency of the Economy 2020 (2013) – The Transport Development Strategy 2020 (till 2030) (2013) – The Sustainable Development of Villages and Agriculture Strategy 2012–2020 (2012) – The National Strategy of Regional Development 2010–2020 (2011)

↓ ↓

Development of the Green Logistics concept

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Selected Polish policy documents
– The National Reform Programme for Europe 2020 Strategy Implementation (2017) – The National Spatial Development Concept 2030 (2012) – The Polish Energy Policy until 2030 (2009) – The National Ecological Policy 2030 (2018) – The Poland's Climate Policy. Greenhouse Gas Emissions Reduction Strategy in Poland till 2020 (2003) – The Strategy for Change of Production Patterns and Consumption for Sustainable Development Rules Implementation (2003) – The Strategy for implementation of Integrated Product Policy in Poland (2005) – The National Transport Policy 2006–2025 (2005) – The National Energy Efficiency Action Plan for Poland (2014) – The Green Transport Pact (2017)

Figure 2. Essential documents supporting the development of the Green Logistics concept

Source: own elaboration

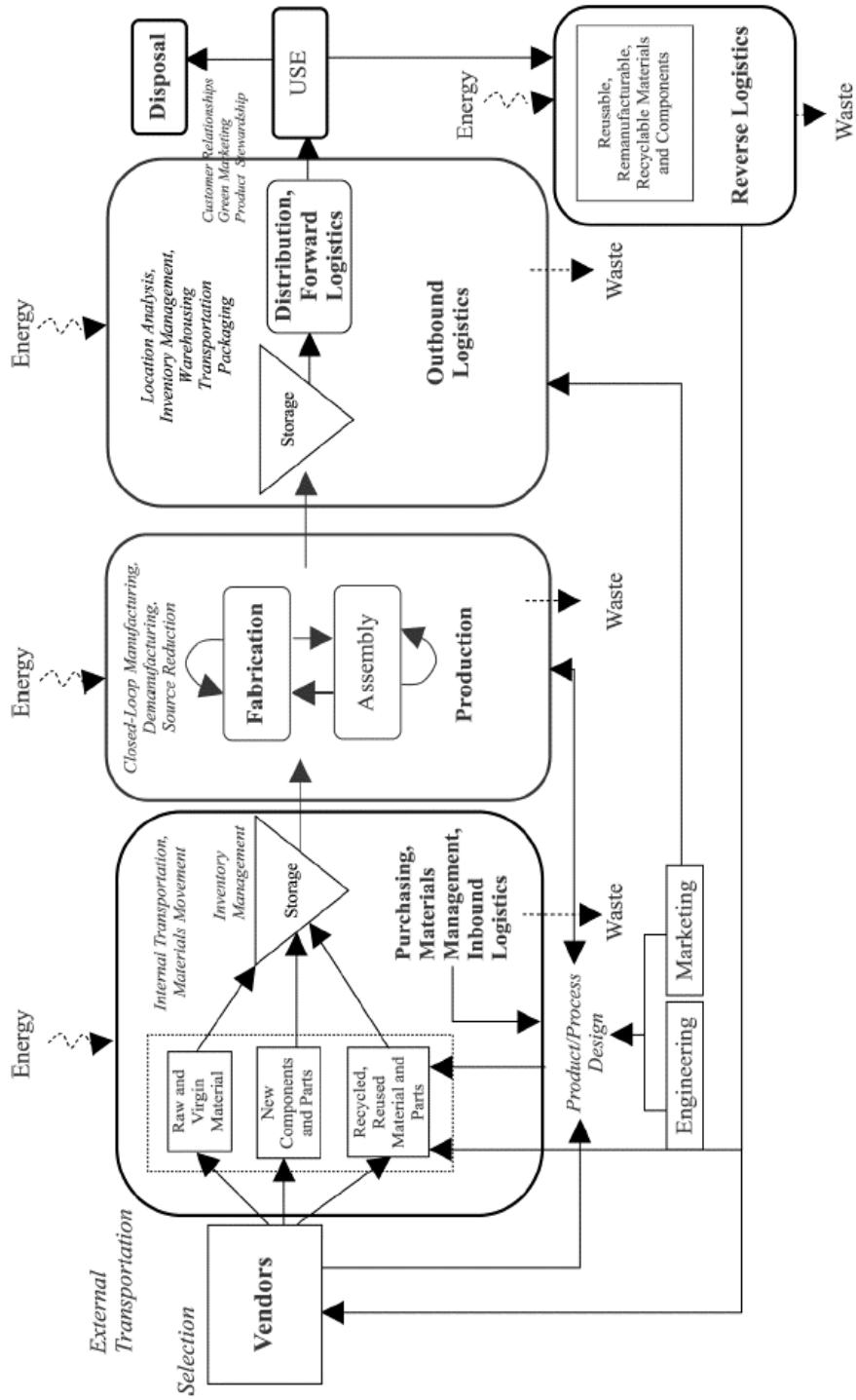

Figure 3. Green Supply Chain model
Source: Hervani, Helms, Sarkis, 2005: 335

4. Analysis of factors determining the development of Green Logistics

The challenges related to the functioning of Green Logistics and Green Supply Chain relate, apart from traditional goals, to: cost reduction, improvement of customer service quality, maximisation of operational profits, implementation of functions related to resource-efficient management and environmental impact (Tundys, 2015: 293). The overriding goal for developing the Green Logistics and Green Supply Chain concepts is to optimise economic benefits in the long term. One of the key specific objectives is to minimise the costs of achieving the assumed or desired environmental goals, e.g.: reducing CO_2 emissions, increasing the level of recycling. The achievement of other specific goals requires, among others, taking actions to reduce the costs of ecological sustainable growth. In Evangelista, Santoro and Thomas' (2018: 1–34) review of research, published in 2010–2016, five main categories of factors important for the development of Green Logistics were identified, i.e.: technological, organisational and financial factors as well as consumers and government authorities (Table 1). The effects of the development of Green Logistics result from interactions in the supply chain occurring between the improvement of environment quality, resource-efficient management of natural resources and the increase of tangible and intangible assets in the economy. The development of Green Logistics has two dimensions: internal and external. The internal dimension concerns organisational culture, quality of human resources as well as environmental and social responsibility of enterprises. The external dimension is related to the expectations of customers, relations with stakeholders, regulatory pressure and support of governing bodies.

The number of enterprises taking into account environmental criteria in the area of: supply chain design, selection of suppliers, physical flows, information and capital flows, as well as the process of storage and transportation continues to grow. In practice, the implementation of projects in the field of Green Logistics requires abandoning the traditional way of conducting current activities. The main task of the company, i.e. the creation and sale of high-quality products, cannot be achieved without taking into account environmental aspects. However, "greening" the supply chain is associated with many difficulties. Green Logistics projects are characterised by a high degree of capital intensity and complexity of their implementation. Moreover, the effectiveness of their implementation is associated with a certain degree of risk and uncertainty. The use of environment-friendly technology is connected with the necessity of implementation of many investment projects which will not be economically profitable in the short term. These activities therefore require a specific approach in the decision-making process in the field

of evaluation of their implementation and selection of appropriate support mechanisms. In the short term, the potential benefits of implementing Green Logistics projects are focused primarily on increasing customer satisfaction and creating ultimate pro-environmental attitudes. Achieving these benefits is important for the gradual proliferation of these solutions, which will result, among others, in an increase in economic profitability and improvement of the natural environment (Gevaers, Van de Voorde, Vanelslander, 2014: 410–411). In the long-term perspective, the effects of these activities should contribute to the growth of the company's competitiveness.

Table 1. Factors, activities and effects of the development of Green Logistics

Factors	Activities	Effects
Technological	– Integration of environmental practices with existing company values – Integration of environmental practices with the company's logistics processes – Research and development	– Improvement of the company's image – Improving the profitability of logistics processes – Increase in the ecological efficiency of the enterprise
Organisational	– Education of employees – Employees' involvement in ecological activities	– Increased environmental responsibility – Development of ecological behaviours
Financial	– Preferential loans – Subsidies – Preferential tax rates	– Increased interest in Green Logistics – Development of ecological projects
Consumers	– Social campaigns – Corporate Social Responsibility	– Increased ecological awareness – Promotion of ecology
Government authorities	– Coordination of activities – Green public procurement – Expenses related to research and development – Environmental regulations for logistic operations	– Increased competitiveness – Improving the quality of the environment – Development of social participation – Legal support for the development of Green Logistics

Source: own elaboration based on Evangelista, Santoro, Thomas, 2018: 10–12.

4.1. Methodology and tools

Achieving the benefits resulting from the implementation of Green Logistics projects requires the development of an action strategy including appropriately matched instruments (Table 2). These activities are characterised by a diversified level of legal, economic, administrative, information, technological and organisational complexity.

Table 2. Degrees of complexity of Green Logistics projects implementation

Degree of economic, technological and organisational complexity			
	High	Technical and adaptive activities: – research and development activity, – reorganising the structure of enterprises, – the staff reorganisation, – reduction of the environment complexity, – environmental expertise, – an efficient communication network in the supply chain.	Activities in the field of technology development: – standardisation of technical specifications, – investment and environmental costs of the development of new technologies, – a friendly impact of production and products on the environment, – managing environmental quality and risk, – a high health level of technologies and products.
	Low	Information and promotional activities: – social campaigns, – cooperation with local communities, – consulting and training, – a common system of preferences and values.	Organisational and legislative activities: – the authorities' strategies for financial support for ecological technologies, – procedures for green public procurement, – exemptions and tax breaks, – rules on the promotion of organic products.
		Low	**High**
		Degree of legal, administrative and information complexity	

Source: own elaboration

The highest level of complexity is presented by activities in the field of development of environmental friendly technologies. At the same time, these activities can be attributed to a high degree of uncertainty and risk. Information and promotional activities characterised by a low degree of complexity have a great potential in terms of effectiveness and efficiency of Green Logistics projects development. As research shows (Bloemhof et al., 2015), a company that calls itself ecologically sustainable cannot forget that its suppliers also have an impact on their responsibility. The company is responsible not only for its activity but also for the entire value chain within which it produces and supplies products or services to consumers (Cossu, 2016: 1524). However, in business practice in Poland, it does not always look so optimistic. According to in-depth interviews, companies thinking about long-term horizons and building values are forced to make short-term decisions. As a rule, projects in the field of Green Logistics are treated as those whose costs are most real and measurable at a given moment, while benefits are usually quite delayed in time. For more complex projects, capturing and quantifying benefits is difficult, which was pointed out as a significant barrier to their implementation. Representatives of eight companies participating in the study emphasised that two issues should be noted while analysing the profitability of Green Logistics projects. Firstly, measuring profitability means monetising, i.e. converting the results

of activities into money. Secondly, the mentioned profitability has two dimensions: profitability for the enterprise and profitability for the environment. The profitability for the environment takes place in four dimensions: economic (G), environmental (E), social (S) and spatial (P). The effects of implementing Green Logistics projects being the subject of the study are presented in Table. 3.

Table 3. Value model for Green Logistics projects

Factors	Value	Indicators of partial actions				Indicators of the direction of partial actions impact				Indicators of the achievement of partial objectives			
		G	E	S	P	G	E	S	P	G	E	S	P
Technological	30	40%	30%	20%	10%	1	1	1	1	6.00	4.50	3.00	1.50
Organisational	20	20%	40%	25%	15%	1	1	1	1	3.00	6.00	3.75	2.25
Financial	20	40%	30%	20%	15%	1	1	1	1	6.00	4.50	3.00	2.25
Consumers	15	20%	45%	30%	5%	1	1	1	1	3.00	6.75	4.50	0.75
Government authorities	15	20%	35%	15%	30%	–1	1	1	0	–3.00	5,25	2.25	0.00
Total	100									15.00	27.00	16.50	6.75

Source: own elaboration

The values assigned to the main activities focusing on the development of Green Logistics projects in Poland made it possible to determine the nature of these activities. It was assumed that the total number of points evaluating the activities under the five factor categories amounts to 100. According to the fuzzy set theory, the sum of percentages for each factor is 100%. These values form a four-level scale of significance of partial actions. The highest of these values indicates the most important partial effect, while the smallest value is the least significant partial effect.

Indicators of the direction of the impact of partial actions are the input variables of the model. They allow for expressing the nature of the impact of partial actions on the implementation of sub-objectives. The character of this influence may be "favourable" (then the indicator of the direction of the influence takes the value "1"), "neutral" (the indicator of the direction of the influence takes the value "0") or "unfavourable" (the indicator of the direction of the influence takes the value "–1"). Implementation indicators of partial objectives play the role of the output variables of the model. Values of indicators for achieving sub-objectives are determined for each of the factor categories and for each sub-objective. They are calculated each time as a product of three factors, i.e. the value of the factor, the value of the relevant indicator of partial actions and the value of the appropriate indicator of the impact direction of these activities.

4.2. Results

Referring to the above-presented description of the quantitative features of the model related to particular categories of factors, it can be stated that by assigning 30 points to technological factors, representatives of enterprises participating in the survey considered them as the most important for the development of the Green Logistics concept in Poland. Indices of partial actions for this factor indicate that it will present the largest, i.e. 40% commitment to achieving economic goals (G). It was considered that the technological factor would contribute in 30% to the achievement of environmental goals (E). In addition, it was assumed that 20% of the value of this factor would translate directly into the achievement of social goals and 10% to the achievement of spatial order.

Indicators of the direction of the impact of partial actions inform about the favourable influence of technological factors on the implementation of all the partial objectives (economic, environmental, social and spatial order). The calculations made with the use of the model allowed for a score evaluation of these influences. A positive contribution made by technological factors amounts to: 6 points for economic goals, 4.5 points for environmental purposes, 3 points for social purposes and 1.5 points for spatial order. The distribution of indications regarding the next two categories of factors, i.e. organisational culture and finances, shows that these factors were considered as quite significant in the study. According to the representatives of enterprises participating in the study, the indicated five main groups of factors have a positive impact on the development of the concept of Green Logistics and Green Supply Chain, ensuring the highest efficiency of achieving environmental objectives.

5. Conclusions

The Green Logistics concept reduces the intensity of exploitation of environmental resources and contributes to cost reduction of running a business. The sources of ecological efficiency of logistic processes are resource-efficient manufacturing technologies, rational management of materials and raw materials, eco-design of products, ecological transport as well as limiting the generation of waste and its effective use. For Poland, the development of Green Logistics is still a major conceptual, technological and financial challenge. The research shows that enterprises are more and more aware of the subject of sustainable development in building their own competitive advantage and creating value in the long term. Often, along with the maturation of the company's organisational culture, there is an increasingly broader understanding and implementation of environmental aspects in logistics. Enterprises, transferring from minimising investment risks to using the opportunities resulting from the implementation of Green Logistics projects, create their own value and at the same value for their customers, and as a result a competitive advantage.

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Ocena czynników wpływających na realizację projektów w zakresie Green Logistics w Polsce na tle koncepcji rozwoju zrównoważonego

Streszczenie: Celem artykułu jest identyfikacja czynników wpływających na realizację projektów Green Logistics oraz zakresu działań podejmowanych przez podmioty gospodarcze na rzecz zrównoważonego rozwoju potencjału logistycznego przedsiębiorstw w Polsce. W opracowaniu podjęto dyskusję na temat strategicznej roli biznesu na rzecz angażowania się w realizację celów z zakresu zrównoważonego rozwoju procesów logistycznych. Stanowi ona rezultat międzynarodowych konwencji i wynikających z nich obowiązków nałożonych na państwo i przedsiębiorstwa. Na podstawie studiów literaturowych oraz analizy danych zastanych zidentyfikowano pięć zasadniczych kategorii czynników determinujących rozwój projektów Green Logistics. W ramach tych obszarów wyłoniono konkretne działania istotne z punktu widzenia przedsiębiorców, które poddano ocenie w wyniku przeprowadzonego pogłębionego wywiadu kwestionariuszowego. Szczególną uwagę zwrócono na kluczową dla rozwoju zielonej logistyki potrzebę wdrażania rozwiązań technologicznych. Podkreślono, że zielona logistyka może stanowić ważny element zrównoważenia gospodarki światowej.

Słowa kluczowe: rozwój zrównoważony, zielona logistyka, zielone łańcuchy dostaw

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