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# COOPERATION OF SMALL AND MEDIUM-SIZED ENTERPRISES WITH OTHER SUPPLY CHAIN PARTICIPANTS IN IMPLEMENTING THE CONCEPT OF GREEN LOGISTICS

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# WSPÓŁPRACA MAŁYCH I ŚREDNICH PRZEDSIĘBIORSTW Z INNYMI UCZESTNIKAMI ŁAŃCUCHÓW DOSTAW WE WDRAŻANIU KONCEPCJI ZIELONEJ LOGISTYKI

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**Summary:** The concept of green logistics meets the expectations of various groups of stakeholders who, being aware of the negative impact of logistics processes on the natural environment, encourage enterprises to start implementing environmentally friendly solutions, thus ensuring the economic efficiency of these processes. The implementation of green solutions takes place in four stages and their advancement increases at each stage. The highest stages require cooperation with other enterprises. The article deals with the subject of undertaking this kind of cooperation by small and medium-sized enterprises in a supply chain. The aim is to identify which chain participants most often establish cooperation in the area of green logistics with these companies in Poland. It was found that the most intense cooperation takes place with a supply chain leader and suppliers. At the highest level of advancement a horizontal cooperation with competitors is also established.

**Keywords:** green logistics, green practices in supply chain, cooperation in supply chain.

**Streszczenie:** Koncepcja zielonej logistyki wychodzi naprzeciw oczekiwaniom różnych grup interesariuszy, którzy mając świadomość negatywnego wpływu procesów logistycznych na środowisko naturalne, oddziałują na przedsiębiorstwa tak, aby zaczęły one wdrażać rozwiązania przyjazne środowisku, zapewniając jednak efektywność ekonomiczną tych procesów.

Wdrażanie zielonych rozwiązań następuje w czterech etapach, na każdym z nich rośnie stopień ich zaawansowania. Etapy najwyższe wymagają podjęcia współpracy z innymi przedsiębiorstwami. W artykule poruszono tematykę podejmowania takiej współpracy przez małe i średnie przedsiębiorstwa w łańcuchu dostaw. Celem było rozpoznanie, z którymi uczestnikami łańcucha przedsiębiorstwa te najczęściej nawiązują współpracę w zakresie zielonej logistyki w Polsce. Ustalono, że najintensywniejsza współpraca zachodzi z liderem łańcucha oraz z dostawcami, a na najwyższym stopniu zaawansowania nawiązywana jest także współpraca horyzontalna z konkurentami.

**Słowa kluczowe:** zielona logistyka, zielone praktyki w łańcuchu dostaw, współpraca w łańcuchu dostaw.

## 1. Introduction

Improving contemporary supply chains, in addition to increasing the efficiency and effectiveness of logistics processes, should also aim to limit the negative impact of these processes on the natural environment. This is driven by the influence of various stakeholder groups – both external and internal. These stakeholders are primarily the government and other legislative institutions, different types of non-governmental organisations and lobbyists, society, suppliers, customers, competitors, supply chain leaders, logistics service providers (external) and owners, managers and other employees of businesses (internal).

The impact of these stakeholders is based on a constantly expanding base of scientific research findings on the effects of anthropogenic environmental changes and is reinforced by the media – more and more often on an international or even a global scale. One of the supply chains' responses to this impact is the use of 'green logistics', which is a concept created at the end of the 20th century. It is implemented in the form of specific green practices used in various logistics processes, mainly the most environmentally damaging ones, i.e. transport and storage.

Businesses may show various degrees of advancement in terms of green logistics, with some of them compelled to move to higher levels, and others inclined to remain at a given level. It is also possible that some companies – for various reasons – may reduce their extent of green logistics solutions. A prerequisite for the complete 'greening of a company' is to establish inter-organisational cooperation in this area with other supply chain partners, which significantly increases the pro-ecological effect of the resulting green practices compared to those used in only one company. There is a research gap in the literature regarding this cooperation, in particular with enterprises from the SME sector. Therefore, this article centers on this issue, aiming to identify members of the supply chain with which small and medium-sized companies in Poland cooperate most often when implementing the concept of green logistics.

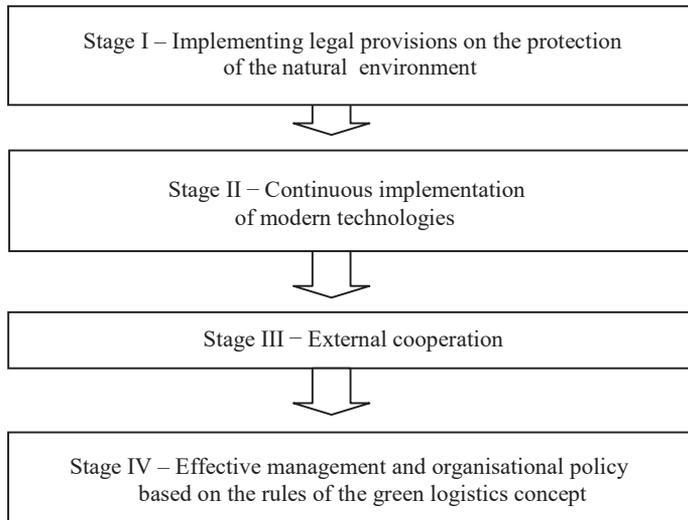
## **2. The essence and development of green logistics in business operations**

Customarily, the emergence of the concept of green logistics is recognised to be the early 1990s, i.e. a period of growing public awareness and responsibility towards issues related primarily to global warming and environmental pollution [Murphy et al. 1996]. The starting point for properly defining green logistics is the correct interpretation of the phrase 'green logistics'. According to Chittyal et al. [2013], it denotes environmentally friendly logistics practices. Rong [2011] wrote that the word 'green' in the concept of green logistics is the epitome of the idea of environmental protection in the field of economic activities. A similar interpretation was presented by Rodrigue, Slack and Comtois [2001], who believe that 'green' is a keyword which signifies environmental aspects in a positive sense. Thus, green logistics guidelines allow us to create logistics systems that are compatible with the natural environment, environmentally friendly and, at the same time, logistically effective. However, the concept of green logistics is still relatively new enough that to this day there is no single, universally accepted definition for it. According to Jedliński [2010]: green logistics is the integrated management of all activities required to move the product along the supply chain to meet the expectations of customers at minimum global cost including also the external costs related to, among others, climate change, air pollution, noise, vibration and accidents. It is generally accepted that it is primarily designed to measure and reduce the negative impacts of the overall logistics activities on the ecology, and the parameterization of the effects increases the state of awareness of the consequences of the actions taken, and at the same time gives the possibility of indicating potential areas for optimization. In the opinion of McKinnon et al. [2015], 'green logistics is a form of logistics which is expected to be not only environmentally but often socially friendly and economically functional'. According to Zowada [2019], green logistics is a concept for managing the flow of material and the accompanying flow of information, starting from the design stage, in such a way that the ecological and economic goals of the organisation can be achieved.

Regardless of the adopted method of defining green logistics, it should be emphasised that compared to traditional logistics, the array of goals that determine the processes of managing material and information flows has been broadened in green logistics, therefore we are talking about economic and ecological goals. In terms of economic goals, the cost reduction of the implemented processes coming from the increased economic efficiency and the improved image and competitive advantage are usually stressed. Among the ecological goals, the decrease of the widely understood burden of logistics processes on the natural environment by creating less pollution and using less resources in a more rational way is usually listed [Porter, Linde 1995; Rao, Holt 2005; Lai, Wong 2012; Pazirandeh, Jafari 2013].

Although over 25 years have passed since the first mention of green practices in the context of applied logistics processes, the concept of green logistics is still poorly

recognised in a wide range of enterprises. In many cases the reason for this is the lack of managers' knowledge about the assumptions of the concept itself, but also about the methods of its implementation [Zowada 2018]. In order to facilitate the application of green solutions in economic practice, the literature on the subject indicates four stages of development of green logistics in business operations (Figure 1).



**Fig. 1.** Stages of green logistics development in business operations

Source: [Sarkis et al. 2004; Vasiliauskas et al. 2013].

In the first stage of the development of green logistics, the implementation of existing legal provisions regarding environmental protection is postulated in the operations of enterprises. If the process of implementing the above-mentioned concept ends at this stage, it is said that the company has adopted a reactive attitude, and thus has reached a certain minimum, which it was most likely mandated to fulfil. Undertaking actions concerning the continuous implementation of modern technologies, and thus realising the assumptions of the second stage, increases the degree of the 'greening' of the enterprise. We are referring to, for example, IT solutions which enable the better use of the company's vehicle fleet, more efficient management of warehouse space, etc. These solutions also include modern transportation and propulsion technologies (low-emission car engines that meet the highest standards of permissible emissions, for example). Therefore it be said that the development of green logistics in business operations is not possible without investment in modern technologies.

In the third stage it was highlighted that one cannot speak of a high level of 'greening' of the enterprise without the cooperation of external entities. In practice, many logistics processes are incorporated with the participation of at least two subsequent links in the supply chain: for example the implementation of a new

distribution system or a new concept of the supply system. According to van Hoek [1999], green logistics implemented at company level is often no longer enough, as it is necessary to adopt the perspective of the entire supply chain. For example, the packaging design for a specific product will translate into the needs and possibilities for the effective use of storage space or vehicle loading surfaces in all subsequent links in the supply chain. Moreover, the choice of material from which the packaging will be made will influence the way it will be managed after the expiration of its useful life with the end user.

The last stage of development of green logistics is associated with the broad adaptation of the green principles to the company's operations. In this case, the assumptions of the concept of green logistics become part of the overall management processes enforced in the company, allowing the highest level of 'greening' to be achieved.

### **3. Cooperation in supply chains in the field of green logistics**

When companies work together at a specific time to reach either a common goal or their own autonomous goals, we are dealing with cooperation between them. Cooperation is a multidimensional issue, and so, depending on its direction, three forms of cooperation are distinguished in the literature: vertical, horizontal and diagonal [Allam et al. 2011]. Vertical cooperation is the most frequent (and the most frequently studied) because it takes place between entities directly connected with the flow of goods in the supply chain, thus necessitating an intensive, direct exchange of information which varies in nature. This exchange of information is the natural seed of cooperation and, basically, it constitutes the entire supply chain. Horizontal cooperation takes place between enterprises at the same stage of the supply chain flow, for example, between two suppliers of the same recipient, but they do not have to be competitors. Diagonal cooperation, sporadically described in the literature, occurs in more complex supply chains with a network structure. Companies at various stages of the flow of goods cooperate here. These companies are not connected by a direct flow, for example by one of the suppliers of a given enterprise cooperating with one of its recipients. We can also talk about horizontal or diagonal cooperation when it occurs between participants in different supply chains. It should be added that with the emergence of 3PL and 4PL logistics operators, research increasingly focuses on multi-entity cooperation in the supply chain (from triads to extensive networks), from this perspective, multidirectional cooperation takes place.

With regard to duration, we can distinguish incidental cooperation and partnership. The former is short-term and involves carrying out a specific transaction; it does not usually go together with much openness of enterprises to mutual interactions and a high level of trust that would allow evolution in the direction of the second, long-term form, i.e. partnership. Multi-area mixed cooperation between enterprises in the supply chain is also possible, combining both of the forms [Meidutė-Kavaliauskiene

et al. 2012]. It is usually concentrated on achieving several common objectives. Some authors also differentiate between the concepts of cooperation and collaboration as defining two different forms of cooperation (although sometimes these concepts are treated as synonyms). In collaboration, enterprises try to achieve their own autonomous goals, mainly thanks to knowledge sharing, and they work together on a common goal. Finally, cooperation between enterprises can be formal – when it is based on a signed agreement – or informal.

According to Świtała et al. [2017], the most important premise for establishing and developing cooperation between enterprises in the supply chain is to reduce the costs of operations and logistics processes. Further on, the authors mention the decrease of fixed assets, shortening the flow of goods, the ability to handle a larger number of orders, more access to information on other stages of the flow of goods in the chain, improving timeliness and completeness of deliveries and ensuring a damage-free operation. All this is to translate into increased satisfaction of the end supply-chain customers. The rationale of reducing the negative impact of logistics processes on the environment is no longer so strongly motivating for companies to undertake and develop cooperation. Therefore, green practices are often developed by supply chain leaders and logistics operators and then imposed, suggested or at least promoted to other partners, including businesses from the SME sector.

Examples of green practices resulting from cooperation between companies in supply chains and described in the literature include:

- practices initiated by supply chain leaders – reducing the weight of bottles for various drinks (Coca-Cola), eliminating wooden pallets from logistics operation as part of Iway Standards (IKEA), increasing the use of rail and sea transport, reducing empty runs and reducing the use of cardboard packaging (Volkswagen and GM), an increase in the share of low-emission transport and a decrease in using protective materials (Fiat Group) [Nunes, Bennett 2010; Nylund 2012; Ocicka 2014],
- practices initiated by logistics operators – reporting on CO2 emissions, environmental consulting and training for partners, low-emission transport on the first and last mile, tree planting (Deutsche Post DHL Group), implementation of the GefBox returnable packaging system (GEFCO), pallet pooling to reduce carbon footprint (CHEP), minimization of empty runs thanks to a central dispatch room, better use of the loading space of transport vehicles of various branches and training for partners (DB Schenker) [Płaczek 2012].

#### **4. Methodology of empirical research**

In order to identify the entities with which small and medium-sized enterprises most often establish cooperation in the area of green logistics, a survey was conducted in June and July 2017 in a group of 200 such enterprises operating in Poland. Invitations to participate in the study were sent to owners and managers by employees of

the Research and Knowledge Transfer Centre at the University of Economics in Katowice using an electronic version of the questionnaire available online.

Due to the inability to conduct a random selection for financial and organisational reasons, we decided to use one of the most well-known and popular types of non-random selection – recommended by A. Sagan [2016] – namely the quota selection, the application of which requires knowledge of the structure of the general population in terms of control variables which define this structure. In this case, the number of individual subgroups distinguished on the basis of selected control variables is proportional to their number in the general population. In other words, based on the available data, the structure of the general population of small and medium-sized enterprises operating in Poland was reflected in the quantified sample. It should be added that the selection of the sample in a quantitative manner was made on the basis of combined characteristics. This means that, taking into account the size of the enterprise expressed by the number of employees and the dominant type of business according to the PKD (Polish Classification of Businesses), the sample reflects the structure of the general population of small and medium-sized enterprises operating in Poland, which takes into account the proportions between the sub-groups of enterprises distinguished on the basis of these two characteristics. As a consequence, 157 small and 43 medium enterprises representing all provinces in Poland were included in the examined group of enterprises.

Another important element of the survey methodology was the proper selection of methods for statistical analysis of the data. To achieve the presupposed goal of the article, measures of community structure and the classification tree method were used.

## 5. Research results

The development of green logistics in business operations increasingly requires businesses to undertake horizontal or vertical cooperation with other members of the supply chain. Therefore, cooperation with suppliers, customers, the supply chain leader (who can also act as a supplier or customer at the same time), competitors or logistics service providers is important.

The research accounted for the type of business conducted by the enterprises surveyed and the degree of advancement of solutions used in the field of green logistics, understood as the stage of development of green logistics of the studied small and medium-sized enterprises. The selection of both criteria is not accidental. As research by Zowada [2019] has shown, both the type of business and the stage of development of green logistics in the business operations significantly differentiate the impact of individual stakeholder groups on the development of green logistics in small and medium-sized enterprises in Poland. On this basis, the authors speculate that in the case of cooperation in the field of green logistics as well, these two criteria differentiate the participants with whom the surveyed small and medium enterprises will cooperate.

In the case of the type of business conducted by the surveyed enterprises, the authors' suppositions were confirmed. The type of business differentiates the entities with which the surveyed enterprises cooperate in the field of green logistics (Table 1).

**Table 1.** Cooperation of the surveyed enterprises in the area of green logistics vs type of business conducted

Intentional cooperation in the area of green logistics is undertaken with:	Types of business				
	Production	Construction	Trade	Transport and warehouse management	Other services
Suppliers (who are not supply chain leaders)	3.0	2.0	3.0	2.5	2.0
Competitors	2.0	2.0	2.0	3.0	1.0
Supply chain leader	3.0	2.0	3.0	3.0	1.0
Recipients (who are not supply chain leaders)	2.0	2.0	3.0	2.5	2.0
Logistics service providers	2.0	3.0	2.0	3.0	1.5

Source: own research; respondents provided answers on a scale of 1 to 5, where 1 meant: we do not cooperate, and 5: we cooperate to a very large extent. The table presents the median of the answers given.

According to the results, enterprises that provide services in the field of transport and storage undertake intentional cooperation in the area of green logistics to the largest extent. The lowest results were recorded in the case of small and medium enterprises offering other services. For the first group, the results were predictable. These companies offer solutions that enable them to adopt the principles of green logistics. Cooperation with clients, who can constitute any link in the supply chain, can take place, for example, in the field of transport processes in such a way as to achieve the desired ecological and economic goals, e.g. reaching the desired level of CO<sub>2</sub> emissions for all deliveries carried out in the supply chain (an example of the IWAY standard implemented at IKEA). In the case of manufacturing companies, construction companies and trade companies, the results obtained were at a similar level. Generally speaking, it can be said that the cooperation of the surveyed small and medium-sized enterprises with other participants of the supply chain is moderate (the highest median of the answers given is 3). Moreover, it is worth emphasising that the highest results were obtained in the case of cooperating with the supply chain leader (enterprises engaged in production and commercial activities as well as those operating in the field of transport and storage), and the second highest was with suppliers.

Considering the degree of advancement of the solutions used in the field of green logistics, these results confirmed that at the third stage of development of green logistics in the operation of enterprises, there is an intensive development of intentional

cooperation with other participants of the supply chain (Table 2). Moreover, it is worth noting that in the 4th stage, i.e. in the case of enterprises that have achieved the highest possible level of development of green logistics (so-called 'green enterprises'), cooperation with the supply chain leader obtained the highest scores.

**Table 2.** Cooperation of the surveyed enterprises in the area of green logistics vs stages of green logistics development

Intentional cooperation in the area of green logistics is undertaken with:	Stages of green logistics development			
	I	II	III	IV
Suppliers (who are not supply chain leaders)	2.0	2.5	3.0	2.0
Competitors	1.0	2.0	2.5	3.0
Supply chain leader	1.0	3.0	3.0	4.0
Recipients (who are not supply chain leaders)	2.0	3.0	3.0	2.0
Logistics service providers	1.0	2.0	3.0	3.0

Source: own research; respondents provided answers on a scale of 1 to 5, where 1 meant: we do not cooperate, and 5: we cooperate to a very large extent. The table presents the median of the answers given.

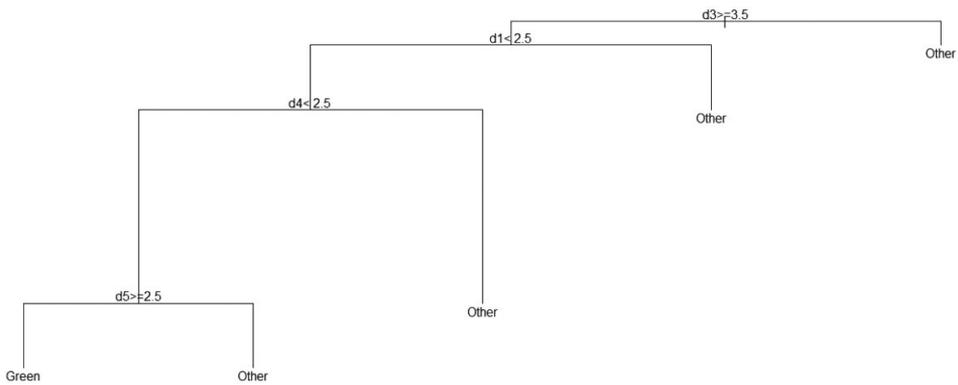
In order to confirm the observations regarding the highest scores on the cooperation between green enterprises and the supply chain leader, the authors used the classification tree method. This method consists of dividing the set of examined objects into homogeneous classes. As a result, a set of classification rules is produced allowing the examined objects to be assigned to a particular class. In the case of the authors' research, we divided the surveyed enterprises into two classes (green and other). Green enterprises were included in the 4th stage of development of green logistics. The remaining enterprises (other) comprised companies that were at earlier stages of the development of green logistics, i.e. I, II or III. The purpose of the classification tree creation procedure was to identify the rules by which the surveyed enterprises belonged to one of the two classes, taking into account the nature of their cooperation with other participants in the supply chain in the area of green logistics. The classification tree resulting from this modelling is presented in Figure 2.

The constructed classification tree shows very good compatibility with the data. The classification error of this model was only 3.5%, which means that the classification rules correctly identify to which of the two separate classes 96.5% of the surveyed enterprises belonged. From the graphic form of the tree (following the edges of the tree from the top down), one can read one rule of belonging for enterprises in the class marked as green, and four rules of belonging to the class marked as other. The rule of belonging to the class marked as green says that these are enterprises which undertake at least extensive cooperation with the leader of the supply chain, which cooperate at most to a limited extent with suppliers and recipients and which engage in cooperation with logistics service providers to at least a moderate extent.

**Table 3.** Features of the surveyed enterprises used in the classification tree construction procedure

Intentional cooperation in the area of green logistics is undertaken with:		where:				
		1. We do not undertake any cooperation 5. We cooperate to a very large extent				
1	Suppliers (who are not supply chain leaders)	1	2	3	4	5
2	Competitors	1	2	3	4	5
3	Supply chain leader	1	2	3	4	5
4	Recipients (who are not supply chain leaders)	1	2	3	4	5
5	Logistics service providers	1	2	3	4	5

Source: own research.



**Fig. 2.** Classification tree

Source: own research.

The results confirmed the need for the small and medium-sized enterprises we surveyed to engage in targeted cooperation with the supply chain leader in the area of green logistics in order to be able to achieve the highest level of development of green logistics and become ‘green businesses’.

## 6. Conclusion

Motivation (also financial motivation – as indicated in [Mafini, Muposhi 2017]) and specific actions taken after implementing solutions mandated by legal regulations are of key importance in the development of green logistics for the surveyed small and medium-sized enterprises. If the companies then decide or are obliged by other participants in the chain to use new technologies focused on green logistics, they will start vertical cooperation, usually with the chain leader, but also with customers (the need for cooperation with the latter is also indicated in [Epho, Mafini 2018]).

Technologies supporting green logistics (mainly transport and packaging) generate high costs and require technological and organisational preparation on the part of SMEs, therefore their implementation creates exit barriers. This is conducive to building a stable, long-term partnership. New technologies also produce new opportunities in other areas of the supply chain. In order to utilise them, small and medium-sized enterprises are also starting to cooperate with suppliers and logistics service providers, thus reaching the third stage of green logistics development. Studies have shown that then, in addition to long-term vertical cooperation, some SMEs decide on horizontal cooperation – with their competitors (in this case, however, as indicated in [Mangla et al. 2015], various types of risk arising from this kind of cooperation should be taken into account). At the same time, their cooperation with the supply chain leader is strengthened.

Among the enterprises in the SME sector, the ones that most often cooperate in the field of green logistics are those that provide transport and storage services, i.e. they are logistics service providers themselves. Partnering with them can be cooperative and collaborative because they can use the resulting green practices in other supply chains, contributing to the diffusion of green logistics throughout the economy.

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