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ENVIRONMENTAL RESPONSIBILITY IN LOGISTICS ACTIVITIES OF SMALL AND MEDIUM-SIZED ENTERPRISES

Abstract

Logistics processes are a significant source of pollution of the natural environment. The fact that they are present in the activities of all enterprises means that also logistics processes implemented by smaller enterprises are not neutral to the natural environment. The article identifies the state of awareness of SME managers regarding the impact of logistics processes on the natural environment and classifies the surveyed SMEs in terms of the scope of implementation of green logistics practices.

Keywords: green logistics, environmental protection, SMEs, classification trees

Introduction

A wide-ranging discussion on the impact of logistics processes on the natural environment started in the world literature in the last decade of the last century. One of the first publications that explicitly indicated a new direction in this field was the special issue of the *International Journal of Physical Distribution & Logistics Management,* devoted entirely to the environmental aspects of logistics (Wu, Dunn, 1995; Murphy, Poist, 1995). Since that time, it has been possible to observe a rapid increase in the number of studies and research works devoted to the environmental aspects of logistics operations of enterprises. As a consequence, the concept of green logistics has appeared in the literature, the meaning of which has broadened the traditional logistics concept to include the environmental dimension (Sbihi, Eglese, 2007; Srivastara, 2007; McKinnon, 2010; Hentschel, 2012; Lai, Wong, 2012; Tacken, 2014; Kumar, 2015; McKinnon et al., 2015).

The starting point to correctly define 'green logistics' is correct interpretation of the phrase 'green logistics'. According to some authors, it means environment-friendly logistics practices (Chittyal et al., 2013). Rong writes that the word 'green' in the concept of 'green logistics' is the embodiment of the idea of environmental protection in the area of economic activities (Rong, 2011). A similar interpretation has been presented by Rodrigue, Slack and Comtois who think that 'green' is the key word regarding environmental aspects in a positive sense, and hence, the guidelines for 'green logistics' allow creating logistics systems compatible with the natural environment, friendly to this environment and logistically efficient at the same time (Rodrigue et al., 2001).

Nonetheless, irrespective of the way of interpreting the concept itself, for which no generally accepted definition has been offered to date, it should be emphasized that green logistics is a concept that applies not only to the largest enterprises. In the author's opinion, the fact that logistics processes take place in all enterprises means that also logistics operations carried out by smaller companies are not neutral to the natural environment. In this context, the aim of the article is to identify the state of awareness of SME managers regarding the impact of logistics processes on the natural environment. Moreover, an attempt will be made to classify the examined SMEs in terms of implementation of green logistics practices.

An empirical survey was conducted on a group of purposefully selected enterprises belonging to the Polish SME sector, using the electronic survey form in order to achieve the assumed research goal[1]. The research tool was developed based on an analysis of the world literature whereby it was possible to create a list of the most popular green logistics practices (Colicchia et al., 2011; Lau, 2011; Lin, Ho, 2011; Zhang et al., 2014). The empirical research was carried out at the turn of November and December 2015. A total of 59 complete answers were received, there was no dominant share of one enterprise type in the sample in terms of employment. The received answers were subjected to statistical analysis, using the methods and tools of descriptive statistics, the rho-Spearman correlation analysis and the classification trees method.

1. Impact of logistics processes on natural environment in small and medium-sized enterprises

The conducted empirical studies have indicated moderate or high significance of environmental protection issues during the implementation of logistics processes in the surveyed enterprises (47% and 14% of the answers, respectively). Environmental issues were of little or no significance to 12% of the respondents in total. Interestingly enough, in the prospect of the forthcoming five years, almost 3/4 of the respondents predict that the importance of environmental protection issues in the studied area will be growing.

[1] The survey was commissioned to the Research and Knowledge Transfer Centre at the University of Economics in Katowice.

Nevertheless, irrespective of how the impact of logistics processes on the natural environment is perceived in terms of significance, the respondents have unambiguously confirmed the fact that transport, storage and packaging waste management processes that are in place in their enterprises have a negative impact on the natural environment (Figure 1).

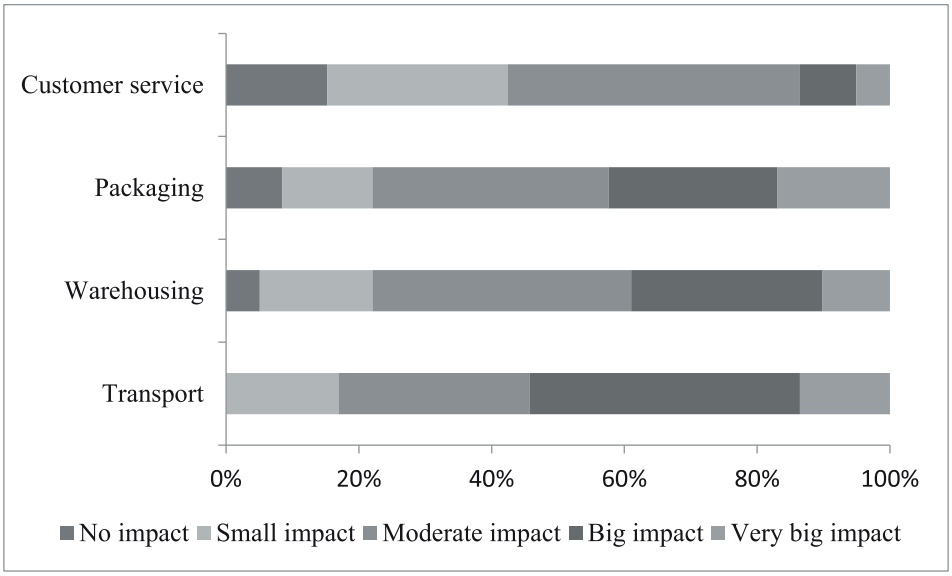

Figure 1. Impact of selected logistics processes on the natural environment in the surveyed SMEs
Source: (own elaboration)

According to the expectations, the greatest negative impact on the natural environment in the surveyed enterprises comes from the transport processes and operations related to the packaging waste management in the broad sense of the term. Nevertheless, the respondents can see a significant potential for reducing the negative impact of logistics processes on the natural environment in all the processes carried out by them (in particular in respect of transport operations) – Figure 2.

The performed analysis of the correlation between the impact of individual logistics processes on the natural environment and the potential for reducing this effect estimated by the respondents have shown a moderate positive correlation in all cases (Table 1). This means that the assessed potential for reducing the negative impact of logistics processes on the natural environment increases along with the increasing assessment of such negative impact.

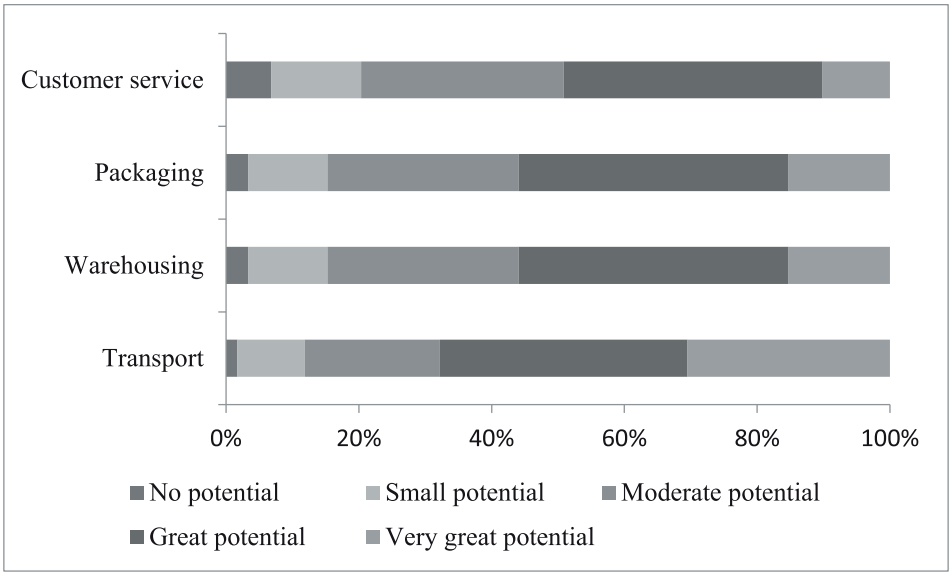

Figure 2. The potential for reducing the negative impact of logistics processes on the natural environment in the surveyed SMEs
Source: (own elaboration)

Table 1. Table of correlation between the impact of individual logistics processes on the natural environment, and the assessment of the potential for reducing this impact in the surveyed SMEs

	P1	P2	P3	P4
W1	,512**			
W2		,427**		
W3			,464**	
W4				,611**

** the correlation is significant at 0.01 (double-sided)
Legend:

Impact on natural environment	Potential for reducing negative impact	Logistics process
W1	P1	Transport
W2	P2	Warehousing
W3	P3	Packaging
W4	P4	Customer service

Source: (own elaboration)

2. Green logistics practices in surveyed small and medium-sized enterprises

In the author's understanding a catalogue of the so-called green logistics practices comprises a set of logistics activities and processes which are assumed to implement the guidelines of the green logistics concept, and hence, they are compatible with the natural environment being at the same time effective – creating the economic value. An analysis of the literature devoted to green logistics allows creating a comprehensive catalogue of activities, in the broad sense of the term, undertaken to reduce the negative impact of logistics processes on the natural environment. Nonetheless, there has been no consistent division line for these practices to date. When classifying green logistics practices, many authors still use the classical division of logistics processes by adding the adjective 'green' to each of these processes. Consequently, it is the terms: green transport, green storage, green packaging waste management, etc. that are used. (Chang et al., 2008; Lau, 2011). Due to the key share of transport processes in the environmental pollution, all the implemented green logistics practices can also be divided into those related to transport practices and all other practices (Martinsen, Huge-Brodin, 2010). On the basis of the analysed world literature, the author has identified a list of 10 most often indicated green logistics practices. These are the following:

– (A) use reusable packaging;
– (B) use alternative propulsion technologies and alternative fuels;
– (C) upgrade the fleet towards environmentally friendly vehicles;
– (D) optimise the routes;
– (E) use intermodal transport;
– (F) train drivers in 'eco-driving';
– (G) upgrade the technologies used in warehouses towards energy-efficient solutions;
– (H) optimise the use of warehouse space;
– (I) reduce paper documents;
– (J) apply the 'green' criteria in selecting suppliers/business partners.

The results of the conducted empirical research have shown that not all green logistics practices are equally popular in the activities of the surveyed SMEs (Figure 3).

The most frequently indicated green logistics processes in the surveyed SMEs include: optimisation of routes and optimisation of storage space utilisation. Not too many fewer answers were received for practices related to the use of reusable packaging and reduction of paper documents. The other solutions were much less popular in the group of the surveyed SMEs. For example, the very little significance attached to the green criteria in selecting suppliers/business partners may result from the fact that the so-called green supply chains where these criteria in selecting business partners are of key importance have only started to appear in the Polish conditions.

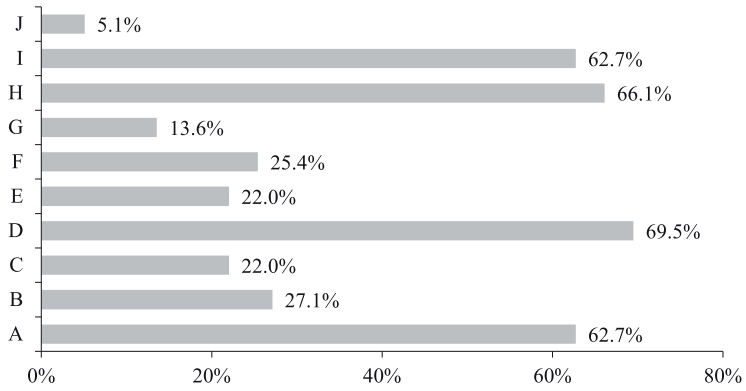

Figure 3. Scope of green logistics practices applied in the surveyed SMEs
Source: (own elaboration)

3. Classification of surveyed small and medium-sized enterprises

In the first step, based on the answers to the question about green logistics practices implemented by the surveyed enterprises, the author identified two types of enterprises. The first group (38 respondents) are *Green* enterprises implementing at least one of the following green logistics practices (B, C, E, F, G, J). The second group (21 respondents) are *Grey* enterprises that do not follow any of the above listed practices. In the second step, the author was looking for an answer to the question whether it was possible to describe the differences between the selected types of enterprises using other features. Table 2 presents a list of features distinguished based on an analysis of the literature (Murphy, Poist, 1995, 2000; Zhu, Sarkis, 2007; Lin, Ho, 2011; Carbone et al., 2012; Kumar, R. Chandrakar, 2012; Wu et al., 2012; Glover et al., 2014), which were analysed using the classification trees method (Breiman et al., 1984). The classification tree created an a result of the modelling is shown in Figure 4.

The classification error of the constructed model is 3%, which means that the classification rules correctly identify the class membership of 97% of the surveyed enterprises. The graphical form of the model shows that 8 rules for enterprises to belong to the Green group are identified. The shortest of the rules is that these are enterprises whose annual revenues do not exceed PLN 5 million (1 in answer to Q2) and they are suppliers of semi-finished products (1 in answer to Q6.2). Another rule, which can be derived from the right side of the tree is that these are enterprises with the annual revenues not exceeding PLN 5 million (1 in answer to Q2), at the same time, these enterprises are not suppliers of semi-finished products (2 in answer to Q6.2), but they have implemented ISO 14001 (1 in answer to Q.7). By analogy, the remaining 6 rules for the surveyed enterprises to belong to the *Green* group can be defined.

Table 2. The set of features used for classification-trees analysis

Q1. Employment		Yes	No
1	Micro	1	2
2	Small	1	2
3	Medium	1	2
Q2. Annual sales			
1	(0–5 million)		
2	(5–10 million)		
3	(10–50 million)		
4	(50–100 million)		
5	(100–300 million)		
6	(300–500 million)		
7	(500 M–1 billion)		
8	>1 billion		
Q3. Type of enterprise		Yes	No
3.1	Manufacturing	1	2
3.2	Trade	1	2
3.3	Services	1	2
Q4. Industry		Yes	No
4.1	Construction	1	2
4.2	Automotive	1	2
4.3	Pharmaceuticals and cosmetics	1	2
4.4	Raw materials and fuels	1	2
4.5	Food products	1	2
4.6	Chemical	1	2
4.7	Wood and paper	1	2
4.8	Electrotechnical	1	2
4.9	Machine	1	2
4.10	Metal	1	2
4.11	Clothing	1	2
Q5. Position in the supply chain		Yes	No
5.1	Indirect supplier of supply chain leader	1	2
5.2	Direct supplier of supply chain leader	1	2
5.3	Supply chain leader	1	2
5.4	Direct customer of supply chain leader	1	2
5.5	Indirect customer of supply chain leader	1	2
Q6. Position in the supply chain		Yes	No
6.1	Supplier of raw materials	1	2
6.2	Supplier of semi-finished products	1	2
6.3	Supplier of finished products	1	2
Q7. Implemented ISO 14001		Yes	No
7	ISO	1	2
Q8. Implemented CSR		Yes	No
8	CSR	1	2

Source: (own elaboration)

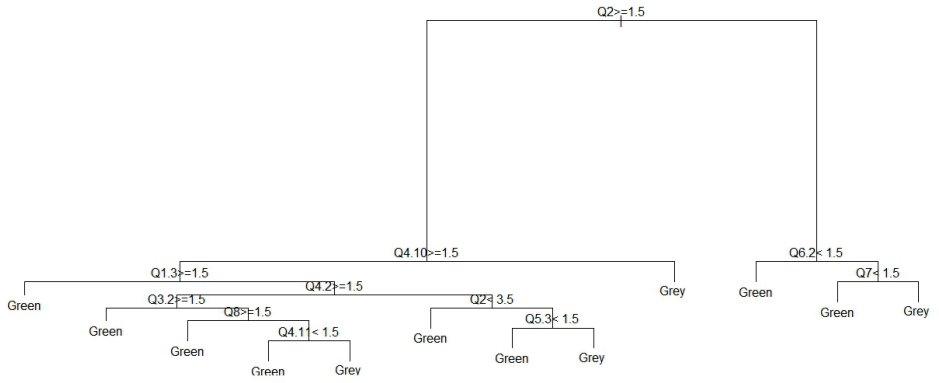

Figure 4. Classification of surveyed SMEs – classification tree
Source: (own elaboration)

Conclusions

The conducted research has shown that managers of the surveyed enterprises are aware of the negative impact of logistics processes on the natural environment and they can see the potential for reducing this impact, especially in the area of transport operations and packaging waste management in the broad sense of the term. In the prospect of the forthcoming years, according to the respondents, the importance of environmental protection in the design and implementation of logistics processes is expected to grow. Environmental awareness of managers of the surveyed SMEs is not always reflected in specific activities, as demonstrated by the results of the analysis carried out using the classification trees method. In addition to *Green* enterprises, quite a large group of *Grey* enterprises has been identified, i.e. enterprises that have not implemented even one green logistics practice. In consequence, the author is of the opinion that the basic motives for the development of green logistics practices in small and medium-sized enterprises should be identified taking into account, for example, such variables as: the size of enterprises, the industry in which these enterprises operate, the role they play in the supply chain, or their place in the supply chain. Therefore, it is postulated to undertake further research towards the possibility of broader development of the concept of green logistics in SMEs. The following specific premises indicating this necessity should be mentioned:

– the ever-growing role and importance of small and medium-sized enterprises in the modern economy;
– the rapid growth of the importance of issues related to environmental protection and the principles of sustainable development in logistic strategies of companies

and the creation of the so-called green supply chains the participants of which are also small and medium enterprises;
– the insufficiency of research and scientific studies on the implementation of the concept of green logistics in small and medium-sized enterprises.

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