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FACTORS INFLUENCING THE APPLICATION OF GREEN LOGISTICS: FINDINGS FROM THE LITHUANIAN LOGISTICS CENTER

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Abstract: The transition to green logistics (GL) and application of the GL practices, besides other solutions, are aimed at abatement of the negative environmental effects and compliance with the European Green Deal objectives. Nonetheless, the GL practices are not usually manifested in the companies' activities. The aim of this article is to identify the drivers and barriers of application of the GL and verify their manifestation by using the case of a logistics centre in Lithuania. For this purpose, the methods of systematic scientific analysis of literature and qualitative research were employed. Based on the scientific literature analysis, the internal and external factors influencing the application of GL were identified. They included the costs, efficiency, image, clients, competitors, and regulation compliance. The majority of the factors may act as drivers or barriers of application of the GL in corporate practices. The manifestation of the drivers and barriers was empirically verified and the GL practices implemented were identified by the qualitative study. The form of a semi-structured interview was used for the qualitative study by using the case of a logistics centre in Lithuania. According to the findings of the empirical study, positive image, reduction of financial costs, and regulation compliance were the drivers of application of the GL practices. Meanwhile, the need for substantial initial investments, lack of technical expertise, challenges related to employee engagement, and lack of interest of the long-term partners were considered as the barriers.

Key words: green logistics, driving factors, green logistics practices, barriers, logistics center

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Introduction

Logistics and the entire supply chain have recently been under the strong influence of the sustainable development principles. Business organizations are exploring innovative methods that would help organize and coordinate all the logistics processes in a more environmentally friendly way. Respective redefinition of the environmental goals and implementation of the appropriate projects to reduce the environmental pollution, including application of the GL practices in the activities, are expected of the companies.

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For the purpose of assessment of the GL application, it is important to take into account the statistical data that represent the existing situation in Lithuania and Europe. The assessment of the situation in Lithuania in the recent five years has shown that the transport and warehousing sector has been growing consistently in all areas, such as sales abroad, investment into material assets, new road tractor fleet, number of jobs and, respectively, the share of taxes paid into the state budget (Verslo žinios, 2021).

Lithuania is the EU's leader by contribution of the transport and warehousing sector into the state budget, accounting for about 13% of the total gross domestic product (GDP). Road cargo transport accounts for the half of the figure (Verslo žinios, 2021). According to the Statistics Lithuania (2020), the revenues of the transport and warehousing service sector were growing consistently. According to the preliminary data, the revenues of the transport and warehousing sector demonstrated record growth in 2021, which was about 20% compared to 2020 and about 15% compared to 2019. Hence, this sector has remained one of the major drivers of the economy. At the same time, growth in cargo turnover for all transport modes could also be observed in Lithuania. According to the preliminary data, this indicator has grown by 3.7% in the recent year compared to 2021 and by 6.9% compared to 2020.

The above figures suggest that the logistics volumes have been growing in terms of both sector revenues and turnover of the transported cargo. This is largely due to the economic growth that propels high consumption of goods and the globalization that has led to massive global flows of goods. As a result, the logistics activities are one of the major sources of pollution (Baah et al., 2020, Khan, 2019; Zowada, & Niestrój, 2019; Aldakhil et al., 2018; Ibrahim et al., 2018). Hence, it is highly important to encourage the general public and business to comply with the environmental principles in order to contribute to abatement of the negative environmental effects. This shows the significant role of the GL and the necessity to implement the GL practices in the companies' activities.

It has been emphasized in the scientific literature (Richnák et al., 2021, Vienažindienė et al., 2021; Baah et al., 2020, Karaman et al., 2020; Trivellas et al., 2020; Centobelli et al., 2020; Zowada et al., 2019) that application of the GL practices is one of the key tools for promotion of sustainability, abatement of the negative environmental impacts, and compliance with the European Green Deal goals both in the economic, social, and environmental aspects. A lot of researchers (Richnák et al., 2021; Rakhmangulov et al., 2018; Trivellas et al., 2020; Vienažindienė et al., 2021; Zowada et al., 2019) recognize the diversity of the GL practices, such as green transport, green warehousing, green packaging, green management, logistics data collection and processing, and waste management. Certain authors (Karaman et al., 2020; Khan, 2019; Richnák et al., 2021; Patra, 2018) tend to associate application of the GL practices with the companies' aim to improve own competitiveness and image, reduce certain financial costs, etc. Nonetheless, the scarce manifestation of the GL in the corporate practices suggests that the managers

at the logistics companies have a limited view towards the benefits of green practices.
The growing need to address the environmental issues and apply the GL practices in corporate activities more actively has inspired the authors of the article to conduct a more comprehensive analysis of the factors influencing application of the GL and the empirical study of the situation by using the case of a logistics centre in Lithuania. The aim of the article is to identify the drivers and barriers of application of the GL and verify their manifestation by using the case of a logistics centre in Lithuania.

Literature Review

Logistics is associated not only with the economic benefit, but also direct environmental impact. Transport, warehousing, packaging, waste management, and other logistics processes use the equipment that contributes directly to the global warming due to the harmful emissions causing the greenhouse gas (GHG) effect. They also lead to water and air pollution, heavily rely on fuel, etc. Hence, the concept of *green logistics* was coined with the aim to reduce the environmental damage while maintaining or even increasing the economic benefit.
Definitions and understanding of the GL differ across the scientific literature. Nevertheless, they are usually associated with reduction of pollution in the logistics business by application of the green initiatives, respective innovations, and technologies, which would also contribute to higher profits. Table 1 provides the respective GL definitions proposed by various authors.

Table 1. Definitions of green logistics.

Author and year of publication	Definition of green logistics
Su-Young Kwak, Woo-Sung Cho et al. (2020)	The logistics that accounts for the effect of logistics on the transport and environmental sectors in the whole process of activities. In the narrow sense, green logistics is the activity related to the efforts of reduction and management of pollutants, for example, reduction of air pollution and exhausts in cargo transportation. However, in the broad sense, the concept of green logistics covers not only the environment influenced by logistics, but also all the logistics processes.
K. Zowada and K. Niestrój (2019)	The concept of management of material flows accompanied by the information flow, starting with establishment of the organization, thereby contributing to the efforts towards the economic and environmental goals.
T. Athanasios (2018)	An environmentally accountable system that encompasses implementation of the "preliminary" logistics processes, such as purchase of raw materials; production, packaging and distribution of goods, and reverse logistics procedures such as reverse logistics and packaging recycling.

Patra (2018)	A set of efforts undertaken by the organization to measure and reduce the environmental impact of the logistics activity.
A. Mckinnon, M. Brownet al. (2015)	A form of logistics that should be not only environmentally, but also socially friendly and economically functional.
M. Jedlinski (2014)	Integrated management of logistics processes in the supply chain for satisfaction of clients' expectations on a global scale, including the factors related to the climate change, air pollution, noise, vibration, and accidents. It is generally recognized that green logistics is primarily intended to assess and reduce the negative environmental effects of logistics.

Source: Made by the authors according to Zowada and Niestrój, 2019; Patra, 2018; Athanasios, 2018; Mckinnon, 2015; Jedlinski, 2014; Su-Young Kwak et al., 2020.

According to the scientific literature, GL may be viewed as a form of logistics, which, in its practice, focuses on reduction of the negative environmental effects of logistics throughout the logistics processes without compromising any social and economic goals. Wang (2018), Zowada (2018), Karia and Asaari (2016), Athanasios (2018), Zatrochová et al. (2021) and others have identified the following areas of activity where the GL practices tend to manifest themselves actively:

• Design of the GL products: production standards aimed at reduction of the environmental effect (use of the resources, use of the production equipment, use of the packaging materials, recycling, etc.).
• Green transportation: environmental pollution control during the logistics distribution, i.e., respective planning of routes, use of cargo vehicles with lower pollution ratings, efficient use of the container capacities, cargo consolidation, collaboration with the third-party logistics (3PL) companies, etc.
• Green warehousing: improvement of the logistics efficiency by rational planning of warehouse management, reduction of product time in warehouse, and improvement of the cargo turnover, application of the latest loading methods and safety stock together with the containers and other equipment, active processing of long-term negative inventory, and other. These actions not only help reduce the costs incurred by the warehouse, but also reduce the environmental impact.
• Green packaging: sustainability of the packaging used, use of the environmentally friendly materials in the packaging, etc.
• Green collection and handling of the logistics data: application of the IT, logistics process management systems, and innovative management.
• Waste management: waste recycling/utilization scheme.

Hence, the GL practices which provide the obvious motivating benefit manifest themselves in the above areas of the logistics activity. Nevertheless, there are certain obstacles encountered as well.

Drivers and barriers of green logistics application

Application of the GL at the companies is based on the economic and environmental goals set, where all the logistics processes are implemented on the basis of the GL principles. Discussions among the research community have suggested that

application of the GL practices doubtlessly improves the competitive advantage on the market and efficiency of the supply chain, corporate image and financial return on investment (ROI), reduces the risk, improves the investor and partner relationship, satisfies the suppliers and consumers' needs, etc. Nonetheless, it has been noticed that businesses not only enjoy the benefits of application of the GL, but also encounter certain obstacles.

The clients and the need to satisfy them are the main drivers prompting the businesses to implement the GL practices. Nonetheless, the lack of true commitment of the organizations has been noticed in certain cases (Colicchia, Marchet, Melacini & Perotti, 2013). Meanwhile, other authors (Loke et al. 2017; Murthy et al. 2018; Seroka-Stolka 2014) consider the regulations and legislation passed by the government as the main driver. According to the latter, as soon as the requirements on implementation of the GL are defined by the government, the businesses become directly committed to the application thereof.

According to Loke et al. (2017) and Murthy et al. (2018), encouragement and support by the senior management at the organizations for application of the GL practices are also very important factors. It is the senior management that decides on the allocation of resources at the organization and investment into the latest technologies. McKinnon et al. (2015) have emphasized that the organizations have positive attitude towards application of the GL, if this improves the sustainability and environmental indicators of the company while reducing the costs or, at least, maintaining them at the same level. According to the authors, the costs incurred are considered both as a driver and as a barrier. The desire to be the leaders of sustainable development, growing prices on power and fuels, greater competitive advantage and differentiation, compliance with the existing or prospective legislation, and the relatively growing transport costs are the drivers and barriers in further application of the GL.

Chiaw Fen et al. (2020) have noted that the companies that practice GL enjoy the economic benefit. The authors have emphasized that if planned adequately, the system of GL application could help reduce the amount of waste, transport costs, and power consumption, and increase the profits by using less materials. These factors drive the organizations for change thereby strengthening their positions on the market and improving client satisfaction.

In the scientific literature, the barriers of application of the GL practices have also been discussed comprehensively. According to Colicchia et al. (2013), competitive advantage is one of the drivers of application of the GL, which, however, has not proven itself to be a strong factor in practice. They claim that this is due to the short-term nature of the cooperation contracts in logistics.

According to Gommel, Westerberg (2016), the lack of communication and coordination, unreasonable requests, inactivity, technical difficulties, and costs are the barriers of the GL or environmental projects. Chiaw Fen et al. (2020) agree that the costs incurred are the major barrier of development of the GL. Acquisition of advanced and modern technologies, employee training according to various

educational programs or hiring an additional qualified specialist are highly investment-intensive. Hebaz and Oulfarsi (2021) agree that the lack of human and financial resources hinders companies from adopting GL practices. This is an important factor in adaptation of new and innovative ways to improve company performance and competitiveness. Meanwhile, Pålsson and Johansson (2016) have identified four types of barriers: 1) costs and delivery nuances (flexibility, time, quality), 2) organizational, 3) external, and 4) technical. The authors refer to flexibility, time, and quality as the delivery nuances. According to the authors, the organizational barriers include the logistics barriers, lack of IT or motivation, while external barriers include conflicting national legislation and other regulations as well as the working environment. Furthermore, the technical barriers include the lack of infrastructure, technical knowledge, or commercial solutions. Mathiyazhagan, Govindan, Noorulhaq and Geng (2013) have a similar approach and consider legal regulations, poor commitments of the suppliers, and specific industrial barriers as the external barriers, while costs and lack of legitimacy – as the internal barriers.

Based on the scientific literature, the authors of the article have summarized the drivers and barriers of application of the GL by classifying them as the internal and external barriers covering the following five dimensions: costs, productivity, image, clients, competitors, and regulation compliance (see Figure 1).

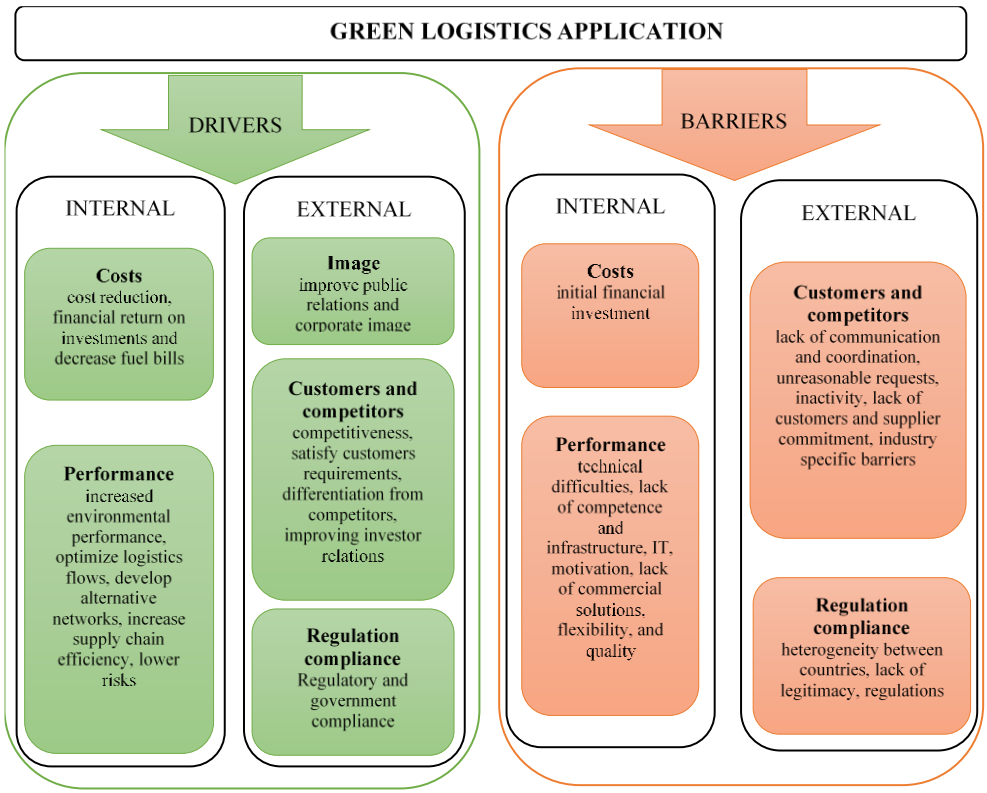

Figure 1: Drivers and barriers of application of the GL.
Source: Made by the authors according to Gommel and Westerberg, 2016; Mathiyazhagan et al., 2013; Pålsson and Johansson, 2016; Fen et al., 2020; Lew et al., 2018; Karuppiah et al., 2020; Hebaz and Oulfarsi, 2021**.**

The GL practices are implemented at the business organizations by making use of the innovations and technological changes with the aim to increase the profits, improve the efficiency of the logistics activity, and reduce the negative environmental effects. The factors behind application of the GL make this practice multidimensional, and may be both the drivers and the barriers. According to Fen, Kamaruddin and Mohd Nor (2020), if the barriers are removed, application of the GL at business companies may help the vendors of logistics services maximize their operational efficiency, improve own competitive position, and become the leaders of the sustainable logistics industry. The authors of the article note that application of the GL practices is most often limited by the lack of internal incentives, as the senior management have little understanding of the benefits and underestimate the potential economic or financial benefits in the long-term perspective. Moreover, business companies often lack qualified specialists capable of managing the advanced IT technologies, using the innovative business models, and making unconventional decisions in the business environment. Business companies are often

cautious when evaluating their individual contribution into reduction of the environmental pollution due to the absence of a clearly defined evaluation methodology, which would otherwise help and encourage them to adopt sustainability-centred business decisions. It should be noted that more active involvement of the government in application of the incentive measures for the businesses could help minimize the barriers of application of the GL barriers. The incentive measures could include the following: reconsideration of the tax policy, more support measures, promotion of good practice examples, etc.

Based on the scientific literature review, the following research questions are raised by the authors of the article: 1) What are the drivers of GL practices application at the company? 2) What are the activities that the practices are integrated into? 3) What are the major barriers or challenges in application of the GL? 4) Which criteria are considered to define the benefit of GL?

Research Methodology

An empirical study using the case of a logistics centre in Lithuania was conducted in order to identify the drivers and barriers of application of the GL in practice. The logistics centre was chosen as it was one of the major logistics centres in the Baltic countries. It had a comprehensive market experience and declared the importance of environmental protection, directly related to the GL. The logistics centre analyzed sought to promote and implement the environmental prevention by regulation compliance and consistent improvement of the quality and environmental management systems in accordance with the company and environmental changes.

A qualitative research method, i.e., a semi-structure interview, was used for the empirical study. According to Žydžiūnaitė and Sabaliauskas (2017), Kardelis (2017), the interview method is the most reasonable when it is aimed to look deeper into the problem area, or when the available knowledge on the problem area is scarce. The semi-structured interview was chosen due to the major advantages of this method presented by the interviewees' verbal responses to the prepared questions. Having noticed that the interview departs from the subject matter or something might be omitted, the researcher may ask additional, specifying questions. Based on the requirements related to the research ethics, the interview questions were posed in a respectful manner, did not create any conditions for the respondents to lose their anonymity, corresponded to the principle of respect to human dignity, justice, and the results obtained were processed and presented in the statistical form (Žydžiūnaitė, Sabaliauskas, 2017). Verbal consent to participate in the interview was obtained before the interview.

According to Seidman (2013), validity of the information collected during the semi-structured interviews depends on the interviewees' experience and knowledge about the predefined problem area rather than on the number of interviewees. The author claims that valid and consistent results of a semi-structured interview may be obtained from 5-7 persons at an organization, if the interviewees share similar knowledge on the problem area have over 5 years of experience in the respective

field. A larger number of the interviewees does not have any significant influence on the study findings. Based on the criteria above, the authors of the present article identified 5 staff members at the logistics centre who held managing positions and had over 5 years of experience in the logistics processes of the company. To maintain anonymity, the research participants were coded as I1, I2, I3, I4 and I5.
The interviews were verbal (phone, face-to-face conversations), voice recording of the responses was performed, and the answers were transcribed subsequently. Average duration of each interview was about thirty minutes. The study was conducted in August to September 2021.
The method of content analysis was used for the analysis of the semi-structured interview results. The main principle of the method is content analysis of the interviewees' responses to the questions. This included identification of the similarities and differences between the responses, interpretation and classification of the responses into categories and subcategories.

Research Results

The empirical study was primarily aimed at identifying the opinion of the managers of respective areas at the logistics centre, namely, the drivers of the GL-based activity and the practices employed in the activities. Table 2 presents the interviewees' responses classified into two categories and six subcategories.

Table 2. Drivers of the GL and practices employed in the activity of the logistics center.

Category	Subcategory	Underlying arguments
Drivers of the GL	Positive image	"<...>we improve competitiveness in relation to the competitors <...>" (I1), "<...> the environmental principles help assure that we have greater advantage compared to other logistics companies <...>" (I4).
	Legal regulations	"<...> the environmental position is particularly important for the transport sector throughout the EU due to the increasing requirements to the transportation of cargo <...>" (I3)
	Financial cost saving	"<...> helps make the operational processes more effective <...>" (I1), "<...> in the long-term perspective, cost reduction by application of the environmental initiatives could be expected <...>" (I4)
Practices of the GL	Warehousing	"<...> respective IT applications have been implemented at the warehouse for greater efficiency <...>" (I5), "<...> we apply innovations complying with the environmental standards at the European scale in this area, implement the warehouse software <...>" (I2)

	Transportation	"<...> the fleet and route planning are also managed by updating the IT technologies accordingly <...>" (I3), "<...> the fleet is in line with the EURO 6 standard, is regularly upgraded, and Paragon routing application helps manage it <...>" (I1)
	Data management	"<...> the ISO quality standards have been implemented <...>" (I4), "<...> the respective standards are being implemented to assure the environmental practice at the companies, and the centre is no exception as we have implemented the ISO 9001 and ISO 14000 <...>" (I1).

According to the interviewees, the application of the GL practices at the company was driven by the aspiration to build a positive image in comparison to the competitors. They put particular emphasis on the fact that the logistics sector was one of the major sectors in Lithuania by its share in GDP and by the geographic advantage. The geographic advantage was presented by the East-West Transport Corridor that the logistics businesses were making great use of. This enabled the business establish strong position among the transport service providers in Europe. Consequently, Lithuania has a number of large logistics companies, let alone small- and medium-sized logistics companies. They consistently follow up on the operating standards of the major European industrial or service companies in order to collaborate, establish contacts and develop business with them. Besides the positive image aspired, legal regulations across the EU are one of the factors determining the focus on the sustainability. The logistics sector is one of the major causes of the environmental pollution in the EU and contributes to the climate change, air pollution, and noise. Moreover, large areas of land are allocated to transport contributing to the urbanization and fragmentation of habitats (reduction of the natural habitat areas) and soil sealing. Abatement of the negative effects of transport is an important goal of the EU policy. Key areas of related activity: transition to the less polluting and most effective modes of transport, more sustainable transport technologies, use of the types of fuel and measures of infrastructure, and the aspiration to make sure that the transportation prices fully reflect the negative effect on the environment and health. This may be limited and promoted by using the respective taxes, initiatives, which also prompted the logistics centre analysed to follow this direction. According to the interviewees, another driver was the aspiration to reach greater effectiveness and reduce the financial costs. Whereas application of the GL practices in the long-term perspective was associated with the driver mentioned above, the company had interest in implementing new technologies with the aim to reduce the environmental pollution. Moreover, the interviewees mentioned that the state regulations and satisfaction of the consumers' needs were also important factors.

The interviewees' responses about the GL practices employed showed strong manifestation of the practices, in particular, in warehousing and transportation. The practices also manifested themselves significantly in the innovative IT management systems (warehouse management application Manhattan, routing application Paragon) and in the equipment used, such as cargo loading equipment and novelty of the fleet assuring compliance with the environmental standards. Moreover, application of the ISO quality management standards at the logistics centre was also emphasized and could be attributed to the GL data management practice.

Another aim of the interview was identification of the barriers of application of the GL practices at the Lithuanian logistics centre. Two categories were identified upon assessment of the interviewees' responses: 1) internal and external barriers to application of the GL, 2) barriers to more extensive application of the GL in practice (see Table 3).

Table 3. Barriers to application of the green logistics.

Category	Subcategory	Underlying arguments
Internal and external barriers to application of the GL	Initial investments	"<...> all the environmental decisions at the company require considerable initial financial investments <...>" (I2), "<...> upgrading the existing technologies or changing the operating methods costs a lot and requires preparation that may take years <...>" (I5)
	Methods that have not proven themselves in practice	"<...> green methods in logistics encourage the companies to replace diesel vehicles with electric or gas-powered ones. This does not prove itself in practice, as the infrastructure has not been sufficiently developed yet, and the servicing of the latter is more frequent and expensive <...>" (I3)
	Lack of technical knowledge	"<...> each decision to modernize requires appropriate knowledge, and this, in turn, requires additional practice, training or good practice examples from the foreign or other Lithuanian companies for all the employees participating in the decision <...>" (I1)
	Challenges related to employee involvement	"<...> moreover, they often are "inconvenient" to the employees, and it is therefore difficult to communicate them to the employees and involve the employees into the decisions aimed at reduction of the environmental pollution <...>" (I2)
	Problematics of application	"<...> it is easier to describe it in theory than implement in practice by involving not only the managers, but also the specialists<...>" (I5)

	Lack of interest from the long-term partners	"<...> the major global businesses that we collaborate and have signed long-term contracts with do not show any interest <...>" (I4)
Barriers to more extensive application of the GL in practice	Deteriorating financial indicators	"<...> if any deterioration of financial indicators is registered, the investments or projects are put to a stop, because this situation usually shows that the risk is too high <...>" (I1)
	Decreasing sales revenue	"<...> the major barrier would be the decreasing return on investment, i.e., if the sales revenue drops for any reason, and this would influence the decrease in profitability<...>" (I4)
	Force majeure	"<...> the recent years' practice has shown that Force Majeure situations, such as the pandemics, may affect the businesses considerably. In this case, the plans of the initiatives are reconsidered, and usually, the most investment-intensive plans are suspended in order to reduce the risk of loss <...>" (I2)

The senior managers at the logistics centre who participated in the interviews claimed that the application of the GL was complicated due to the required considerable initial investments. They also noted that the methods proposed to the companies were either impractical or required the use of the technical knowledge which was scarce. Moreover, they claimed that involvement of and communication with the employees may be complicated due to additional work conditions and mentioned the lack of interest of the long-term partners. Analysis of the challenges identified has suggested that application of this practice and its full deployment would require preliminary preparations including anticipation of the possible barriers. The GL is based on the advanced approach and innovation, i.e., the latest technologies available on the market are needed to help the companies achieve the required sales and cost saving targets and, at the same time, reduce the environmental pollution. Larger initial investments are needed in order to upgrade, administer, and manage the software. The fleet and warehousing equipment should also be upgraded regularly. These were the main causes behind poor application of the GL practices at the companies. The interviewees also mentioned that the solutions proposed by the developers of equipment or software did not prove themselves to be fully applicable in the respective industry. There may be several reasons, such as lack of consideration of the internal and external operating business environment and infrastructure, human error, etc. Hence, the GL practice is usually tested for a certain period of time before the decision is made to deploy it in the company's activity. This, again, increases the initial investments due to the growing human resource

costs and time required. For the GL to perform in practice, employees at all tiers of the organization need to be involved. This usually means that conventional work methods need to be changed through introduction of additional components (for example, the ECO Driving indicators). This change is difficult to communicate appropriately to the employees in order to encourage them to eagerly engage in the activity planned. Hence, this aggravates application of the GL at the companies. Another relevant issue mentioned by the interviewees was the lack of interest of the long-term partners of the organization towards the GL practice, or the interviewees did not refer to the interest of the long-term partners as an additional advantage. Despite the evident call, both globally and at the EU level, to address the environmental pollution, the lack of motivation was felt at the organization. This was due to the lack of assessment of the contribution by different entities into reduction of pollution.

The responses provided by the interviewees and presented in Table 3 have suggested that all financial indicators have negative effect on more extensive application of the GL practices. This means that if there is no benefit to the business and business environment identified during the monitoring and assessment period, the initiated development is reconsidered to decide whether it should be resumed, in particular, where it relates to environmental protection. Moreover, the recent events in Lithuania and on the global scale involving restrictions related to businesses and their operations have prompted the companies to reconsider their development plans in terms of the GL application. The research participants noted that the companies had to suspend the plans and manage the potential risks, i.e., plan the client retention and attraction measures, maintain the existing premises and equipment, human capital, etc.

Table 4 presents the interviewees' responses in relation to the benefit provided by the GL application and the criteria used for the analysis thereof at the company analysed. Following consideration of the responses, four subcategories were identified, i.e., financial cost reduction, image improvement, performance efficiency, and regulation compliance (see Table 4).

Table 4. Criteria defining the benefit of the application of GL.

Category	Subcategory	Underlying arguments
Criteria defining the benefit of GL	Financial cost reduction	"<...> the key goal of the environmental initiatives at the company is the documented reduction of financial costs in the long run as it is sought to reduce the transport costs, warehousing costs <...>" (I1)
	Improvement of company's image	"<...> competitiveness is improved <...>" (I4), "<...> clients' favorable views <...>" (I1), "<...> improving indicators of assessment of the service quality<...>" (I2)
	Performance efficiency	"<...> it is particularly important to monitor the change of the vehicle maintenance costs,

		turnover of the stock in storage, the "pallet" value calculated, and so on <...>" (I1), "<...> the asset turnover, stock turnover is assessed <...>" (I3), "<...> the main criterion is the profitability <...>" (I5), "<...> ROI <...>" (I4)
	Regulation compliance	"<...> compliance with the legislation <...>" (I1), "<...> regulation compliance <...>" (I4).

The interviewees indicated that the financial costs and the return on investment were assessed at the company in the long-term perspective, as the GL solutions required considerable initial investments. This, in particular, applied to the transportation area, as the fleet would receive the most frequent upgrades. As a result, the variation in the operating costs due to the fuel costs, maintenance, and related taxes (pollution, road, etc.) was assessed. Warehousing costs are also assessed, even though they are usually related to the performance efficiency indicators. According to the interviewees, performance efficiency at the company was assessed by calculating the asset turnover, inventory turnover, and profitability of the activity. The GL practices were associated with modernization and innovative solutions, and their benefit was also assessed through the prism of the overall performance efficiency of the company. Moreover, the company complied with the state regulations and legislation in its performance.

The study also aimed at identifying further possibilities for application of the GL practices at the logistics centre. Two subcategories were identified according to the interviewees' responses: external cooperation and further integration into the processes (see Table 5).

Table 5. Possibilities for application of the green logistics practices.

Category	Subcategory	Underlying arguments
Possibilities for application of the GL practices	External cooperation	"<...> the environmental initiatives require reconsideration of the collaboration agreements with other logistics or service companies in order to implement the entire supply chain based on principle of pollution abatement <...>" (I1)
	Further integration in the processes	"<...> the main initiatives have been implemented in transport and warehousing so far, but it is important to continue improving our services and integrating the environmental protection in other processes as well, such as packaging, raw material supply, administrative operations<...>" (I2). "<...> digitalization of the administrative operations <...>" (I3), "<...> more active use and storage of documents in the digital format (I4)." "<...> packaging and labelling operations are

		standardized, there are no environmental standards pertaining to them, and the green packaging practices should be implemented <...>" (V5).

According to the interviewees, the GL practices may be implemented at the company through more active external cooperation and further integration into the processes. The logistics centre analyzed was offering a wide range of services and cooperating with other companies to assure the quality of the services provided. The interviewees claimed that the partnership was chosen according to the time and quality criteria, while partners' compliance with the GL principles and approach to the environmental protection were not the criteria for partner selection. The research participants noted that the green initiatives were implemented at the company, in particular, in the transportation and warehousing areas, including the overall enterprise resource planning system. Nonetheless, the green practices were not defined in other processes (product packaging and labelling, supply of the required raw materials, waste management, administrative operations), and those processes did not account for the environmental pollution and its potential reduction. Hence, these areas at the company were considered as the opportunity for more extensive application of the GL practices.

Discussion

The article has sought to not only theoretically identify the drivers and barriers of the GL application, but also verify the manifestation thereof at the logistics centre in Lithuania used as the case of the present study. The results of the qualitative study have supported the drivers identified during the scientific literature analysis. The results of the semi-structured interviews revealed that the legal regulations, more efficient use of the financial costs, and improvement of competitiveness were the drivers of application of the GL practices at the logistics centre in Lithuania. This is also confirmed by the research findings in Lew, Chew and Ham (2017). Having conducted the study at an international logistics company, the authors identified that the efforts to increase the cost efficiency, improve competitiveness, and company image prompted the company to implement the GL practice. The authors also found that professional development of human resources and support by the top management, efficient use of the IT, integration with other enterprises providing the logistics services and vendors prompted them to implement the GL practice at the organization analysed.

Moreover, Fen et al. (2020) conducted a study at 163 enterprises providing the logistics services and identified 5 strongest drivers and barriers to application of the GL practice. The authors identified that the key factors were the need to reduce the negative environmental effects, IT compatibility for better performance efficiency, economic benefit, company image, and improved competitiveness. The study presented herein has proven these drivers to be present as well.

Nevertheless, application of the GL practices is multidimensional due to the associated challenges. The results of the case study of the logistics centre in Lithuania have demonstrated that the financial costs are the main barrier to application of the GL practices. The latter require considerable initial investments, and improvement of financial indicators is time-intensive, sudden change does not happen, etc. In their findings, Fen et al. (2020) identified 5 barriers to the GL practice. Considerable initial investments were also included in the list of the main barriers, which is in line with the present study. Moreover, the authors identified that the barriers included the lack of state regulation and legislation, lack of incentives from the authorities, lack of cooperation with other companies, and overall complicated application. Similar findings were obtained by Karuppiah et al. (2020). In their study, the authors identified the following key barriers to application of the GL practice: lack of dissemination of information, poor management of the supply chain, absence of market diversification, and lack of accreditation. These barriers were not determined by the authors of the present article, but it could be claimed that both the drivers and the barriers of the GL were similar in the practices of the companies.

The GL practice in an organization is a full set of logistics processes implemented according to the GL principles in order to achieve the economic and environmental goals of the company that help improve the competitive advantage on the market, financial position in the long-term perspective, and efficiency of the supply chain. The companies aspiring to achieve these goals should plan on how the barriers will be handled, as they will be faced in the long run during application of the GL practices. It is highly important that the GL practice is directly integrated into business risk management and business model diversification.

Conclusion

More extensive application of the GL and its practices is one of the solutions of reduction of the negative environmental effect and compliance with the European Green Deal goals. The key objective is the elimination of the barriers preventing the companies from more active application of the GL practices in their activities and logistics processes is the . The systematic analysis of the scientific literature has shown that the factors influencing application of the GL practices in the companies' activities may be either external or internal. The authors of the article have associated the company image, clients, competitors, and regulation compliance with the external factors. Meanwhile, the costs and efficiency have been classified as the internal factors determining application of the GL practices. It should be noted that the factors, except for the image, may serve both as drivers and as barriers to the application of the GL practices in the companies' activities. It is obvious that each company is prompted to implement the GL practices by the aspiration to improve public relations and company's image, rather than the opposite. The semi-structured interview results have shown that positive image, financial cost saving, and legal regulations were the drivers of application of the GL practices at the logistics centre

analysed. Meanwhile, the key barriers included considerable initial investments, lack of technical knowledge, issues related to employee involvement, and absence of interest of the long-term partners. In general, it could be claimed that the company managers, practitioners, and policy makers could benefit from the identification of the drivers of application of the GL practices when addressing the challenges related to the environmental pollution. Identification of the barriers of application of the GL practices, on the other hand, provides a platform for discussions and prospective scientific research in the effort to find the most rational solutions of reduction of these barriers.

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CZYNNIKI WPŁYWAJĄCE NA ZASTOSOWANIE ZIELONEJ LOGISTYKI: WNIOSKI Z LITEWSKIEGO CENTRUM LOGISTYCZNEGO

Streszczenie: Przejście na zieloną logistykę (GL) i stosowanie praktyk GL, obok innych rozwiązań, ma na celu złagodzenie negatywnych skutków dla środowiska i zgodność z celami Europejskiego Zielonego Ładu. Jednak praktyki GL zwykle nie przejawiają się w działaniach spółek. Celem artykułu jest identyfikacja czynników i barier stosowania GL oraz weryfikacja ich przejawów na przykładzie centrum logistycznego na Litwie. W tym celu wykorzystano metody systematycznej naukowej analizy literatury oraz badań jakościowych. Na podstawie analizy literatury naukowej zidentyfikowano wewnętrzne i zewnętrzne czynniki wpływające na stosowanie GL. Obejmowały one koszty, wydajność, wizerunek, klientów, konkurencję i zgodność z przepisami. Większość czynników może działać jako czynniki napędzające lub bariery stosowania KG w praktykach korporacyjnych. Przejawy czynników i barier zostały zweryfikowane empirycznie, a wdrożone praktyki KG zostały zidentyfikowane w badaniu jakościowym. Do badania jakościowego wykorzystano formę wywiadu częściowo ustrukturyzowanego na przykładzie centrum logistycznego na Litwie. Zgodnie z wynikami badania empirycznego pozytywny wizerunek, redukcja kosztów finansowych oraz zgodność z regulacjami były czynnikami decydującymi o stosowaniu praktyk KG. Tymczasem za bariery uznano potrzebę znacznych inwestycji początkowych, brak wiedzy technicznej, wyzwania związane z zaangażowaniem pracowników oraz brak zainteresowania partnerów długoterminowych.

Słowa kluczowe: zielona logistyka, czynniki napędowe, praktyki zielonej logistyki, bariery, centrum logistyczne.

影响绿色物流应用的因素：立陶宛物流中心的调查结果

摘要：除了其他解决方案，向绿色物流 (GL) **的**过渡和 GL 实践的应用旨在减少负面环境影响并符合欧洲绿色协议的目标。尽管如此，总账做法通常不会体现在公司的活动中。本文旨在通过立陶宛物流中心的案例，确定 GL 应用的驱动因素和障碍，并验证其表现形式。为此，采用了对文献进行系统科学分析和定性研究的方法。在科学文献分析的基础上，确定了影响GL应用的内部和外部因素。它们包括成本、效率、形象、客户、竞争对手和法规遵从性。大多数因素可能成为在企业实践中应用 GL **的**驱动因素或障碍。驱动因素和障碍的表现得到了实证验证，并通过定性研究确定了实施的 GL 实践。以立陶宛物流中心为例，采用半结构化访谈的形式进行定性研究。根据实证研究的结果，正面形象、降低财务成本和遵守法规是应用 GL 实践的驱动力。同时，大量初始投资的需求、缺乏技术专长、与员工敬业度相关的挑战以及长期合作伙伴缺乏兴趣被认为是障碍

关键词：绿色物流，驱动因素，绿色物流实践，壁垒，物流中心