

SUSTAINABLE LOGISTICS IN LATVIA AND LITHUANIA *ILGTSPĒJĪGA LOĢISTIKA LATVIJĀ UN LIETUVĀ*

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Abstract. *Sustainable logistics, also known as green logistics, focuses on processes that aim to improve the sustainability of supply chain operations from the acquisition of raw materials to the receipt of goods. Sustainable logistics is related not only to reducing environmental pollution, but also to corporate social responsibility. Saving resources, improving waste management, increasing productivity, reducing the negative impact of the organization's activities on the environment, increasing competitiveness and ensuring an ergonomic working environment are the main objectives of investing in green logistics. Consequently, this article analyzes green logistics principles and application of sustainable logistics in the Lithuanian and Latvian transport sector through the survey.*

Keywords: *electronic trucks, green logistics, intermodal transportation, sustainable logistics, transport sector.*

Introduction

Sustainable logistics is a comprehensive approach that considers the economic and social impacts of activities and aims to benefit society, both economically and environmentally. As we move from a linear economic model based on cycles of extraction, transformation, distribution and consumption to a circular economy, sustainable logistics is becoming increasingly important. As the world's population continues to grow, more and more things need to be produced, and they need to get around. All the goods are being transported by lorries, trains, ships and planes, all of which have a negative impact on the environment. As this issue becomes increasingly important in today's society, a solution must be found as quickly and efficiently as possible to protect the planet from vehicle pollution.

The aim of the research is to do the analysis of the sustainable logistics and examine the application of sustainable logistics in Lithuania and Latvia.

Objectives of the research are:

- to reveal main characteristics of sustainable logistics;
- to discuss application of sustainable logistics principles to transport operations;
- to discover transport process tools for sustainable logistics.
- to ascertain the attitudes of Lithuanians and Latvians towards sustainable logistics.

The object of the research - sustainable logistics in Latvia and Lithuania.

Research methods: scientific literature analysis, questionnaire survey.

The results of the research are provided in the conclusion part of this paper.

Characteristics of sustainable logistics

Green logistics focuses on reducing the environmental impact of logistics - the aim is to minimize the carbon footprint of the supply chain while maintaining efficiency and

profitability. Sustainable logistics is a comprehensive approach that considers the economic and social impacts of activities and aims to enhance societal interests, both economic and environmental (*Macharis et al., 2014*). Sustainable logistics is increasingly important in the shift from a linear economic model, based on extraction, transformation, distribution, and consumption cycles, to a circular economy. The main objective of a circular economy is to extend the life of products and optimize the use of resources over time (*Logistics Cluster, 2024*). Sustainability concludes 3 pillars: the economy, society and the environment. These principles are commonly referred to as the '3 P's': profit, people, and planet. Striving for a balance between these pillars enables logistics to provide optimal service while also promoting a more conscious use of resources (*Logistics Cluster, 2024*). There are four areas of implementation of green logistics (*Čepinskis & Masteika, 2011*):

1. Modal split: modal transport, reverse logistics, alternative modes of transport (rail, inland waterways, sea).
2. Energy use: reduction of energy consumption, reduction of environmental pollution, reduction of CO² emissions, integrating CO² reduction into corporate policy, measuring the environmental impact of logistics activities.
3. Manufacturing: using clean technology, reducing, treating and managing waste.
4. Extraction of raw materials: sustainable purchasing, use of less polluting materials, recycling of waste, re-use of products.

Key aims of investing in green logistics include: saving resources; waste management improvement; improvement of labor productivity; reduction of the negative impact of the organization's activities on the environment; improving competitiveness; providing an ergonomic working environment (*Čepinskis & Masteika, 2011*).

Applying green logistics principles to the transport process

The ever-increasing population in the world is driving production processes of various aspects that require transportation. Various goods are transported by trucks, trains, ships, planes. All these vehicles pollute the environment. In the modern world, this problem is becoming more and more relevant, so it is necessary to find a solution to protect the planet from vehicle pollution as quickly and efficiently as possible.

Today, the whole world is talking about the need for sustainable development and one of its key elements is the so-called sustainable logistics. It seems that sustainable development policy is finally moving from being a smart corporate slogan to a legal requirement for the whole European Union and its partner economies.

The general philosophy of “sustainable logistics” is not limited to the reduction of harmful environmental impacts, in particular limiting carbon dioxide emissions, although these are the most important objectives, but also related to achieving business goals. The most important goal is to reduce the costs of logistics processes and increase profits while adhering to the principles of sustainable development. The pandemic and the war in Ukraine have disrupted or weakened existing supply chains, but paradoxically, it was these events that made Europe realize that it needs real, not imagined, change (*Lysionok, 2017*).

The development of sustainable practices and green logistics is revolutionizing the supply chain industry, with profound implications for the entire field of logistics (*Hermann Services, 2023*). It can be defined as the rational and efficient use of resources in supply chain activities, from raw material sourcing to transformation processes, warehousing, packaging, distribution, and end-of-life management. Sustainable logistics is defined as the application of practices designed to reduce the environmental impact of logistics operations. Green logistics, on the other hand, refers to the implementation of sustainable and environmentally friendly practices throughout the entire supply chain (*Hermann Services, 2023*). The potential for waste reduction in the supply chain is evident. This can encompass reducing packaging waste,

optimizing warehouse layouts to eliminate unnecessary wastage of space, and identifying potential avenues for recycling or reusing materials that would otherwise be discarded (*Hermann Services, 2023*). The minimization of waste should result in reduced costs, thereby enhancing economic performance.

Sustainable logistics in the transport process

In today's society, with the constant increase in cargo turnover both within countries and between countries, environmental safety issues become very relevant. Verification mechanisms exist, however green transport research and practice are still in their infancy and call for a thorough examination and identification of the development of green transport systems in global cities (*Mazúrová et al., 2021*) reported intriguing findings from a public poll on green transportation in Slovakia. It was shown that the respondents are more content when they commute by automobile or foot than when they take public transportation. As a result, they believe that the nation has to implement a more environmentally friendly and "green" transportation system. Thus, it can be said that the idea of "green transport" has connections to social issues in addition to business and freight transportation (*Larina et al., 2021*).

Many of the tasks once performed by more conventional modes of transportation for the delivery of commodities have now been replaced by aviation. For instance, it is obviously less expensive to carry containers from China to Europe than to do so via air. However, because fuel prices are growing swiftly and commodities take weeks or months to arrive, purchasing a batch of goods can end up being utterly unprofitable for the recipient by the time it does. Manufacturers of electronics, for instance, who are highly sensitive to changes in pricing and currency rates, have long realized this. Then, aircraft can assist in resolving novel optimization issues (*Demkers et al., 2021*).

Scandinavian nations one natural impediment to the flow of goods is the Baltic Sea. For the majority of goods that are imported and exported, the mode of transportation must be switched at least once. This necessitates the development of an accurate dispatch service operation, as well as the computation of additional time that shipments will take to *arrive* (*Demkers et al., 2021*). Railways that are a part of the sea-rail or road-rail transport chains must be used to move commodities within the parameters of a sustainable transportation system. This is basically a Swiss issue, especially in Austria (*Saparovna et al., 2018*). Significant environmental pollution issues arise from changes in the unregulated transportation industry, such as those in the newly formed states of Germany and Poland, which result in an excessive reliance on roads (*Taczanowski et al., 2018*).

To promote national sustainable transport systems initiatives, a close alliance between those with the authority to deal with transportation issues, such as local government, the auto industry, trade unions, vehicle associations, "green" organizations, etc., may be required. The strength of national governments will be insufficient to support significant modifications to the transportation infrastructure.

Tools for the transport process in sustainable logistics

There are different ways of applying the principles of sustainable logistics in the transportation process, but they have differences that determine what the business developer will choose. It may depend on the price, realization time, payback, availability.

We present several tools that could be applied in the transportation process to make the logistics company more sustainable:

1. **Electronic trucks.** With the rapid development of environmentally friendly transportation, batteries and EV infrastructure, it is likely that electric heavy-duty vehicles will become an increasingly popular choice for companies using tow trucks in the future. Although the price

of electric trucks is higher than trucks powered by internal combustion engines (ICE), these vehicles have many advantages. For example, the maintenance cost of a nine-year-old Isuzu diesel truck is about 300 Euros for every 1000 km traveled (*Feng & Figliozzi, 2012*). On the other hand, electric trucks with far fewer moving parts have lower maintenance costs and break down less frequently. Trucks alone account for around 7 % of global CO² emissions. Unhealthy air pollutants such as sulfur oxides, particulate matter and nitrogen oxides from these vehicles accumulate in cities; the key benefits of electric trucks are cleaner mobility, cleaner air and ultimately a more sustainable world. Many think that there may be a problem with charging the battery, but it is not a problem, because according to European Union legislation, truck drivers must take a break for at least 45 minutes after driving for a maximum of 4.5 hours. Therefore, if they stop for a break, this time can be used to recharge the battery. It is important to ensure that there is a sufficient amount of charging stations.

2. **Intermodal Transportation.** By definition, intermodal transport, also known as combined transport, is a mode of transport based on the transportation of goods using different modes of transport. It is important to emphasize that this type of goods is not reloaded during transport, but only changes the means of transport. Mostly multipurpose containers, semi-trailers and swap bodies are used (*TransEdu, 2022*). One of the biggest advantages of intermodal transportation is environmental friendliness. In this case, the ecological combination of road, rail and water transport means that the energy costs of transporting a given commodity are significantly lower than if only road transport is used. Air pollution is also reduced by up to 90 % compared to automobile transportation. Intermodal transport is weather and obstacle resistant and can be transported “door to door”. The use of intermodal transport can also significantly reduce traffic on roads and at borders, allowing larger loads to be transported over longer distances (*TransEdu, 2022*).
3. **Route Optimization.** It is one of the essential factors for ensuring the efficiency of freight transportation. Various IT solution modules are usually used to optimize routes. One of the most important functions is route search, which finds the best route based on different criteria (*Terra IT, 2024*). The route planning module allows you to monitor different activities such as deadlines, cargo size and weight, traffic conditions and vehicle restrictions on the road. This ensures that the most efficient routes are found, reducing travel time, environmental impact, helps to reduce vehicle fuel consumption and increase the overall efficiency of operations (*Terra IT, 2024*).
4. **Load optimization.** It is very important to ensure that semi-trailers and containers are completely filled to maximize the efficiency of each trip. This reduces the number of trips required and minimizes the waste of space, fuel and emissions. The Figure 1 shows how many megajoules per passenger kilometer traveled.

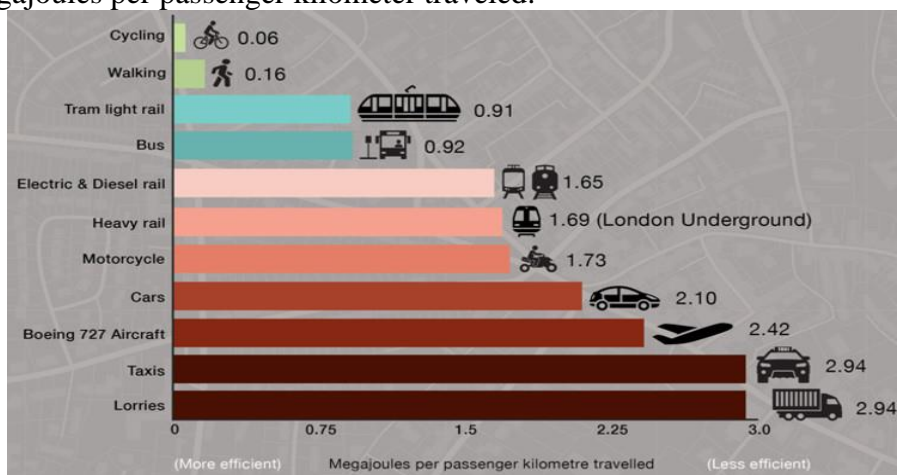


Figure 1. **Transport energy efficiency comparing different types of transportation** (*The Earthbound report, 2022*)

It can be seen from the graph that the least efficient are lorries and taxis, and the most efficient is the bicycle. The most average option is heavy rail (London Underground). Efforts should be made to reduce the use of lorries and taxis by replacing them with another vehicle or changing their technical characteristics, such as the engine. It is also necessary to encourage the public to use bicycles and walk by creating pedestrian and bicycle paths.

Application of sustainable logistics in the Lithuanian transport sector

The study was conducted using a survey method. This involved the creation of an online survey, which was made available to the general public. The primary aim of it was to ascertain the opinions and beliefs held by the Lithuanian public regarding sustainable logistics practices. The survey yielded a diverse range of responses from the 50 individuals surveyed (68 % female, 32 % male). When queried as to whether they believed that Lithuania devoted sufficient attention to sustainable logistics, respondents exhibited a marked divergence of opinion, with 42 % expressing disagreement, 36 % indicating agreement, and the remaining 22 % expressing no opinion. The survey revealed that 42 % of respondents expressed satisfaction with the current situation regarding the implementation of sustainable logistics practices in Lithuania. Conversely, 30 % expressed disagreement with this statement, while the remaining 28 % indicated that they lacked sufficient knowledge or opinion to provide an answer.

With regard to questions related to the government, the majority of respondents (88 %) agreed that the government should provide financial support to sustainable logistics companies in Lithuania, while the remaining 12 % did not agree. When queried as to whether the government should encourage companies to invest more in sustainable logistics, the majority of respondents (82 %) indicated that they agreed with this proposition, 6 % of them did not agree and the remaining 12 % expressed a neutral stance. Moreover, a substantial majority of the respondents, representing 84 % of the sample, indicated that education programs should be expanded in order to increase awareness about sustainability in society. Conversely, the remaining 16 % expressed disagreement with this proposition.

In a subsequent inquiry regarding the potential of sustainable logistics to reduce environmental pollution and energy consumption, a clear majority of respondents (90 %) expressed agreement with this proposition. The remaining 10 % either disagreed or expressed no opinion. One of the final questions posed to respondents was whether they agreed that, in 50 years' time, the majority of vehicles will be powered by electricity. The responses to this question exhibited a considerable degree of heterogeneity, with 74 % respondents indicating their agreement, 14 % expressing disagreement, and the remaining 12 % respondents indicating that they were unable to answer the question due to a lack of opinion.

One of the primary objectives of this study was to ascertain the public's perceptions regarding the advancement of sustainable logistics in Lithuania and Latvia. To this end, we posed the following question: Which country, Lithuania or Latvia, has more advanced sustainable logistics? A total of 42 % respondents indicated that they believe that Lithuania is the country where sustainable logistics is better developed. Conversely, 18 % respondents expressed the opposite view, and an additional 40 % respondents indicated that they had no opinion on this matter. This suggests that the general public may not be sufficiently familiar with the principles of sustainable logistics.

In summary, the results of this study indicate that there is a need for further public awareness and education on the principles of sustainable logistics because a significant proportion of respondents were unable to provide a response to all the questions posed by selecting the option indicating that they held no opinion.

Application of sustainable logistics in the Latvian transport sector

The survey on sustainable logistics in Latvia revealed diverse perspectives among its 30 respondents. A significant majority, comprising 60 %, expressed dissatisfaction with the current level of attention given to sustainable logistics in the country. Meanwhile, 26 % agreed that sufficient attention is paid, and 14 % found it difficult to ascertain. In terms of satisfaction with the implementation of sustainable logistics, opinions were divided, with 39 % expressing dissatisfaction. Regarding government intervention, an overwhelming 92 % believed that the national government should encourage companies to invest more in sustainable logistics, highlighting a consensus on the need for policy support.

Furthermore, respondents widely recognized the potential of sustainable logistics to mitigate environmental pollution and reduce energy costs, with 96 % expressing agreement. Opinion divergence emerged regarding punitive measures for companies failing to adopt sustainable practices, with 61 % advocating for penalties while 13 % disagreed. Regarding the future of transportation, 57 % agreed that most vehicles would be electric in 100 years, underscoring optimism about technological advancements in sustainability.

When comparing Latvia's sustainable logistics development with that of Lithuania, opinions were split, suggesting a lack of consensus on regional progress. However, a majority (65 %) believed that sustainable logistics could enhance Latvia's business competitiveness. Respondents were evenly divided on their willingness to pay more for services provided through sustainable logistics practices, reflecting differing priorities among consumers. Notably, there was strong support (91 %) for expanding education to increase public awareness of sustainability issues.

Overall, the survey highlighted a nuanced landscape of perspectives, indicating both challenges and opportunities for advancing sustainable logistics in Latvia, with a clear call for greater awareness, policy intervention, and financial support.

Conclusions

1. Green logistics focuses on reducing the environmental impact of logistics - the aim is to minimize the carbon footprint of the supply chain while maintaining efficiency and profitability.
2. To summarize the application of sustainable logistics principles to transport operations, it is believed that the nation has to implement more environmentally friendly and "green" transportation system. The strength of national governments will be insufficient to support significant modifications to the transportation infrastructure.
3. The company developer will decide which of the several approaches to implementing the principles of sustainable logistics in the transportation process to use because of their distinctions. Availability, payback period, realization time, and cost might all be factors. The main tools would be: electronic trucks, intermodal transportation, route optimization and load optimization.
4. The survey's overall findings revealed a complex panorama of viewpoints, highlighting potential as well as obstacles for the advancement of sustainable logistics in Latvia and Lithuania. There was a definite need for increased public awareness, legislative action, and financial assistance.

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