“Research on the impact of innovations on green marketing and green logistics in Lithuania”

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RESEARCH ON THE IMPACT OF INNOVATIONS ON GREEN MARKETING AND GREEN LOGISTICS IN LITHUANIA

Abstract

The growing relevance of innovations in green logistics and green marketing is transforming the business models of the transport sector. Modern technologies now enable continuous vehicle condition monitoring and cargo tracking, improving both safety and operational efficiency. Sustainability considerations further drive the optimization of logistics processes. The implementation of innovative solutions, such as green logistics and green marketing practices, contributes to these objectives and supports environmental protection. The purpose of this article is to evaluate the impact of innovation on green marketing and green logistics. A literature review was conducted to identify the main theoretical and empirical approaches in this field. At the same time, a multi-criteria method was applied to assess the influence of technological development on the marketing strategies of transport companies. The findings indicate that innovations, particularly in green electric vehicles, significantly influence green logistics and marketing strategies. The analysis highlights strong interconnections between innovation adoption, green logistics, and sustainable marketing practices. The most critical criteria identified include the perceived benefits of green options and brand value. The results can serve as a foundation for developing comprehensive green strategies and implementing sustainable logistics practices. The study emphasizes that adopting green strategies in cooperation and logistics processes reduces operating costs, improves customer service quality, and accelerates logistics operations.

Keywords innovation, green marketing, green logistics, sustainable development, environment, sustainability

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INTRODUCTION

The topic of green logistics and green marketing is increasingly relevant as modern transport and logistics sectors strive to minimize their environmental impact. This approach encompasses all stages of logistics from the transportation and storage of goods to packaging and waste management, ensuring that each process aligns with sustainability principles. Green logistics and marketing focus on improving efficiency, reducing energy consumption, and lowering emissions throughout supply chains.

Key principles of green logistics include the use of sustainable vehicles such as electric and hybrid trucks, which not only decrease greenhouse gas emissions but also reduce noise pollution. Effective route planning and advanced digital technologies enable optimized logistics processes that minimize fuel consumption and travel time. Another crucial aspect is waste management, where recycling and reuse play a central role in reducing waste and its environmental footprint.

Green marketing and the promotion of green electric vehicles have become essential for socially responsible companies that aim to conserve natural resources, attract environmentally conscious consumers, and

enhance their competitiveness in sustainable markets. Companies that adopt green logistics principles seek suppliers who likewise comply with environmental standards, thereby strengthening the overall sustainability of the supply chain.

Green marketing encompasses all marketing activities carried out with environmental protection in mind. It emphasizes that by conserving and improving environmental quality, organizations contribute to sustainable development and ensure a better environment for future generations.

This article addresses a significant research gap: the lack of analysis regarding the impact of innovation on green marketing and green logistics in Lithuania. The novelty of this study lies in providing, for the first time, an evaluation of how innovations influence green marketing and logistics practices within the Lithuanian transport sector.

1. LITERATURE REVIEW AND HYPOTHESES

Green marketing is becoming an important aspect in developing a socially responsible business, preserving the environment, attracting new consumers, and entering new business markets. When developing a business, it can be a means of influencing consumers to buy more environmentally sustainable materials. Park et al. (2021) analyzed customer-generated information related to sustainability or green practices. According to Park et al. (2021), the audience perceives this information as more relevant and correct than the information created by a company or marketer. Managing such information creates a competitive advantage. Green marketing gives a transport company a competitive advantage, increasing the value of the service to the consumer. Majeed et al. (2022) evaluated that green marketing increases the value of the product and competitive advantage, and complies with environmental progress. Sustainability is important in the operations of every transport company. Often, sustainability is associated only with sorting and ecology, but sustainable decisions are made by companies in today's world. Kaur et al. (2022) argued that sustainability covers many business areas and processes. Implementing changes in all these areas could be too difficult for the company in terms of resources and time. It is recommended to start with the most relevant and impactful areas of sustainability. Green purchasing encourages goods, services, or works to be as environmentally friendly as possible. The objectives of green purchasing are to strengthen the capacity of contracting authorities to carry out green procurement and to ensure that green purchasing is carried out in accordance with environmental criteria and that the products thus purchased are environmentally friendly. García-Salirrosas and Rondon-Eusebio (2022) and Román-Augusto et al. (2022) analyzed green purchasing behaviors and developed marketing programs. Lievano Pulido and Ramon-Jeronimo (2023) state that green marketing meets three requirements: to meet the needs of consumers, to achieve the goals of the subject, and to achieve both things in a respectful and compatible way with various ecosystems, while Alkhatib et al. (2023) stated that sustainable marketing requires public support. Skackauskiene and Vilkaite-Vaitone (2023) analyzed that organizations accept the challenges of green marketing to meet the ever-increasing customer demand for sustainable consumption and improves customer behavioral indicators, namely purchase intention and energy consumption.

Summarizing the opinion of the authors, it could be stated that green marketing green electric cars on strengthens the brand image, increases the value of the product, increases the competitive advantage, adhering to environmental progress, which includes pricing, advertising and distribution of the final product, promoting demand for sustainable increasing consumption, and the novelty of business interaction.

Sustainable development is very important worldwide. Green logistics reduces the harmful impact by reducing carbon dioxide emissions (Table 1). Karia and Asaari (2016) present green logistics as logistics processes. Logistics processes include green packaging, green transportation, which includes the use of green vehicles; green ware-

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housing, which includes the layout of warehousing space; green management, which includes the strategic planning of green logistics. Green logistics was defined by Pannirselvan et al. (2016) as activities to meet environmentally friendly consumer needs. Green trend in logistics, green electric cars, on companies to gain efficiency (Khoa & Nhung, 2020).

Summarizing the authors' opinion, it can be stated that green logistics involves increasing the profits of companies. It also affects the promotion of pollution prevention and the promotion of sustainable production. It should be emphasized that it also affects the reduction of the impact of the external environment and the pursuit of a balanced economy, the development of society and the environment, ecology and environmental sciences, engineering, mathematics, and economics, to achieve significant scientific research results.

It is very important that transport activities are as environmentally friendly as possible and conserve resources. When it comes to green logistics, it is important that the services provided are greener and more environmentally friendly. Gubová (2020) stated that green logistics focuses on increasing customer concerns about the environment, buyers, community. New innovations and technologies in transport and logistics, such as real-time tracking, advanced data analytics and artificial intelligence solutions, are fundamentally changing the way the sector operates.

There is a need to reduce environmental impact, address workforce challenges and ensure the industry's resilience to rapid change. Richnák and Gubová (2021) considered that the goal of developing new logistics technologies and innovations is the expectation of positive results. According to Bibo et al. (2023), the technological innovations of companies have a long-term impact on green logistics, and companies must follow well in production lines and supply chain management. Song and Hu (2023) mentioned that various companies are pursuing green innovation, while Issa et al. (2024) state that it is important to reduce environmental damage and promote sustainability. Wang et al. (2024) mentioned that higher expectations are necessary for green technology innovation efforts. According to Wang et al. (2024), green technology is important in the sustainability of ecological economy, while Jalu et al. (2024) note that innovation is the result of a firm's business activities, focusing mainly on technological improvements. It has been noticed that an increasing number of customers demand that service providers adopt an appropriate and responsible approach to the natural environment surrounding us. Most often, the choice of consumers and their satisfaction with services is also determined by whether the company complies with environmental standards, cares about nature, and strives for sustainability in its activities. Weng et al. (2015) stated that customer concerns about environmental protection have made environmental management a central part of strategic planning in many organizations, while Tan et al. (2022) stated that branding is key components of environmental knowledge, attitudes and purchase intentions. Consumer expectations for responsible business behavior are constantly growing, so companies must effectively incorpo-

Table 1. Green logistics impact aspects

Source: Compiled by the authors.

Field of research	Author	Impact
Oriented to the environment	Wang et al. (2018)	To decrease the external environmental impact.
	Vienažindienė et al. (2021)	To reduce the negative impact of logistics.
	Khayyat et al. (2024)	Reduce the environmental impact
	Cheng et al. (2023)	Reduce global environmental impacts, promote pollution prevention, and promote sustainable production.
Oriented to reduce costs and improve efficiency	Zhou et al. (2023)	Improve resource efficiency and reduce costs.
	He and Xu (2024)	Promote the sustainable development of socioeconomic production and gain a competitive advantage, and achieve transformation and renewal.
Oriented to the supply chain	Čižiūnienė et al. (2024), Čižiūnienė and Matijošius (2018)	Increase green activities in supply chain management.
	Setyadi et al. (2023)	To integrate the movement of products in the supply chain.

rate sustainability principles into their marketing strategy and clearly communicate their actions. Zhang and Berhe (2022) implemented to provide sustainable marketing, while–Zheng et al. (2022) stated bilateral innovation, scholars mainly adhere to the bilateral equilibrium theory.

The purpose of the article is to evaluate the impact of innovation on green marketing and green logistics.

The study is based on the following statements (hypotheses):

H1: Long-term marketing strategy of transport/logistics companies is associated with environmental progress.

H2: Technological application of transport companies depends on their ability to conserve natural resources.

2. METHODOLOGY

A multi-criteria method was selected to assess the impact technological development on the marketing strategy transports companies. According to the multi-criteria method, the group of experts *n* quantitatively evaluates the objects.

The estimation matrix, consisting of *n* rows and *m* columns, is presented in Table 2. (Sivilevičius, 2011). In the rating procedure, the most critical indicator is assigned a rating equal to one *R*, the second one is assigned a rating of two, and the last one is assigned a rating of *m* (*m* is the number of benchmarks). Indicators are evaluated on a ten-point scale.

Expert indicator ranking is applied to calculate the concordance coefficient and the average of the sum of ranks (Podvezko, 2005):

$$\sum_{i=1}^{n} R_{ij} = \frac{1}{2} n(m+1), \quad (1)$$

m is the number of benchmarks, *n* – the number of experts, R_{ij} – a rank of *R*.

$$W = \frac{12S}{n^2 m(m^2-1)} = \frac{12S}{n^2(m^3-m)}, \quad (2)$$

W – the concordance coefficient. Pearson criterion χ^2 is calculated:

$$\chi^2 = n(m-1)W = \frac{12S}{nm(m+1)}, \quad (3)$$

$$W_{\min} = \frac{\chi^2_{v,\alpha}}{n(m-1)}. \quad (4)$$

Suppose *S* (variance) is the true sum of squares calculated by formula (1). In this case, the coeffi-

Table 2. Matrix of evaluation indicators

Expert X_1		Symbol, j = 1, 2, ..., *m*				
		X_2	X_3	...	X_m	
i = 1, 2, ..., *n*	E_1	R_{a1}	R_{a2}	R_{a3}	...	R_{am}
	E_2	R_{w1}	R_{w2}	R_{w3}	...	R_{wm}
	E_3	R_{d1}	R_{d2}	R_{d3}	...	R_{dm}
	...	...	...	...	...	...
	E_n	R_{n1}	R_{n2}	R_{n3}	...	R_{nm}
$\sum_{i=1}^{n} R_{ij}$	...	...	...	...	...	...
$\overline{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	...	...	...	...	...	...
$\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)$	...	...	...	...	...	...
$\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)\right]^2$	...	...	...	...	...	...

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cient of conformity (2), in the absence of product ranks, is defined as the ratio of the obtained S to the corresponding maximum S_{max}. The threshold value of the coefficient of conformity (W) is determined when the expert assessment can be agreed, and the coefficient of conformity can be used using (3) the Pearson criterion χ^2. The minimum value of the coefficient of conformity W_{min} is calculated (4). The consistency of expert opinions is determined by the Kendall coefficient of agreement of ranks.

Considering that the minimum recommended number of experts to from an expert group is 3, and the optimal size of an expert group is from 5 to 10 experts, 6 experts were included (Tidikis, 2003; Kardelis, 2002).

3. RESULTS

When conducting a study using the multi-criteria ranking method, according to Podvezko (2005), the recommended number of expert group members should be at least three. Drejeris et al. (2024) state that the optimal number of expert groups in multi-criteria studies ranges from 8 to 10 members, and at least 5 experts should be interviewed.

Six experts from different transport companies participated in the study. The experts had from 3 to 10 years of experience in the management of logistics and transport companies.

To assess the importance of the criteria, experts had to use a multi-criteria ranking method (in order of importance: 1 is the most important, 7 is the least important) which of applying long-term strategies to support the natural environment are important. The results are presented in Figure 1 in order to:

- follow environmental progress;
- benefit from green opportunities;
- strengthen the brand image;
- increase the production volumes;
- increase the competitive advantage;
- increase the value of the product;
- include the final product pricing.

Figure 1 shows that the experts gave the highest score to criterion 3 – strengthening the brand image.

The analysis of the distribution of ratings from the questionnaire data, which were validated by experts, is presented in Table 3.

When there are no related ranks, the concordance coefficient W is calculated according to formula (5):

$$1W = \frac{12S}{n^2\left(m^3 - m\right)} = \frac{12 \cdot 870}{6^2\left(7^3 - 7\right)} = 0.8631. \quad (5)$$

Then, according to formula (6), the weight of the concordance coefficient χ^2 is calculated and a random variable is obtained:

Source: Compiled by the authors.

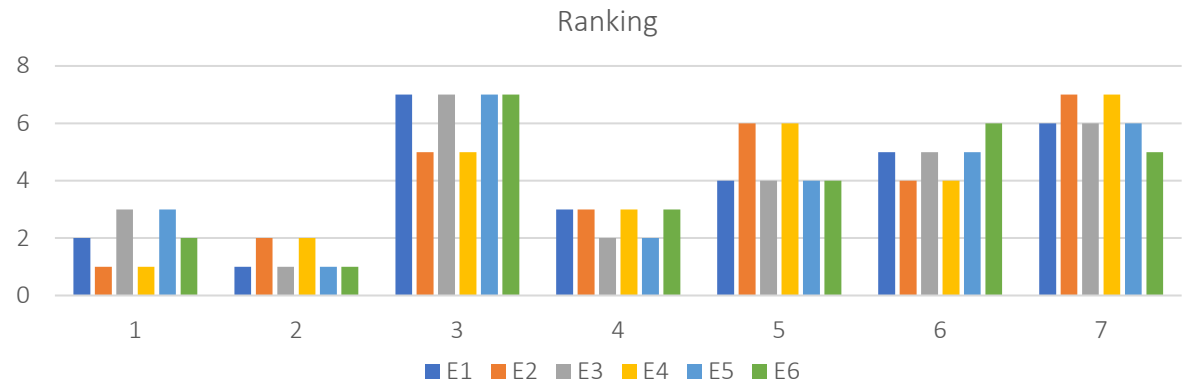

Figure 1. Expert rank distribution

Table 3. The most important criteria for applying long-term strategies for maintaining the natural environment

Respondent$_1$'s queue. No.	Factor encryption symbol (m = 7)						
	1	2	3	4	5	6	7
$\sum_{i=1}^{n} R_{ij}$	12	8	38	16	28	29	37
$\bar{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	2	1.333	6.333	2.667	4.667	4.833	6.167
$\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)$	–12	–16	14	–8	4	5	13
$\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)\right]^2$	144	256	196	64	16	25	169

$$\chi^2 = n(m-1)W = \frac{12S}{nm(m+1)} = \frac{12 \cdot 870}{6 \cdot 7(7+1)} = 31.07. \quad (6)$$

χ^2, the calculated value of 31.07 was higher than the critical value (equal to 12.5916), therefore, the respondents' opinions can be considered consistent, and the average ratings indicate the general opinion of the experts.

$$W_{\min} = \frac{\chi^2_{v,\alpha}}{n(m-1)} = \frac{12.5916}{6(7-1)} = 0.3498 < 0.8631. \quad (7)$$

The minimum value of the coefficient of correspondence $W_{\min}$, calculated according to the formula (7), where $W_{\min}$ = 0.3498 <0.8631, states that the opinions of all 6 respondents on 7 main criteria are still considered to be in agreement.

The main indicators of innovative technology tools are important in current operations are calculated – Q_j. The obtained data are presented in Table 4.

Based on expert assessments, the list of importance of the main criteria is as follows:

1) to benefit from green opportunities (2);
2) to follow environmental progress (1);
3) to increase the production volumes (4);
4) to increase the competitive advantage (5);
5) to increase the value of the product (6);
6) to include the final product pricing (7);
7) to strengthen the brand image (3).

Using a multi-criteria ranking method, experts had to assess the importance of criteria used to achieve green logistics goals (in order of importance: 1 is the most important, 9 is the least important) is presented in Figure 2:

- reduce the external environmental impact of logistics operations;

Table 4. The main important indicators Q_j

Source: Compiled by the authors.

Indicator marker	Factor encryption symbol (m = 7)							Sum
	1	2	3	4	5	6	7	
q_j	.0714	.0476	.2262	.0952	.1667	.1726	.2202	1
d_j	.9286	.9524	.7738	.9048	.8333	.8274	.7798	6
Q_j	.1548	.1587	.1290	.1508	.1389	.1379	.1300	1
Q_j'	.2143	.2381	.0595	.1905	.1190	.1131	.0655	1
Factor layout	2	1	7	3	4	5	6	–

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- important prerequisite for reducing the negative environmental impact of logistics processes;
- improve the resource efficiency and reduce costs;
- reduce the global environmental impact, promote the pollution prevention and promote sustainable production;
- integration of all activities related to the movement of products in the supply chain, and the process starts from the raw materials of certain products through production and distribution systems to end users, while linking reverse logistics;
- focus is on the relationship between transport modes and the environment;
- promote the sustainable development of social and economic production and gain competitive advantage and achieve transformation and renewal;
- reduce the environmental impact of logistics activities and reducing waste, increasing the product brand value, improving operational efficiency and reducing costs through optimal energy use;
- growing trend in supply chain management, incorporating green elements into global strategies.

Figure 2 shows that the experts gave the highest score to criterion 5 – the integration of all activities related to the movement of products in the supply chain, and the process starts from the raw materials of certain products through production and distribution systems to end users, while linking reverse logistics.

The analysis performed by six experts and the calculation of the distribution of ratings from the questionnaires are presented in Table 5.

When there are no related ranks the concordance coefficient, W is calculated according to formula (8). Then, according to formula (8), the weight of the concordance coefficient χ^2 is calculated and a random variable is obtained:

$$\chi^2 = n(m-1)W = \frac{12S}{nm(m+1)} = \frac{12 \cdot 1344}{6 \cdot 9(9+1)} = 29.87. \quad (8)$$

χ^2, the calculated value of 29.87, was higher than the critical value (equal to 15.5073), therefore, the respondents' opinions can be considered consistent, and the average ratings indicate the general opinion of the experts.

$$W = \frac{12S}{n^2\left(m^3 - m\right)} = \frac{12 \cdot 1344}{6^2\left(9^3 - 9\right)} = 0.6222. \quad (9)$$

$$W_{\min} = \frac{\chi^2_{v,\alpha}}{n(m-1)} = \frac{15.5073}{6(9-1)} = 0.3231 < 0.6222. \quad (10)$$

The minimum value of the coefficient of correspondence, $W_{\min}$, calculated according to the for-

Source: Compiled by the authors.

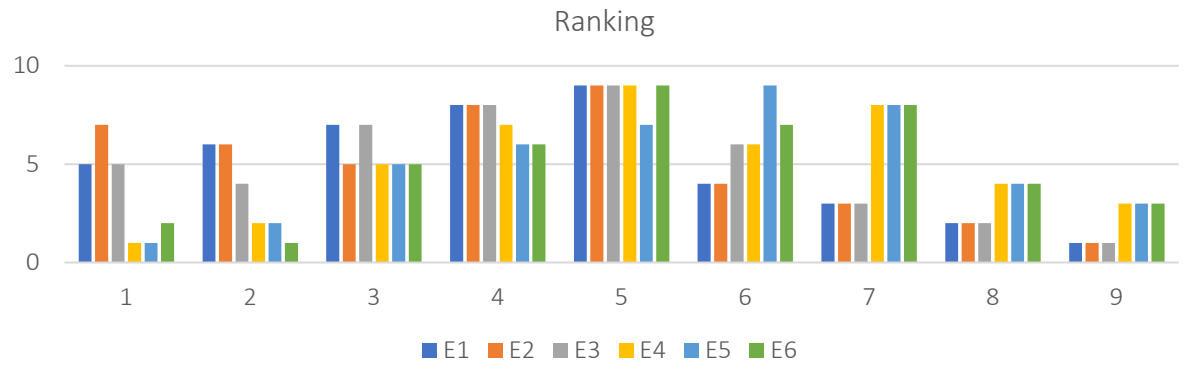

Figure 2. Distribution of expert ranks to achieve green logistics goals

Table 5. The most important criteria for achieving green logistics goals

Calculation	Symbols (m = 9)								
	1	2	3	4	5	6	7	8	9
$\sum_{i=1}^{n} R_{ij}$	21	21	34	43	52	36	33	18	12
$\overline{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	3.50	3.50	5.667	7.167	8.667	6	5.50	3	2
$\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)$	–9	–9	4	13	22	6	3	–12	–18
$\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)\right]^2$	81	81	16	169	484	36	9	144	324

mula (10), where $W_{\min} = 0.3231 < 0.6222$, states that the opinions of all 6 respondents on 9 main criteria are still considered to be in agreement.

The main indicators of innovative technology tools are important in current operations are calculated – Q_j. The obtained data are presented in Table 6.

Based on expert assessments, the list of importance of the main criteria is as follows:

- growing trend in supply chain management, incorporating green elements into global strategies (9);
- reducing the environmental impact of logistics activities and reducing waste, increasing the product brand value, improving operational efficiency and reducing costs through optimal energy use (8);
- important prerequisite for reducing the negative environmental impact of logistics processes (2);
- reduce the external environmental impact of logistics operations (1);
- promote the sustainable development of social and economic production and gain competitive advantage and achieve transformation and renewal (7);
- improve the resource efficiency and reduce costs (3);
- focus is on the relationship between transport modes and the environment (6);
- integration of all activities related to the movement of products in the supply chain, and the process starts from the raw materials of certain products through production and distribution systems to end users, while linking reverse logistics (5);
- reduce the global environmental impact, promote pollution prevention and promote sustainable production (4).

Table 6. The important indicators Q_j

Source: Compiled by the authors.

Marker	Symbols (m = 9)									Sum
	1	2	3	4	5	6	7	8	9	
q_j	.078	.078	.126	.159	.193	.133	.122	.067	.044	1
d_j	.922	.922	.874	.841	.807	.867	.878	.933	.956	8
Q_j	.115	.115	.109	.105	.101	.108	.110	.117	.119	1
Q_j'	.144	.144	.096	.063	.030	.089	.100	.156	.178	1
Factor layout	3	3	6	9	8	7	5	2	1	-

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Source: Compiled by the authors.

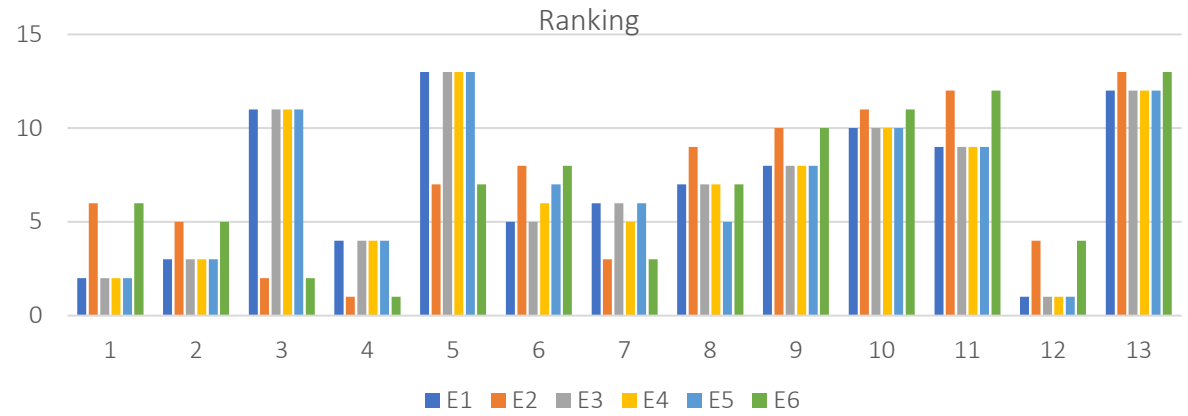

Figure 3. Ratings data

The experts had to use a multi-criteria ranking method to assess the importance of the criteria of applying to achieve green logistics goals (in order of importance: 1 is the most important, 13 is the least important) is presented in Figure 3:

- for green packaging;
- for ecological storage;
- information sharing with manufacturing companies and retailers;
- for the environmentally friendly application of technologies to save resources;
- for logistics emissions;
- for vehicle route optimization;
- for the development of logistics networks;
- new or modified products and processes;
- competitive advantage in implementing ambiguous green innovation behavior;
- regulation on consumer education on environmental issues;
- improving the company's image in the markets;
- green brand;
- green brand awareness.

The analysis performed by six experts and the calculation of the distribution of ratings from the questionnaires are presented in Table 7.

When there are no related ranks the concordance, coefficient W is calculated according to formula (11):

$$W = \frac{12S}{n^2\left(m^3 - m\right)} = \frac{12 \cdot 5002}{6^2\left(13^3 - 13\right)} = 0.7634. \quad (11)$$

Then, according to formula (12), the weight of the concordance coefficient χ^2 is calculated and a random variable is obtained:

$$\chi^2 = n\left(m-1\right)W = \frac{12S}{nm\left(m+1\right)} = \frac{12 \cdot 5002}{6 \cdot 13\left(13+1\right)} = 54.967. \quad (12)$$

χ^2, the calculated value of 54.967, was higher than the critical value (equal to 21.0261), therefore, the respondents' opinions can be considered consistent, and the average ratings indicate the general opinion of the experts:

$$W_{\min} = \frac{\chi^2_{v,\alpha}}{n\left(m-1\right)} = \frac{21.0261}{6\left(13-1\right)} = 0.2920 < 0.7634. \quad (13)$$

The minimum value of the coefficient of correspondence $W_{\min}$, calculated according to the formula (13), where $W_{\min}$ = 0.2920 <0.7634, states that the opinions of all 6 respondents on 13 main criteria are still considered to be in agreement.

Table 7. Ranking 1 of the most important criteria according to the of the impact of green logistics and marketing component innovations

Source: Compiled by the authors.

Formula	Symbols (m = 13)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
$\sum_{i=1}^{n} R_{ij}$	20	22	48	18	66	39	29	44	52	62	60	12	74
$\bar{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	3.333	3.667	8	3	11	6.5	4.833	7.333	8.667	10.333	10	2	12.333
$\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)$	–22	–20	6	–24	24	–3	–13	2	10	20	18	–30	32
$\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2} n(m+1)\right]^2$	484	400	36	576	576	9	169	4	100	400	324	900	1024

Table 8. The main indicators of the impact of green logistics and marketing component innovations important indicators Q_j

Source: Compiled by the authors.

Indicator marker	Factor encryption symbol (m = 13)													Sum
	1	2	3	4	5	6	7	8	9	10	11	12	13	
q_j	0.037	0.040	0.088	0.033	0.121	0.071	0.053	0.081	0.095	0.114	0.110	0.022	0.136	1
d_j	0.963	0.960	0.912	0.967	0.879	0.929	0.947	0.919	0.905	0.886	0.890	0.978	0.864	12
Q_j	0.080	0.080	0.076	0.081	0.073	0.077	0.079	0.077	0.075	0.074	0.074	0.082	0.072	1
Q_j'	0.117	0.114	0.066	0.121	0.033	0.082	0.101	0.073	0.059	0.040	0.044	0.132	0.018	1
Factor layout	3	4	8	2	12	6	5	7	9	11	10	1	13	–

The main indicators of the impact of green logistics and marketing component innovations – Q_j – are calculated. The obtained data are presented in Table 8.

Based on expert assessments, the list of importance of the main criteria is as follows (Table 8):

- green brand (12);
- for the environmentally friendly application of technologies to save resources (4);
- for green packaging (1);
- for ecological storage (2);
- for the development of logistics networks (7);
- for vehicle route optimization (6);
- new or modified products and processes (8);
- information sharing with manufacturing companies and retailers (3);
- competitive advantage in implementing ambiguous green innovation behavior (9);
- improving the company's image in the markets (11);
- regulation on consumer education on environmental issues (10);
- for logistics emissions (5);
- green brand awareness (13).

It can be stated that the influence of technological innovations on green logistics and marketing strat-

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Source: Compiled by the authors.

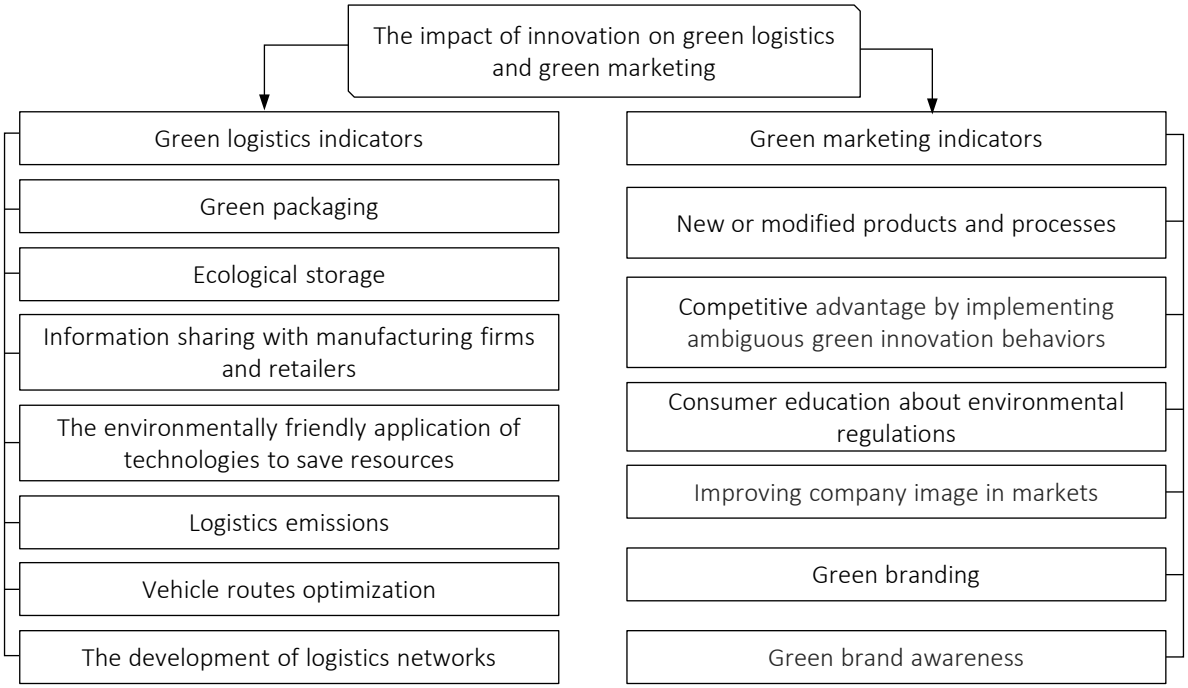

Figure 4. The impact of innovation green electric cars on green logistics and green marketing

egy is significant. The analysis of the application of innovations in the company's activities shows the connection and interaction with green logistics and marketing strategy. This confirms the hypothesis that the long-term marketing strategy of transport/logistics companies is related to environmental progress. The most important criteria are the following: the growing trend of supply chain management, including green elements in global strategies and the benefits of using green options and the green brand itself. This confirms the hypothesis that the application of technologies by transport companies depends on their ability to conserve natural resources.

Figure 4 shows the impact of innovation on green logistics and green marketing Ecological storage. The goal of the eco-friendly storage is to reduce energy consumption and electronic waste by optimizing how data centers manage and maintain digital storage systems. Information sharing, synchronization of augmentation, and collaboration in product development. The environmentally friendly application of technologies to save resources apply to environmentally friendly innovations. Logistics emissions. A successful transition to more sustainable logistics requires meaningful approaches. Vehicle routes optimization. Uses data and productivity of fleet routes. Gasset et al. (2024) mentioned that optimization challenges are finding the best routes. The development of logistics networks. New or modified products and processes. Successful commercial application of new technologies, ideas and methods by bringing new or improving existing.

Competitive advantage by implementing ambiguous green innovation behaviors.

Consumer education about environmental regulations. Consumer education is the readiness of individual decisions when purchasing products the consumer culture. It usually includes various consumer that the consumer can expect: standard trading practices and environmental regulations.

Improving company image in markets. Clearly demonstrates trust and reliability with its audience, and shows the main values on the company's website and marketing materials.

Green branding is a brand in which environmental values form the brand.

4. DISCUSSION

Green logistics is most often associated with air pollution, noise, land use or landscape dam-

age. The concepts and implementations, problems and opportunities of green logistics have been widely studied by Lithuanian and foreign authors. One could single out the study by Radavičiūtė and Jarašūnienė (2019), which presents the stages of green logistics that are necessary for managing a the company's green logistics strategy. Patra (2018), studying the factors affecting green logistics, distinguished price, emissions. Kwak et al. (2020) distinguished the goal of green logistics in their research, which includes the management of the environmental impacts of activities, and of general logistics activities, i.e. logistics operations (direct and reverse activities). Therefore, companies that carry out logistics activities must also evaluate the marketing strategy of the company's activities before making decisions related to green logistics. Larina et al. (2021) linked green logistics to the environmental impact. Reducing environmental pollution provides an opportunity for competitive advantage. This is related to customers who demand that the logistics service would be performed with sustainable technologies. Tüzün Rad and Gülmez (2017) stated that the field of green logistics must improve the operational efficiency of a logistics company. Of course, implementing green logistics is a complex and resource-intensive process. Logistics companies face the knowledge of implementation processes due to the lack of information and competent employees. Another problem in implementing green logistics processes is the lack of innovative technologies and the inability to assess potential benefits. Strategy requires large investments in employee training or hiring additional specialists, and the acquisition of modern and advanced technologies. Most companies do not apply a green logistics strategy due to the lack of knowledge and funds. This was also confirmed by the study by Prieskienytė (2022). Gelmez et al. (2024) and Wang et al. (2022) mentioned that green innovation plays an important role in green logistics, while Wang et al. (2022) considered that green innovation in the logistics industry is key to mitigating environmental crises and ensuring a sustainable development. It is generally accepted that all logistics processes have an impact on the environment. This sustainability awareness is a key element of a green strategy. Companies wishing to transition to green logistics should implement green solutions in their operations. Green solutions should be related to a green long-term strategy. This could be related to innovative technologies used in logistics processes, greener transport, process automation. Most often, logistics companies face a lack of innovation, which is necessary to introduce or produce new products.

The research of this article shows that the most important criteria are the benefits of using green options, and the green brand itself. The results of this study showed that logistics companies' long-term strategies to preserve the natural environment are related to opportunities to take advantage of green opportunities and monitoring environmental progress. The results of the study showed that the main investments of logistics companies are related to green branding and the application of environmentally friendly technologies, saving natural resources.

CONCLUSIONS

Changes in the market are orienting logistics/transport companies towards sustainable data exchange and improving service quality. This includes focusing on green marketing in all activities and its implementation with the help of innovative technologies.

It has been established that the long-term marketing strategy of transport/logistics companies is associated with environmental progress. The most important elements (presented in Table 4) are: 1) taking advantage of green opportunities (2); 2) following environmental progress (1); 3) increasing production volumes (4).

It has been established that the marketing tools used to achieve the goals of green logistics are most often green marketing elements. The most important elements (presented in Table 6) are 3 and are arranged in the following order: 1) the growing trend of supply chain management, including green elements in global strategies (9); 2) reducing the environmental impact of logistics activities and reducing waste, increasing the value of the product brand, improving operational efficiency and reducing costs through optimal use of energy (8); 3) an important assumption for reducing the negative impact of logistics processes on the environment (2).

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The results of the expert assessment show that in order to achieve the relationship between green logistics and a green marketing strategy, the following are most important (Table 8): 1) green branding (12); application of environmentally friendly technologies to save resources (4); 3) green packaging (1).

It was found that the data obtained confirmed both hypotheses: 1) the long-term marketing strategy of transport/logistics companies is related to environmental progress; 2) the application of transport companies' technologies depends on their ability to conserve natural resources.

The results of the study can be used as a basis for green strategy and green logistics applications, as well as part of the application of innovative technologies.

LIMITATIONS

The level of provision of innovative technologies and the scope of logistics processes depends on the size of the companies. The question of the reliability of the results obtained arises, since only large logistics companies were surveyed during the study and the interviewed experts represented only large logistics centers.

The research can be extended beyond multi-criteria assessment methods. Similar studies can be conducted in specific modes of transport, modelling non-standard, movement-restricting situations. It would also be appropriate to review possible areas in other studies, such as the management system used and its impact on green strategy and green logistics.

AUTHOR CONTRIBUTIONS

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Supervision: Kristina Vaičiūtė, Margarita Išoraitė.
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Writing – original draft: Kristina Vaičiūtė, Margarita Išoraitė.
Writing – review & editing: Kristina Vaičiūtė, Margarita Išoraitė.

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