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ANALYSIS OF FREIGHT TRANSPORT EFFICIENCY AND IMPROVEMENT OPPORTUNITIES

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Abstract

Relevance of the topic. In the modern world, the logistics sector is one of the most important components of the modern economy, which ensures the smooth movement of goods both internationally and locally. To ensure operational results and competitiveness in the market, it is worth considering the efficient process of cargo transportation. Extremely high competition in the transport sector forces companies to achieve better and more efficient results and to look for ways to optimize operations, improve the process of cargo transportation and reduce costs. According to Grzełakowski (2025), the transport sector in the European Union is undergoing a transformation – companies are encouraged to reduce emissions, find more effective solutions in response to geopolitical, energy and market challenges, as well as implement advanced technologies. Liu et al. (2024) emphasize that sustainable development, the use of digital solutions in logistics activities and energy efficiency are becoming increasingly important in the freight transportation sector, and consumers increasingly appreciate the company's efforts to contribute to environmental protection. Liu et al. (2024) emphasize that sustainable development, the use of digital solutions in logistics activities and energy efficiency are becoming increasingly important in the freight transport sector, and consumers increasingly appreciate the company's efforts to contribute to environmental protection.. **Problem statement.** Very small companies often face operational efficiency problems due to lack of human resources, limited resources, aging transport fleet or insufficiently developed solutions. Without organizational and financial capabilities, it is very difficult for them to compete with large logistics companies. For this reason, it becomes extremely important to identify areas for operational improvement and look for internal optimization solutions that would reduce costs, organize freight transportation and improve service quality. Therefore, this paper raises the problem – how can very small transport companies increase operational efficiency when organizing transportation? **Purpose of the article.** To analyze the activities of small companies and propose solutions to improve freight transportation activities. Research objectives. Conduct a theoretical analysis of freight transportation activities and determine the main criteria for assessing efficiency and propose solutions to improve freight transportation operations. **Research methodology.** To properly disclose the topic of the dissertation and achieve the set goal and objectives, the following research methods were used: analysis of scientific literature and other sources, document analysis, comparative analysis.

Key words: freight transportation, logistics management, KPI, digitalization, supply chain.

Introduction. Relevance of the topic. In today's world, the logistics sector is one of the most important components of the modern economy, which ensures the smooth movement of goods both internationally and locally. To ensure operational results and competitiveness in the market, it is worth considering the efficient process of cargo transportation. Extremely high competition in the transport sector forces companies to achieve better and more efficient results and look for ways to optimize operations, improve the cargo transportation process, and reduce costs. According to Grzelakowski (2025), the transport sector in the European Union is undergoing a transformation – companies are encouraged to reduce emissions, seek more effective solutions in response to geopolitical, energy and market challenges, and implement advanced technologies. Liu et al. (2024) emphasize that sustainability, the application of digital solutions in logistics activities, and energy efficiency are becoming increasingly important in the freight transportation sector, and consumers increasingly appreciate the company's efforts to contribute to environmental protection.

The increase in demand for transportation services and the complexity of supply chains poses more risks to the smoothness of logistics processes. According to Vrhovac et al. (2023), to eliminate these obstacles, it is necessary to improve the quality of the transportation process, since it is on it that both the implementation of environmental goals and efficiency depend. As Norman-López et al. (2024) argue, the analysis of supply chain efficiency becomes a prerequisite for increasing customer satisfaction, ensuring flexibility and reducing system vulnerability.

Problem Statement. Very small companies often face operational efficiency problems due to

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lack of human resources, limited resources, aging transport fleet or insufficiently developed solutions. Without organizational and financial capabilities, it is very difficult for them to compete with large logistics companies. For this reason, it becomes extremely important to identify areas for operational improvement and look for internal optimization solutions that would allow reducing costs, organizing cargo transportation, and improving the quality of services. Therefore, this paper raises the problem – how can very small transport companies increase operational efficiency when organizing transportation?

The purpose of the article. To analyze the activities of small companies and provide solutions for improving freight transportation activities.

Research objectives. To conduct a theoretical analysis of freight transportation activities and determine the main efficiency assessment criteria and provide solutions for improving freight transportation operations.

Methodology of investigation. In order to properly reveal the topic of the thesis and achieve the set goal and tasks, the following research methods were used: analysis of scientific literature and other sources, document analysis, comparative analysis.

Logistics activities. According to Grant et al. (2022), logistics management encompasses a variety of activities that are designed to ensure the efficient, effective movement of goods and services through the supply chain. These include services such as inbound and outbound transportation coordination, warehousing, order management, materials handling, logistics network organization, inventory control, supply and demand planning, and management of third-party logistics services. Logistics functions also include: customer service, procurement and supply, scheduling and production planning, packaging, and assembly. Bowersox et al. (2020) mention in their study that the organization of freight transportation must comply with clear requirements, laws and regulations, which include environmental standards and safety requirements. Knowledge of these legal requirements can help avoid potential sanctions and ensure the smooth execution of domestic and international transportation.

According to Urazán-Bonells et al. (2024), the importance of freight transport in every country is undeniable, it is an essential component of the transport economy. Freight transportation must be extremely well organized to achieve the highest level of efficiency while reducing transportation costs. As stated by Xu et al. (2022), ensuring efficiency depends on the appropriate selection of transport, consistent route planning, and the application of modern technologies that allow for real-time vehicle tracking.

The management of the flow of goods from suppliers to end users is directly related to the core logistics activity. According to Grant et al. (2022), this includes services such as:

– transportation. The transportation of goods from one place to another, using various means of transport such as: road, sea or air;

– warehousing. The storage of goods in warehouses to ensure their availability to customers;

– inventory management. The control and regulation of inventory levels allows you to avoid excess or shortages;

– order management. It includes the entire process from order acceptance to shipment to the customer, including order processing, packaging, logistics;

– materials handling. The efficient organization of the movement of goods in warehouses or distribution centers;

– packaging. The protection of goods during storage and transportation in order to maintain their quality to the customer.

According to Grant et al. (2022), auxiliary logistics activities such as:

– provisioning. The acquisition of goods and services is essential for smooth logistics operations;

– logistics information systems. For tracking goods, preparing reports, and other logistics management functions;

– demand planning. Forecasting future customers in order to effectively manage inventory and ensure their availability;

– customer service. Delivering goods on time and satisfying customers;

– reverse logistics. Repair, recycling, or returns processes that allow for the efficient handling of returned goods.

Due to the complexity of logistics processes, companies often use external partners – 2PL, 3PL or 4PL logistics service providers. According to Maersk (2024), in the 2PL model, the company directly hires a carrier to transport cargo from point A to B, maintaining control, but having more coordination responsibility. According to Kmiecik (2024), 3PL service providers usually perform functions such as transport management, order fulfillment and distribution, warehousing, performing these functions for the company, allowing it to focus on its core business. 4PL service providers often assume full responsibil-

ity for managing the entire supply chain. These service providers also coordinate several 3PL partners, as well as provide strategic planning, technological solutions and analysis. According to Leylaparast et al. (2025), the application of both 3PL and 4PL models contributes to increasing logistics efficiency, especially when logistics solutions require sustainability, flexibility, and price matching with customer needs.

As Winiarska and Kizielewicz (2023) write in their work, analyzing common company processes and applying appropriate structural changes and coordinating them properly results in more effective employee communication and improves the smoothness of ongoing processes.

Considering that transportation is one of the main functions in logistics, it is important to evaluate different modes of transport, their pros and cons, in order to choose the optimal solution for transporting goods. As Ambrazevičius (2008) states, each mode of transport has its own pros and cons, therefore, when choosing a transport for transporting goods, it is important to take this into account.

Air transport is one of the most reliable, fastest, but most expensive types of cargo transportation. Therefore, this method of cargo transportation is most often used to transport high-value goods, as well as goods requiring urgent delivery – perishable products or urgent shipments. According to Norman-López et al. (2024), the advantages of air transport include a low risk of loss or damage, short transit time and the ability to reach even the most remote, remote places in the world. However, this mode of transport has several significant disadvantages, such as limited loading space, high transportation costs and dependence on airport infrastructure and weather conditions. Due to high operating costs, this transport is mainly used for small cargoes that are small in volume but high in value, for example: electronics, medical equipment, perishable products, and urgent shipments.

Road transport is one of the most flexible and popular modes of freight transport and is particularly suitable for short to medium distances. According to the European Road Freight Transport Report (2024), road transport is the dominant mode of freight transport. However, road transport faces infrastructure pressure and increasing operating costs. However, despite these economic challenges, the road transport market is expected to continue to grow. This is due to advantages such as the ability to transport goods from door to door, high flexibility and speed, which allows for a quick response to customer needs or market changes. Road transport also has disadvantages, such as: fuel prices, road taxes, traffic congestion, strict environmental requirements. These disadvantages can negatively affect the road transport sector. According to the European Road Freight Transport Report (2024), a significant proportion of freight is still transported by road, although the increasing infrastructure load and increasing operating costs encourage the search for alternatives that can distribute the load and reduce costs. One such alternative could be to shift freight to inland waterways, since the vast majority of freight such as construction materials, grains or fertilizers are still transported by road. This transfer could reduce freight transport costs and infrastructure load. Despite these aspects and challenges, this mode of freight transport is unlikely to be replaced by another in the near future. Because it ensures fast, convenient, flexible, direct delivery of freight under various conditions. This is also confirmed by Xu, Zhu and Pu (2025), who note that with the growth of digital technologies and environmental requirements, road transport is much better able to adapt to market changes and customer needs due to its flexibility.

Railway transport is particularly suitable for long-distance and large-volume cargo. According to a study by Sansyzbay et al. (2024), the demand for railway transport has been growing steadily in recent years. This mode of transport is a strategically important part of the supply chain, as it is characterized by lower operating costs compared to other means of transport such as road transport. Infrastructure is the main factor in the development of this mode of transport, because only properly developed railway infrastructure allows for the optimization of logistics processes, reduction of road congestion, and ensuring reliable and stable freight transportation. Railway development also directly affects the country's economy. Because this mode of transport allows for the reduction of transportation costs, thereby increasing the efficiency of the movement of goods internationally. Kolasa (2024) emphasizes that in order to increase the competitiveness of the sector, it is necessary to invest in modern digitalization and signaling systems. These systems can help reduce operating costs and increase transportation speed. However, the biggest problem in this sector is that the infrastructure is limited, and where the infrastructure is developed it has already reached its capacity limits, therefore it is important to continue to address this problem and invest in network development. Network development can help maintain supply chain effi-

ciency. In order to create a competitive, successful, reliable and less polluting transport sector, infrastructure development remains an important way to solve the problem. Although rail transport is also becoming an increasingly relevant alternative.

Sea transport is one of the main modes of transportation used for international transportation of large, heavy items. According to Grabauskienė and Čaplikienė (2020), the advantages of sea transportation include high loading capacity, the ability to transport various types of cargo, even hazardous materials, with lower transportation costs over long routes. However, sea transport has several disadvantages, which include: a higher risk of cargo loss or damage, long transit time, and dependence on weather conditions. It is precisely because of these features that sea transport is usually chosen for cargoes for which delivery time is not so relevant, but low delivery cost is the main factor, which are most often large, heavy cargoes.

Pipeline transport is one of the fastest, safest, and most efficient ways to transport natural gas and oil over long routes. According to Kang et al. (2024), they ensure uninterrupted, reliable supply, and are an excellent artery for the country's energy development. However, the risks of this transportation can contribute to natural disasters, as the explosive and flammable risks of materials transported by pipelines are high. However, research shows that modern pipeline transportation methods are applied to efficiency and safety. According to Bo Liu et al. (2025), in order to reduce resistance losses and optimize pipeline transportation, it is necessary to spend time analyzing hydrodynamics, since it plays a major role in pipeline transportation systems. It has also been noted that it is necessary to properly select the flow parameters and composition of the transported material. Despite these aspects, pipeline transportation remains not only more environmentally friendly than traditional transportation methods, as it reduces emissions, but also more economical.

Key KPIs in logistics. According to Tian et al. (2024), specific tools such as KPI (Key Performance Indicator) can be used to assess efficiency, which can measure specific indicators that show how well processes are being implemented, for example, in the field of customer service, supply, logistics or transportation. One of the most important KPI indicators is OTIF (On-Time-In-Full), this indicator shows whether the company delivers on time, full or partial loads. This indicator consists of two main parts:

– On-time – did the delivery occur when agreed with the customer?

– In-Full – was everything that was ordered delivered?

This OTIF indicator in the supply chain is quite important because it allows you to assess the reliability of the company and its ability to comply with the agreed conditions. A high OTIF result reduces the risk of disputes, increases customer trust and ensures smooth management of the supply process.

As Mahmoud Ali (2024) states, one of the most important practical indicators in the transport and logistics sector is the transport utilization indicator. This indicator shows how efficiently the company's transport fleet is used over a certain period. It allows you to assess whether the available means are fully utilized in terms of working hours, mileage, and number of orders.

Rasool, Greco and Stazzullo (2024) state that fuel consumption is an indicator, which is usually expressed in liters per hundred kilometers – l/100 km, and this indicator is one of the essential components of both financial and environmental efficiency of logistics activities. It helps to analyze whether the company is economically carrying out transportation activities. Lower fuel consumption is directly related to lower emissions, lower operating costs. Systematic monitoring of this indicator allows you to identify driving style, technical condition of transport, and efficiency of route planning.

According to Mahmoud Ali (2024), transportation costs per kilometer are the most used logistics cost indicators. This indicator shows how much one kilometer with cargo costs on average, including all costs incurred during the trip – labor, fuel, insurance, maintenance, road taxes, etc. Analysis of this one of the KPI indicators helps to identify economically inefficient routes, plan pricing or compare different types of vehicles.

According to Velasco et al. (2024), the transportation duration indicator allows you to assess the speed of the logistics process. It measures the delivery time of the cargo, from departure to delivery to the final recipient. Transportation duration is important both for customers and in supply chain planning, as longer transportation duration can indicate suboptimal planning, downtime at the border or inefficiency of routes.

According to See et al. (2024), the widely used logistics efficiency assessment method is the Logistics Performance Index (LPI), which consists of six main components: infrastructure quality, logistics service quality, shipment tracking and delivery timeliness, customs clearance efficiency, and international ship-

ping accessibility. The study emphasizes that efficiency assessment is becoming increasingly important because it can contribute to a country's economic growth. The assessment can also be useful in maintaining a competitive advantage internationally. This assessment tool was developed by the World Bank, which also uses it to compare how countries organize logistics activities and assess strengths and weaknesses. This tool is suitable not only at the company level, but also at the national level. The LPI method helps not only countries but also companies make strategic decisions.

Based on the insights of Ali (2024), Rasool et al. (2024) and Velasco et al. (2024), to more fully assess the efficiency of logistics activities, it is necessary not only to identify individual KPI indicators, but also to analyze their interrelationships. High vehicle utilization can affect both transportation duration and fuel consumption. By effectively utilizing the fleet, it is possible to ensure a better OTIF result and reduce costs per kilometer. Also, monitoring these indicators allows for timely identification of deviations and application of preventive measures to improve efficiency. The assessment of such KPI indicators is especially important in very small companies, whose performance depends on the optimization of each process link.

Challenges of practical application of KPIs in very small transport companies. According to Huseynova et al. (2025), KPIs are an integral part of modern logistics management, but their application in micro-enterprises often faces practical challenges. Performance assessment is often based on limited data, such as cost reports, travel sheets or subjective manager assessment, as micro-enterprises often do not have separate analysts or specialized information technology (IT) systems. This makes it difficult to make objective decisions and limits the potential of the KPI system.

One of the biggest challenges is the lack of time and expertise. As Grant et al. (2022) point out, managers of micro– or small enterprises often perform several tasks at the same time (customer service, documentation preparation, logistics planning), so there is not enough time for systematic KPI monitoring or it remains secondary. Also, data processes are not standardized, which creates risks of human error and hinders the analysis of long-term trends.

Another aspect is the limited use of KPIs for decision-making. As Rasool et al. (2024), although at a theoretical level it is clear that, for example, an increase in the fuel consumption indicator should encourage a technical audit of the transport fleet, when assessing the efficiency of vehicles, operating costs, however, in practice small or very small companies often have neither the financial resources nor the time to implement such actions. For this reason, KPI often remains only a formal, rather than a really applied management tool.

However, even very small companies can successfully apply simple KPI systems in their activities. According to Huseynova et al. (2025), simple Excel-based templates allow you to track key indicators: the number of orders and delivery times, fuel consumption, vehicle mileage. Such practice allows you to gradually move to more informed decision-making and structured management.

As Keramat et al. (2024) point out, the application of KPI in very small logistics companies is becoming increasingly relevant due to customer expectations and growing competition. Even small improvements, such as optimizing transport routes based on efficiency indicators, can significantly reduce operating costs and increase customer satisfaction. Therefore, this measure must be applied not only formally, but also in practice, the KPI system must be adapted to the capabilities of the company.

Specifics and challenges of very small vehicle companies. Based on a study conducted by the Ministry of Transport and Communications of the Republic of Lithuania in 2021, it can be assumed that small and medium-sized enterprises occupy a significant place in the logistics sector. According to a study conducted by Grzelakowski, A.S. (2025), 91 percent of land transport sector companies in the European Union (EU) are small or very small enterprises with fewer than 10 employees. According to data from the Ministry of Transport and Communications of the Republic of Lithuania (2021), as many as 99 percent of transport sector companies operating in the country are small or medium-sized enterprises with only a few vehicles or only a few employees.

Small and very small vehicles are characterized by flexibility, closer and closer contact with customers, and quick decision-making. According to Hamza et al. (2024), it is much easier for very small companies to adapt to market needs – they are better aware of infrastructure, seasonal fluctuations, regional specifications, and customer flows. For this reason, they are often chosen by larger partners or manufacturers who need fast, reliable distribution on a local scale.

According to Kapoor and Singh (2021), the biggest problem of very small transport companies is that

they usually operate in an unregulated market, highly fragmented, dominated by many intermediaries. For this reason, companies often become dependent on freight platforms or forwarders, which is reflected in the company's efficiency, costs, and profitability. Very small companies rarely have strategic planning and usually make decisions based only on the operational level.

According to Kapoor and Singh (2021), low technological readiness is a second significant problem. Very small companies still usually do not use technological systems and manually fill out documents, waybills, use non-automated accounting systems, and the level of digitalization still remains minimal. The lack of use of technological systems limits their ability to monitor cargo in real time, respond to customer needs, and optimize routes.

Another acute problem and difficulty faced by the companies in question is the shortage of labor, i.e. drivers. As Quintero-Azcunaga et al. (2024) states, very small companies experience frequent employee turnover because they cannot offer attractive working conditions or competitive wages. This only contributes to even greater inefficiency, as it is difficult to ensure delivery accuracy and consistent service quality.

Also, very small companies often face limited access to financial resources. According to Hamza et al. (2024), economic uncertainty and competitive pressure can reduce the effectiveness of such investments – it is difficult for companies to allocate funds to update technologies, improve employee qualifications, and modernize their transport fleet. Also, tightening European Union requirements and environmental requirements can often require a systematic approach to risk management.

As Singh and Rastogi (2023) argue, micro and small enterprises often face weak corporate governance, as decision-making is often made by a single person, based on personal connections, rather than on sound judgment. Such decisions prevent the enterprise from realizing its full potential and limit the development of professional management.

Conclusion. After conducting a theoretical analysis of freight transportation activities, the main efficiency assessment criteria were established. The theoretical part examined the principles of freight transportation organization, the main logistics activities, different transportation methods and their features. The main efficiency assessment methods were identified – Logistics Performance Index (LPI), Data Envelopment Analysis (DEA) and key KPI indicators, such as OTIF (On Time In Full), vehicle utilization rate, fuel per kilometer, transportation costs. The theoretical basis formed the assumptions for further practical analysis.

Logistics management integrates key activities such as transportation, warehousing, inventory control, and customer service to ensure an efficient flow of goods across the supply chain. Among these, transportation plays the most critical role, directly influencing costs, delivery speed, and service quality. Each transport mode has specific advantages and limitations, which must be evaluated according to cargo type, distance, and cost-efficiency.

The use of 3PL and 4PL service providers enhances logistics performance by increasing flexibility, technological integration, and sustainability. Efficiency in logistics can be measured through key performance indicators (KPIs) such as OTIF, transport utilization, and fuel consumption, which allow objective evaluation and improvement of operations.

Very small transport companies face challenges such as limited resources, low digitalization, and lack of systematic KPI use. However, their flexibility and customer focus provide potential for gradual improvement through simple digital tools and efficiency monitoring.

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АНАЛІЗ ЕФЕКТИВНОСТІ ВАНТАЖНИХ ПЕРЕВЕЗЕНЬ ТА МОЖЛИВОСТЕЙ ЇХ ПОКРАЩЕННЯ

Анотація

Актуальність теми. У сучасному світі логістичний сектор є одним з найважливіших компонентів сучасної економіки, який забезпечує безперебійне переміщення товарів як на міжнародному, так і на місцевому рівнях. Для забезпечення операційних результатів та конкурентоспроможності на ринку варто враховувати ефективний процес перевезення вантажів. Надзвичайно висока конкуренція в транспортному секторі змушує компанії досягати кращих та ефективніших результатів і шукати шляхи оптимізації операцій, покращення процесу перевезення вантажів та зниження витрат. За словами Гжелаковського (2025), транспортний сектор у Європейському Союзі переживає трансформацію – компанії заохочуються до скорочення викидів, пошуку більш ефективних рішень у відповідь на геополітичні, енергетичні та ринкові виклики, а також впровадження передових технологій. Лю та ін. (2024) наголошують, що сталий розвиток, застосування цифрових рішень у логістичній діяльності та енергоефективність стають дедалі важливішими в секторі вантажних перевезень, а споживачі все більше цінують зусилля компанії щодо внеску в охорону навколишнього середовища. Зростання попиту на транспортні послуги та складність ланцюгів поставок створюють більше ризиків для безперебійності логістичних процесів. За словами Врховаца та ін. (2023), для усунення цих перешкод необхідно покращити якість транспортного процесу, оскільки саме від цього залежить як реалізація екологічних цілей, так і ефективність. Як стверджують Норман-Лопес та ін. (2024), аналіз ефективності ланцюга поставок стає необхідною умовою для підвищення задоволеності клієнтів, забезпечення гнучкості та зниження вразливості системи. **Постановка проблеми.** Дуже малі компанії часто стикаються з проблемами операційної ефективності через брак людських ресурсів, обмежені ресурси, старіння транспортного парку або недостатньо розроблені рішення. Без організаційних та фінансових можливостей їм дуже важко конкурувати з великими логістичними компаніями. З цієї причини стає надзвичайно важливим визначити напрямки для операційного вдосконалення та шукати внутрішні оптимізаційні рішення, які дозволили б знизити витрати, організувати перевезення вантажів та покращити якість послуг. Тому в цій роботі порушується проблема – як дуже малі транспортні компанії можуть підвищити операційну ефективність під час організації перевезень? **Мета статті.** Проаналізувати діяльність малих компаній та запропонувати рішення для покращення діяльності з вантажних перевезень. **Завдання дослідження.** Провести теоретичний аналіз діяльності з вантажних перевезень та визначити основні критерії оцінки ефективності та запропонувати рішення для покращення операцій з вантажних перевезень. **Методологія дослідження.** Для належного розкриття теми дисертації та досягнення поставленої мети й завдань було використано такі методи дослідження: аналіз наукової літератури та інших джерел, аналіз документів, порівняльний аналіз.

Ключові слова: вантажні перевезення, управління логістикою, KPI, цифровізація, ланцюг поставок.

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