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An Evaluation Method of Transport Capabilities for Companies in the Abnormal Transportation Sector

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Abstract:

Purpose: *The aim of this article is to propose a novel method for evaluating the transport capabilities of companies operating in the abnormal transportation sector.*
Design/Methodology/Approach: *The method proposed in this article evaluates the transport capabilities of companies by analyzing three key areas: the size and quality of the transport fleet, the number and experience of personnel, and the supporting elements used. For the purposes of this article, a survey on the reliability of tractor units was developed, along with a method for assessing the adaptability of semi-trailers for transporting various types of cargo.*
Findings: *The application of the described method enables a comprehensive assessment of transport capabilities in the abnormal transportation sector, integrating both qualitative and quantitative data. The results allow for benchmarking across companies and identifying deviations from an ideal reference state. In a pilot study involving three enterprises, the calculated capability indicators were 0.58, 0.66, and 0.71 (with 1.0 representing the ideal state).*
Practical Implications: *The method supports strategic and operational decision-making by providing a clear visualization of a company's current situation. It facilitates the identification of inefficiencies, optimization opportunities, and directions for future development.*
Originality/Value: *This study makes several unique contributions including, analyzing key criteria in the abnormal transportation industry that impact company competitiveness, evaluating the usability of tractor units in the abnormal transportation segment, proposing an innovative method for assessing the transport potential of enterprises in the abnormal transportation sector.*

Keywords: *Transportation, multi-criteria decision analysis, transport management, transport planning.*

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1. Introduction

In today's business environment, numerous factors influence the efficient operation of a company. Regardless of whether the objective is to provide services or deliver goods, ensuring appropriate quality and reliability is often the primary business goal. From an economic perspective, it is crucial that incurred expenses align with expected profits. To achieve this, companies seek cost savings and strive to reduce expenses. In order to properly assess these factors and identify areas requiring process optimization, evaluation methods are applied.

These methods are highly beneficial in the decision-making process regarding business strategies in the context of corporate objectives (Owston, 2007). Evaluation methods also play a crucial role in decision-making processes related to transport policy. They contribute to informed decision-making, resource optimization, and the consideration of various impacts, including sustainable environmental development and public preferences. The combination of different methods allows for a holistic approach to the assessment and selection of transport policies that align with social needs and legal requirements (Mouter, 2021).

Evaluation methods are essential for assessing the transport capabilities of a company in the context of logistics and supply chain management. Their application can lead to significant cost reductions in key areas (Rouhani, 2019). Effective management of the transport fleet, inventory, and storage space remains of great importance.

Conducting analyses of the relationship between costs and demand can help companies adopt a more efficient approach. The use of these methods can be valuable in solving the fleet sizing problem and directly translating into more rational utilization of available resources (Ertogral, Akbalik, and González, 2017).

Moreover, in transport operations, evaluation methods enable the monitoring and assessment of transport service quality. This facilitates the identification of areas for improvement, implementation of enhancements, and adaptation of the transport service offering to customer needs. Enhancing delivery punctuality, increasing reliability, minimizing errors, and ensuring high-quality service contribute to customer satisfaction and loyalty.

Another significant aspect is the role of risk and safety management. Evaluation methods allow for the identification, analysis, and management of risks in transport processes. They enable early detection of potential threats such as delays (Betkier, 2025), breakdowns, cargo loss, or safety issues (Betkier, Mitkow, and Kijek, 2019). This, in turn, allows companies to take appropriate preventive and protective measures, minimizing financial losses, cargo damage, and negative impacts on their reputation (Brewer, Button, and Hensher, 2001).

For the purposes of this article, the following research questions were formulated:

- What aspects should be considered when analyzing transport capabilities in the abnormal transportation industry?
- How can the transport potential of enterprises in the abnormal transportation segment be assessed?

This study makes several unique contributions including:

- Analyzing key criteria in the abnormal transportation industry that impact company competitiveness,
- Evaluating the usability of tractor units in the abnormal transportation segment,
- Proposing an innovative method for assessing the transport potential of enterprises in the abnormal transportation sector.

The rest of the paper is organized as follows. Section 2 presents a review of scientific studies published in recent years, illustrating the spectrum of research problems in the area of evaluation methods in transportation company and the current state of scientific literature.

Next section contains a proposed methodological approach for evaluating the transport capabilities of companies operating in the abnormal transportation sector.

The method discusses how to evaluate the company's owned tractor units, specialized semi-trailers, employed personnel, and supporting elements. Section 4 shows the application of the proposed method in analyzing the transport capacity of three selected companies and discusses obtained results. The final section presents the conclusions from the conducted research and analyses.

2. Literature Review

Evaluation methods enable the assessment and improvement of internal logistics processes within an enterprise. By analyzing and measuring key logistics indicators—such as loading and unloading times, order fulfillment times, warehouse utilization, and complaint handling—companies can identify areas for improvement.

Enhancing these processes leads to greater operational efficiency, shorter order fulfillment times, and increased organizational flexibility (Kilibarda, Andrejić, and Popović, 2020). Researchers in their scientific publications present various applications of evaluation methods for assessing different parameters.

An analysis of their work has been conducted, and Table 1 summarizes the presented approaches.

Table 1. *Related works summary*

Study	Examined parameters	Methodology	Weaknesses
Željko Stević et al. 2022 (Stević et al. 2022)	Efficiency of transport	Multi criteria decision making, comparative analysis	Only two companies considered; lack of historical data
Youhei Eitoku, Shoshi Mizokami, 2010 (Mizokami and Eitoku 2010)	Quality of mobility	Capability approach, structural equation modeling	Only two scenarios considered, lack of diverse cases, model does not include safety factor
Di Zhao et al. 2021 (Xu et al. 2021)	Eco-Driving Capability	Qualitative and Quantitative Evaluation	Evaluation does not include factors such as: drivers experience, traffic intensity, weather,
Cristian Giacomini et al. 2018 (Caramuta et al. 2018)	Integration of port and city	Analysis by indicators combined with MCDM method	Subjectivity of evaluation, lack of figures or analytical results

Source: *Authors' research.*

Stević *et al.* (2022) analyzed the efficiency of two transport companies using an integrated Principal Component Analysis (PCA) – Data Envelopment Analysis (DEA) model combined with multi-criteria decision-making methods. The applied methods aimed to assess the efficiency and sustainability of transport companies' operations, as well as how they leverage their potential.

Combining DEA with PCA enables effective consideration of multiple input and output parameters, helping to identify efficient decision-making units. To objectively determine the weights of decision parameters, multi-criteria methods such as CRITIC, Entropy, and MARCOS were applied.

However, a major limitation of the study was the small sample size—only two companies were analyzed, which limits the generalizability of the results. A broader comparison involving companies from different markets or countries would provide more valuable insights. Additionally, the restricted timeframe of the analysis (2013–2020) and the limited number of input/output parameters may impact the comprehensiveness of the efficiency assessment.

When dealing with a larger number of parameters, PCA may generate principal components that are difficult to interpret. Despite these limitations, the methodology can promote sustainable and efficient business operations in transport companies. Future studies should include a larger number of firms to enhance the representativeness of findings. Expanding the scope of parameters could provide a more comprehensive analysis, while an integrated study of Key Performance Indicators (KPI) could offer a more detailed picture of transport companies' efficiency.

Mizokami and Youhei (2010) conducted a study addressing transportation challenges in the context of depopulation, offering a detailed methodology based on the Capability Approach. They explored the concept of Quality of Mobility (QOM) as an integrated indicator of transportation service levels. Their proposed QOM assessment model employs a latent variable approach with structural equation modeling to measure functioning vectors and outputs.

The model incorporates factors such as mobility, transportation mode selection, and comfort within transport facilities. PCA is utilized to address challenges related to the aggregation of functioning vectors. The authors acknowledge the difficulty in establishing a measurement scale for functioning and emphasize the dependency of results on the evaluator's competence. Additionally, comparing functions proves challenging due to the different orientations of vectors. To address this, they propose converting functioning vectors through PCA.

However, the methodology heavily relies on transportation capability data, which may be subject to uncertainty and temporal changes. The strong correlation between results and data availability presents another challenge. Notably, the study does not explicitly consider transport safety factors, as the assessment of transport system policies omits security concerns.

To improve objectivity, the proposed method should reduce reliance on subjective evaluations and incorporate transport safety aspects. Furthermore, adapting the methodology to account for dynamic changes in population and infrastructure over time would provide a more comprehensive approach to transport policy evaluation.

Xu, Xiaohan, Qiao, and Di. (2021) provided valuable insights into eco-driving from theoretical, evaluation, and practical perspectives. However, their study lacks specific examples, and some recommendations—such as global optimal strategies and big data utilization—are presented in a generalized manner. The absence of standardized parameters (e.g., driving style or traffic intensity) complicates result comparisons and may lead to non-measurable outcomes.

The mixed-method approach, combining qualitative and quantitative assessments, introduces subjectivity, particularly in qualitative evaluations. Personal opinions of assessors, especially regarding driving style, may introduce bias and distort results. In quantitative evaluation, distinguishing the impact of driving style from external variables remains problematic, potentially leading to misleading conclusions.

Eco-driving assessment is further complicated by various road, weather, and vehicle load conditions, which can distort results, making it difficult to determine whether a driver truly optimizes fuel consumption. Providing more concrete examples and detailed implementation data could enhance the reliability of the applied methodology.

Caramuta *et al.* (2018) emphasized the need to identify and design appropriate actions to enhance port-city cooperation and improve port operations. Their analysis covers economic, transport, environmental, managerial, and social aspects, using an integrated assessment method that combines indicator analysis with multi-criteria decision-making, considering multiple stakeholders. The methodology was applied to assess the feasibility of two initiatives aimed at improving freight transport management at the Port of Trieste.

A notable limitation of their approach is the lack of specific indicator examples used for evaluation. The indicator analysis does not account for interdependencies between indicators, and the absence of numerical data, sensitivity analysis regarding criterion weight variations, and time-based changes results in a subjective assessment that lacks verification robustness.

Additionally, the study does not clarify how the influence of key stakeholders (e.g., port authorities, freight operators, municipal and regional administrations) on the evaluation was mitigated. To enhance the reliability of the assessment, concrete examples of indicators used should be provided. Transparency in this regard would improve the understanding of the evaluation process.

Conducting sensitivity analyses of weight variations from a quantitative perspective would further strengthen the findings. Furthermore, employing alternative assessment methods and justifying methodological choices would improve credibility. The Analytic Network Process (ANP) would be a more suitable alternative, as it accounts for interdependencies and feedback loops within the decision model.

Despite growing interest in transport fleet management, significant research gaps persist regarding fleet selection assessment methods for non-standard transports. Current studies mainly focus on fleet size optimization and operational efficiency, yet detailed analyses of technical requirements for oversized transport remain scarce. Existing evaluation models prioritize short-term operational factors, such as costs and emissions, while neglecting long-term effects of fleet selection strategies and dynamic assessments under changing economic and regulatory conditions.

Oversized cargo transport (e.g., industrial equipment, wind turbines) requires fleets with specialized technical parameters, including high load capacity, modular trailers, and compliance with strict road regulations (Juściński, 2023). The literature lacks comprehensive indicators for assessing fleet quality and selection criteria tailored to non-standard transport requirements.

Current methods do not address the complexity of managing fleets with diverse technical needs, limiting their applicability to companies engaged in oversized transport. While driver and logistics team expertise are crucial for the safe execution of oversized transport, research on optimal workforce size and competence remains insufficient. Existing studies focus on general driver qualifications, overlooking specific skills required for oversized cargo transport, such as risk management on routes, coordination with pilot escorts or police, and adherence to complex legal regulations (Masłowski *et al.,* 2024).

Additionally, the impact of logistics team experience on operational efficiency and risk minimization (e.g., delays or accidents) is underexplored. Moreover, comprehensive studies on fleet management tools for oversized transport enterprises are lacking. Current research mainly focuses on standard solutions like GPS tracking and fuel management, without addressing specialized needs, such as advanced cargo monitoring systems or navigation tailored to road restrictions.

There is also a lack of cost-effectiveness analyses of modern technologies that could significantly enhance safety and efficiency in oversized transport companies. The main drawback of applying AHP (Analytic Hierarchy Process) and MCDA (Multi-Criteria Decision Analysis) methods is the subjectivity of assessments. AHP relies on pairwise comparisons, leading to potential biases in stakeholder decisions. In the context of oversized transport, risk assessment and technical difficulty evaluations are often subjective, depending on decision-makers' experience.

Capability Approach also has limitations, as it lacks a standardized measurement scale for functions and a clear method for indicator aggregation, reducing comparability and introducing subjectivity into the assessment process. The PCA-DEA-MCDM model effectively measures efficiency based on static historical data.

However, its inability to dynamically adapt to changing operational conditions limits its applicability to oversized transport, where external factors (e.g., road regulations) can change rapidly. Future research should incorporate dynamic assessment frameworks and real-time data integration to enhance decision-making processes in oversized transport fleet management.

3. Research Methodology

A review of the literature on abnormal transport has shown that a company's transport capabilities are determined by three main areas:

Number and Type of Vehicles: Assessed both quantitatively and qualitatively. It is crucial to align the fleet with the company's operational scope and current demand. The diversity and technological advancement of vehicles enhance operational flexibility and transportation efficiency.

Workforce Size and Experience: Affects the duration and quality of the planning process. A skilled and experienced team enables faster route preparation, better risk management, and optimized transport operations.

Supporting Elements: These include equipment that enhances the safety of both personnel and cargo while minimizing costly errors. Key components include escort vehicles, securing elements, cargo handling capabilities, and specialized software.

The article contains numerous mathematical formulas. Therefore, it is advisable to compile all the symbols used in one place, as presented in Table 2.

Table 2. *Summary of key notations*

General notations	Definition
c	parameter describing the transport capabilities of the company,
d_{angle}	maximum trailer steering angle,
d_{axle}	maximum trailer axle load,
$d_{cylinder}$	hydraulic axle steering system of the trailer,
d_{c_limit}	permissible trailer payload,
d_{h_floor}	trailer floor height,
d_{length}	trailer length,
d_{weight}	trailer tare weight,
e	parameter representing the workforce size and experience level related to the execution of oversized transport orders within the company,
e_{exp}	parameter assigned to the e_{exp} category, representing the experience of employees specializing in oversized transport,
e_n	parameter assigned to the e_n category, representing the number of employees specializing in oversized transport,
exp	parameter describing employee experience,
f_p	size of the escort vehicle fleet,
j_t	number of tractor units of type t,
LC	fastening capability of securing elements,
n	number of company employees involved in the transport process,
p	parameter representing the utility level of the available supporting elements,
p_{f_p}	parameter assigned to the utility category p_{f_p} for pilot services,
p_{LC}	parameter assigned to the utility category p_{LC} for securing elements,
p_p	parameter assigned to the utility category p_p for the possession of specialized software,
p_w	parameter assigned to the utility category p_w for cargo handling capabilities
q_d	quality level (adaptability) of trailer d for transporting various cargo types,
tr_{angle}	parameter assigned to the utility category tr_{angle} of the trailer in terms of maximum steering angle,
tr_{axle}	parameter assigned to the utility category tr_{axle} of the trailer in

	terms of maximum axle load,
tr_{h_floor}	parameter assigned to the utility category tr_{h_floor} of the trailer in terms of floor height,
tr_{length}	parameter assigned to the utility category tr_{length} of the trailer in terms of trailer length,
tr_{c_limit}	parameter assigned to the utility category tr_{c_limit} of the trailer in terms of permissible payload,
tr_{weight}	parameter assigned to the utility category tr_{weight} of the trailer in terms of trailer tare weight,
$tr_{cylinder}$	parameter assigned to the utility category $tr_{cylinder}$ of the trailer in terms of hydraulic axle steering,
v_t	parameter assigned to the reliability category v of tractor unit t,
x	level of fulfillment of received transport orders on a monthly basis,
y_d	number of trailers of type d,
z	parameter representing the size and quality of the transport fleet.

Source: *Authors' research.*

3.1 Number and Type of Vehicles

The available transport resources, including their number, type, and associated technical parameters, are the primary factors influencing transport capacity (Baran and Żak, 2014). From a quantitative perspective, the company's operational scope and alignment with current demand are crucial. Owning an adequate number of vehicles enables the handling of diverse orders and increases operational flexibility.

A well-balanced fleet allows adaptation to changing market needs and ensures efficient resource utilization. From a qualitative perspective, the most important criterion is the diversity of the vehicle fleet and its technological advancement. A fleet composed of various vehicles adapted to the specific characteristics of transported cargo enhances the company's ability to manage different projects.

A modern fleet equipped with advanced technologies improves operational efficiency, enhances safety, and minimizes or eliminates potential transport-related issues (Betkier and Macioszek 2022).

A quantitative and qualitative analysis of the vehicle fleet is a key component of the strategy for non-normative transport companies. Enterprises with a diversified fleet, tailored to different cargo requirements, are better equipped to cope with fluctuating market conditions, which translates into their ability to fulfill a wide range of orders and ensure customer satisfaction (Skowrońska and Kołodziejczyk, 2020).

This topic is frequently discussed and analyzed in the literature within a broad context, and the problem of fleet selection is commonly known as the *Fleet Sizing*

Problem (FSP). Redmer, *et al.* (2011) proposed a universal multi-criteria method to solve this problem, based on queueing theory and multi-criteria analysis using the Light Beam Search (LBS) method. Notably, their solution incorporates the aspect of reliability, which was considered through the formulation of an appropriate decision variable (Redmer, Sawicki, and Żak, 2011).

Corredor-Montenegro et al. (2021) present an innovative method that integrates advanced optimization models, risk analysis, efficient route generation algorithms, and acceleration strategies, enabling a comprehensive and effective assessment of a transport company's capabilities. The application of demand scenarios and the ability to choose between a conservative approach or an expected value-based approach provides flexibility.

The transportation of cargo, particularly oversized loads, requires specialized equipment. The transport fleet in the non-normative transport sector consists of both tractor units and specialized trailers. The appropriate selection of trailers for specific tractor units is essential to execute transport orders successfully. This process is referred to as vehicle set configuration.

To establish reliability categories for tractor units, a survey was conducted among users to classify different brands into four predefined categories. For trailers, the most commonly used models for oversized cargo transportation were analyzed, and relevant parameters describing their usability based on desired characteristics were formulated.

The following trailers were selected for evaluation: COMETTO ZSR CST4H, FAYMONVILLE STN-4AU, ACTM 4-axle, LANGENDORF SATV 50-H/68, SCORPION TRAILER HKM4 and trailers manufactured by DEMARKO.

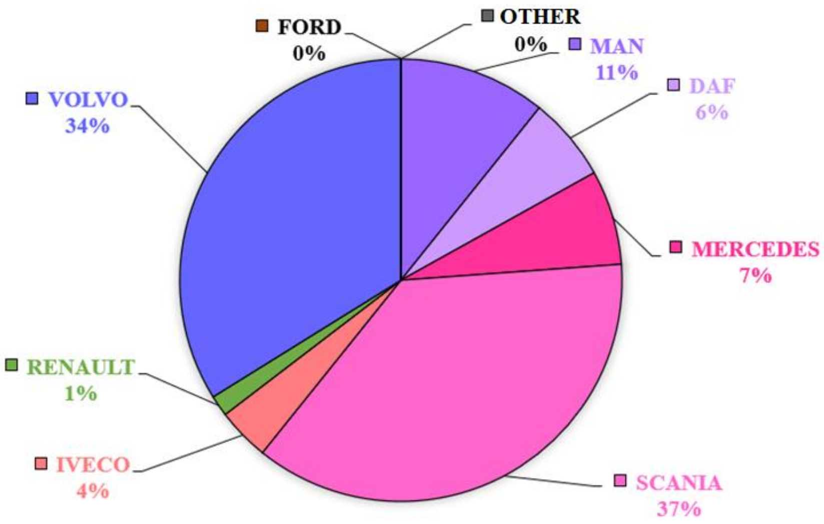
3.1.1 Tractor units

For the purpose of this study, a survey was conducted among truck drivers and transport company owners to assess the reliability of various tractor unit brands, including their suitability for non-normative transport. The survey collected 130 responses to the specified questions. The results of the survey are presented in Figures 1 and 2 below.

Based on the conducted survey, Scania was identified as the most reliable tractor unit manufacturer. Out of 130 responses, it was selected 48 times. The second most reliable brand, according to the respondents, was Volvo, which received 44 votes.

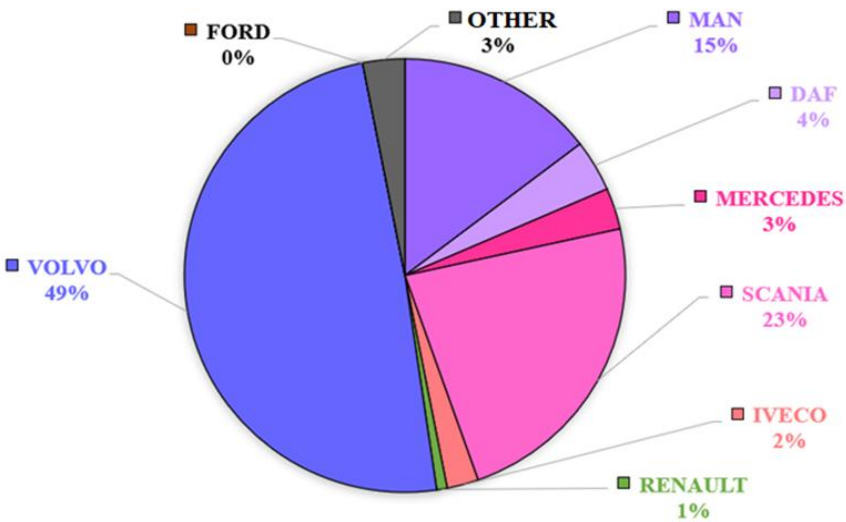
In oversized transport, both Scania and Volvo were once again recognized for their reliability. In this case, Volvo received 64 responses, while Scania received nearly half as many (30). The reliability of tractor units from different manufacturers may largely depend on the quality of the components used in their construction.

Figure 1. *Percentage breakdown of responses regarding the reliability of tractor unit brands.*



Source: *Authors' research.*

Figure 2. *Percentage breakdown of responses regarding the reliability of tractor unit brands in oversized transport.*



Source: *Authors' research.*

The survey conducted for the purpose of this study allowed for the identification of four categories of reliability v_t of a tractor unit. These categories were created based on a question regarding the reliability of tractor units in oversized transport. Category I represents the most reliable category, while Category IV is the least reliable. A numerical value of the v_t parameter was assigned to each category.

The magnitude of v_t is a unique parameter distinguished for the reliability categories v_t of a tractor unit. In the case of Category I, the value of the v_t parameter is 1. The categories were formulated based on responses obtained from respondents, which are shown in Figure 2. The Volvo brand was assigned to Category I. This classification was correlated with the percentage value of respondents selecting a particular tractor unit brand. The classification of the reliability of tractor unit brands used in oversized transport is presented in Table 3.

Table 3. *Classification of the reliability of tractor unit brands used in oversized transport*

Reliability category v_t of the tractor unit	Value v_t	Percentage of respondents selecting the given brand [%]	Tractor unit brand
I	$v_t = 1$	> 25	Volvo
II	$v_t = 0.75$	16 – 25	Scania
III	$v_t = 0.5$	6 – 15	Man
IV	$v_t = 0.25$	0 – 5	Ford, Renault, Iveco, Mercedes, DAF and others

Note: v_t *– parameter assigned to the reliability category* v *of tractor unit* t.
Source: *Authors' research.*

3.1.2 Specialized trailers

The number and technical specification of specialized trailers are crucial for achieving high efficiency in oversized transport, as they directly impact operational flexibility and the scale of completed tasks (Brach, 2023). The larger the available fleet of diverse trailers, the wider the range of non-standard cargo in terms of dimensions, weight, or technological requirements that can be transported while maintaining safety standards and road regulations.

Simultaneously, technical parameters such as higher permissible payload, optimized tare weight, smaller floor dimensions, or a greater maximum steering angle allow for the transport of cargo with specific dimensions and shapes while reducing the risk of damage and improper cargo distribution. Consequently, a company can flexibly adapt its resources to the requirements of various clients and undertake orders requiring unique logistical solutions, thereby increasing both competitiveness and growth opportunities in the transport market (Matwiejczuk, 2019).

Table 4. *Trailer utility classification by technical parameters*

Feature	Category	Value range	Utility	Assigned parameter
trailer tare weight (d_{weight})	I	d_{weight} < 13,000 kg	tr_{weight}	1
	II	13,000 ≤ d_{weight} ≤ 18,000 kg		0.75

	III	18,000 < d_{weight} ≤ 22,000 kg		0.5
	IV	d_{weight} > 22,000 kg		0.25
maximum trailer axle load (d_{axle})	I	d_{axle} ≥ 115 kN	tr_{axle}	1
	II	100 ≤ d_{axle} < 115 kN		0.75
	III	80 ≤ d_{axle} < 100 kN		0.5
	IV	d_{axle} < 80 kN		0.25
permissible trailer payload (d_{c_limit})	I	d_{c_limit} > 50,000 kg	tr_{c_limit}	1
	II	45,000 < d_{c_limit} ≤ 50,000 kg		0.75
	III	35,000 < d_{c_limit} ≤ 45,000 kg		0.5
	IV	d_{c_limit} ≤ 35,000 kg		0.25
trailer floor height (d_{h_floor})	I	d_{h_floor} < 800 mm	tr_{h_floor}	1
	II	800 ≤ d_{h_floor} ≤ 950 mm		0.75
	III	950 < d_{h_floor} ≤ 1050 mm		0.5
	IV	d_{h_floor} > 1050 mm		0.25
maximum trailer steering angle (d_{angle})	I	d_{angle} > 60°	tr_{angle}	1
	II	d_{angle} ≤ 60°		0.5
hydraulic axle steering system of the trailer ($d_{cylinder}$)	I	exists	$tr_{cylinder}$	1
	II	doesn't exist		0.5
trailer length (d_{length})	I	d_{length} > 25,000 mm	tr_{length}	1
	II	20,000 ≤d_{length})≤ 25,000 mm		0.75
	III	15,000 < d_{length})≤ 20,000 mm		0.5
	IV	d_{length}) < 15,000 mm		0.25

Source: *Authors' research.*

The above Table 4 consolidates seven key technical parameters of trailers used in oversized transport: tare weight, maximum axle load, permissible payload, floor height, maximum steering angle, hydraulic axle steering system, and trailer length. Each of these parameters is presented in a single classification, defining the feature (e.g., tare weight – d_{weight}), category (I to IV, in some cases up to II), value range for category assignment, utility parameter name (e.g., tr_{weight}, tr_{axle}) and numerical indicator value (e.g., 1, 0.75, 0.5, 0.25).

This structure enables a coherent assessment of trailer utility in oversized transport, considering numerical thresholds (either upper or lower) determining category selection: the lower the tare weight (d_{weight}), the higher the utility category; the higher the maximum axle load (d_{axle}) or permissible payload (d_{c_limit}), the more advantageous the category; the lower the floor height (d_{h_floor}), the better for transporting high cargo; the larger the maximum steering angle (d_{angle}) and the presence of a hydraulic steering system ($d_{cylinder}$), the higher the maneuverability; and the longer the trailer (d_{length}), the easier it is to transport large-sized cargo.

This classification allows for a clear comparison of trailers, assigning each a numerical utility index tr and categorizing their suitability from I (best) to IV (worst).

Analyzing the above considerations, this study proposes the parameter q_d, which reflects the quality level (adaptability) of a trailer for transporting various types of cargo. The magnitude of q_d is described as follows:

$$q_d = \frac{tr_{weight} + tr_{axle} + tr_{c\_limit} + tr_{h\_floor} + tr_{angle} + tr_{cylinder} + tr_{length}}{7} \to 1 \quad (1)$$

where: q_d – quality level (adaptability) of trailer d for transporting various types of cargo.

The value of q_d represents the arithmetic mean of individual component parameters. For an analyzed trailer, it reaches a value of 1 when all its technical parameters achieve the highest possible category for each of the seven aspects described in the previous sections of this study. As a result, such a trailer would have the highest versatility, enabling the completion of most transport orders.

In the study by Jara-Díaz, Fielbaum, and Gschwender, the optimal bus fleet size was analyzed to match demand within specific time intervals (Jara-Díaz, Fielbaum, and Gschwender 2017). Referring to this approach, it was assumed that a parameter representing the size and quality of the transport fleet, $z \in \mathbb{R}^+$, would be defined. From an economic perspective, this parameter should also relate to the average number of transport orders handled, e.g., on a monthly basis. Summarizing the above, this study defines the parameter as follows:

$$z = \frac{\sum_{t=1} j_t \cdot v_t + \sum_{d=1} y_d \cdot q_d}{\sum_{t=1} j_t + \sum_{d=1} y_d} \cdot x \to 1 \quad (2)$$

where: z – parameter representing the size and quality of the transport fleet, j_t – number of tractor units of type t, v_t – parameter assigned to the reliability category v of tractor unit t, y_d – number of trailers of type d, q_d – quality level (adaptability) of trailer d for transporting various types of cargo, x – level of fulfillment of received transport orders on a monthly basis (1 – full completion).

With this formulation, the transport fleet size and quality parameter reflects the ability to fulfill received transport orders using the available fleet. If a company owns a fleet with the highest technical parameters and utilizes its potential to the fullest, meaning that all received transport orders can be completed, then $z = 1$.

Otherwise, even if the company possesses the highest quality transport equipment but cannot fully meet transport demand, the parameter z will fall within the range $\langle 0 ; 1)$. This approach allows for a comparison of fleet size with actual demand and aligns the technical parameters of transport equipment with the types of cargo. If a company cannot fulfill transport tasks due to technical constraints, the number of unfulfilled transport orders will increase, reducing the value of parameter x.

3.2 Workforce Size and Experience

Every company aiming for significant market results must start with proper workforce planning. The right number of employees, combined with their competencies and commitment, is a crucial factor without which the functioning of a transport company would be impossible. Workforce planning enables a company to prevent a shortage of employees essential for executing various tasks (Leleń, 2010).

Each employee has assigned duties that contribute to the completion of transport orders and the overall functioning of the company. A larger workforce allows the company to expand, take on more transport orders, and consequently generate higher revenues, which is the primary goal of any enterprise. The importance of having an adequate workforce is particularly evident in the entire process of organizing oversized transport. The number and experience of personnel impact the duration of the planning process.

An efficient team can reduce the time required to prepare a route, obtain necessary permits, and coordinate activities related to oversized transport. Experienced personnel can better identify potential route problems and make decisions that optimize routes, minimize risks, and enhance operational efficiency.

Effectiveness, responsiveness to changing conditions, and route planning quality are closely tied to the skills and experience of the workforce, ultimately influencing customer satisfaction and company success in this specialized industry (Macioszek, 2019). The number of employees in a company should strive to maximum in accordance with business needs. Table 5 presents the classification of workforce size in companies specializing in oversized transport.

The classification of employees involved in the transport process across various companies enabled the identification of workforce size categories. Four workforce size categories e_n were distinguished, where Category I represents the largest workforce, and Category IV the smallest. Each category is assigned a numerical value of the e_n parameter, which is a unique value representing workforce size.

Table 5. *Classification of workforce size in companies specializing in oversized transport*

Workforce size category e_n	Value e_n	Number of employees involved in the transport process
I	$e_n = 1$	$n > 100$
II	$e_n = 0.75$	$n \epsilon \langle 50 ; 100 \rangle$
III	$e_n = 0.5$	$n \epsilon \langle 20 ; 50)$
IV	$e_n = 0.25$	$n < 20$

Note: n *– number of company employees involved in the transport process,* e_n *– parameter assigned to the* e_n *category, representing the number of employees specializing in oversized transport.*
Source: *Authors' research.*

For Category I, the e_n parameter is set to 1. Companies classified in Category I have more than 100 employees engaged in the transport process, whereas those in Category IV have fewer than 20 employees involved in the transport process. From the perspective of a transport company, having qualified drivers with appropriate experience and training is crucial (Biskupska, 2016).

Employee experience significantly impacts the company's operations and should be maximized. The greater the experience of employees, the lower the probability of errors occurring during the execution of transport orders.

Table 6. *Classification of workforce experience in companies specializing in oversized transport*

Employee Experience Category e_{exp}	Value e_{exp}	Employee Experience (Years)
I	$e_{exp} = 1$	$exp \geq 10$
II	$e_{exp} = 0.75$	$exp \epsilon \langle 5 ; 10)$
III	$e_{exp} = 0.5$	$exp \epsilon (2 ; 5)$
IV	$e_{exp} = 0.25$	$exp \epsilon \langle 0 ; 2 \rangle$

Note: exp *– parameter describing employee experience,* e_{exp} *– parameter assigned to the* e_{exp} *category, representing the experience of employees specializing in oversized transport.*
Source: *Authors' research.*

The classification of employee experience across different companies allowed for the identification of experience categories. Four experience categories e_{exp} were distinguished, where Category I represents employees with the highest level of experience, and Category IV represents those with the least or no experience.

Each category is assigned a numerical value of the e_{exp} parameter, which is a unique value representing employee experience. For Category I, the e_{exp} parameter is set to 1. Companies classified in Category I have employees with 10 years or more of experience, whereas Category IV represents employees with experience ranging from 0 to 2 years.

The above considerations led to the introduction of the e, parameter, which reflects both the workforce size and experience level of personnel involved in executing oversized transport orders within a company. The parameter e, is defined by the following formula:

$$e = \frac{e_n + e_{exp}}{2} \to 1 \tag{3}$$

where: e - parameter representing the workforce size and experience level related to the execution of oversized transport orders within the company, e_n – parameter assigned to the e_n category, representing the number of employees specializing in oversized transport, e_{exp} – parameter assigned to the e_{exp} category, representing the experience of employees specializing in oversized transport.

A value of $e = 1$ in the analyzed case indicates that both workforce size and experience have reached the highest possible category. This means that the company has achieved the optimal number of employees with the necessary experience, ensuring the high-quality execution of transport orders.

3.3 Supporting Elements

3.3.1 Escort vehicles

The transport of oversized cargo, where the vehicle exceeds 23 meters in length, 3.2 meters in width, 4.5 meters in height, or has a total weight exceeding 60 tons, requires escorting. Escorting in non-standard transport is a key element in ensuring the safe passage of the transport route. Source materials emphasize that an experienced escort driver can effectively identify potential hazards such as route restrictions or difficult road conditions.

Their role also involves cooperating with the driver, eliminating errors, and minimizing risks associated with transporting non-standard cargo. The coordinated actions of escort drivers during transport not only enhance safety but also influence the efficiency and completion time of transport orders. Having qualified escort drivers allows transport companies to achieve greater transport capabilities while increasing customer satisfaction. Moreover, it plays a crucial role in ensuring the safety of other road users (Lesiak and Mitkow, 2022).

A company handling oversized transport orders should be equipped with a fleet of escort vehicles in proper technical condition and with appropriate equipment. The equipment of escort vehicles includes vehicle marking boards for escorting, two yellow flashing lights, direct communication devices with escorted vehicles, and loudspeaker systems.

To handle a large number of transport orders requiring escorting simultaneously, it is essential to have a significant number of escort vehicles. A large fleet of escort vehicles helps save time when executing transport orders. A company with a substantial escort vehicle fleet can handle multiple transport orders at the same time without waiting for the release of escort resources.

However, some companies do not have their own escort fleet and must rely on external escort service providers for each transport order. This significantly increases costs and reduces the flexibility in scheduling transport execution.

Table 7. *Utility classification of escort services in companies specializing in oversized transport*

Utility category p_{f_P} for escorting	Value p_{f_P}	Escort fleet
I	$p_{f_P} = 1$	Large escort fleet ($f_p \geq 8\ vehicles$)
II	$p_{f_P} = 0.75$	Small escort fleet ($f_p < 8\ vehicles$)
III	$p_{f_P} = 0.25$	No fleet, service rental

Note: *f_p – size of the escort vehicle fleet, p_{f_P} – parameter assigned to the utility category p_{f_P} for pilot services.*
Source: *Authors' research.*

The classification of different companies enabled the identification of escort service utility categories. Three utility categories of escorting p_{f_P} were distinguished, where Category I represents the highest level of utility and Category III the lowest. Each category is assigned a numerical parameter value p_{f_P}, which is a unique parameter for the escort service utility classification. For Category I, the p_{f_P}, parameter is set to 1. Companies in this category have a large escort fleet consisting of eight or more vehicles. In contrast, Category III represents companies that either do not have an escort fleet or rent escort services externally.

3.3.2 Securing elements

Ensuring the safety of both people and cargo is a priority in non-standard transport. Supporting elements, such as specialized load securing devices, are crucial for the effective protection of transported materials. Source materials emphasize that proper cargo securing translates not only into safety but also into minimizing the risk of damage or losses during transport.

It is essential to thoroughly secure cargo to prevent slippage or falls (Szczucka-Lasota, Kamińska, and Krzyżewska, 2017). Every transport company should be equipped with appropriate securing elements. The main types of securing elements used in oversized transport include securing straps, steel cables, and chain tensioners (Macioszek, 2021).

Securing straps are available on the market in various variants. The key parameter that defines a transport strap is its fastening capability. The fastening capability (permissible load) is the maximum force at which the strap can be used in direct tension. When the lashing method is applied, the fastening capability doubles.

The fastening capability is referred to as LC and is expressed in the unit [daN]. Steel cables, like transport straps, have a fastening capability parameter, which depends on the diameter of the cable. Another type of securing element is chain tensioners.

Similar to transport straps and steel cables, they have a fastening capability parameter. For chain tensioners, the fastening capability depends on the nominal dimensions of the complete chain tensioning system (Sałek and Słabik, 2019; Macioszek, 2021). Table 8 presents the utility classification of securing elements used in oversized cargo transport.

Table 8. *Utility classification of securing elements used in oversized cargo transport*

Utility category $\boldsymbol{p_{LC}}$ for securing elements	Value $\boldsymbol{p_{LC}}$	Fastening capability of securing element [daN]
I	$p_{LC} = 1$	LC >18 000
II	$p_{LC} = 0.75$	$LC \in \langle 10\,000 ; 18\,000 \rangle$
III	$p_{LC} = 0.5$	$LC \in \langle 2\,500 ; 10\,000 \rangle$
IV	$p_{LC} = 0.25$	$LC \leq 2\,500$

Note: LC *– fastening capability of securing elements,* p_{LC} *– parameter assigned to the utility category* p_{LC} *for securing elements.*
Source: *Authors' research.*

The classification of various securing element variants enabled the identification of their utility categories. Four utility categories p_{LC} were distinguished, where Category I represents the highest level of utility and Category IV the lowest. Each category is assigned a numerical parameter value p_{LC}, which is a unique parameter for the securing element utility classification. For Category I, the p_{LC} parameter is set to 1. Companies in this category use securing elements with a fastening capability exceeding 18,000 daN, while Category IV represents securing elements with a fastening capability of 2,500 daN or lower.

3.3.3 Cargo handling capabilities

During the execution of an oversized cargo transport order, the loading and unloading process plays a crucial role. In both cases, the company must have appropriate cargo handling capabilities to complete these tasks. Cargo handling capabilities refer to the use of suitable transshipment equipment. The primary transshipment equipment used by companies includes forklifts and truck-mounted cranes. Table 9 presents the classification of cargo handling capabilities in oversized transport.

Table 9. *Classification of cargo handling capabilities in oversized transport*

Utility category $\boldsymbol{p_w}$ cargo handling capabilities	Value $\boldsymbol{p_w}$	Company equipment
I	$p_w = 1$	Has equipment
II	$p_w = 0.25$	Lacks equipment

Note: *p_w – parameter assigned to the utility category p_w for cargo handling capabilities.*
Source: *Authors' research.*

The classification of various companies based on cargo handling capabilities has allowed the identification of specific categories. Two utility categories p_w were distinguished, where Category I represents the highest level of utility, and Category II the lowest. Each category p_w is assigned a numerical parameter value. This value is a unique parameter for the utility classification p_w of cargo handling capabilities. In Category I, the parameter value is 1, indicating that the company possesses transshipment equipment, whereas Category II signifies the absence of such equipment.

3.3.4 Specialized software

A crucial factor influencing a transport company's capabilities in the oversized transport sector is the proper selection of transport routes. Route planning becomes significantly easier with the use of modern software designed for this purpose. Programs such as PTV Map&Guide, SOTIPM, and Routimo greatly facilitate route planning. Companies that utilize such programs manage transport orders more efficiently, reducing execution time. Table 10 presents the utility classification for the possession of route planning software.

Table 10. *Utility classification for route planning software in oversized transport*

Utility category $\boldsymbol{p_p}$ for software possession	Value $\boldsymbol{p_p}$	Route planning software
I	$p_p = 1$	Available
II	$p_p = 0.25$	Not available

Note: *p_p – parameter assigned to the utility category p_p for the possession of specialized software.*
Source: *Authors' research.*

The assessment of company equipment has enabled the determination of categories. Two utility categories p_p were distinguished, where Category I represents the highest utility level and Category II the lowest. Each category p_p is assigned a numerical parameter value, which is a unique parameter for the software possession utility classification. In Category I, the parameter is 1, indicating the presence of software, while in Category II, it is absent.

3.3.5 Utility level of supporting elements

Based on the previous analysis, a parameter p has been proposed to reflect the utility level of the supporting elements available in a company. The parameter p is described as follows:

$$p = \frac{p_{f_P} + p_{LC} + p_w + p_p}{4} \rightarrow 1 \quad (4)$$

where: p – parameter representing the utility level of the available supporting elements, p_{f_P} – parameter assigned to the utility category p_{f_P} for pilot services, p_{LC} – parameter assigned to the utility category p_{LC} for securing elements, p_w – parameter assigned to the utility category p_w for cargo handling capabilities, p_p – parameter assigned to the utility category p_p for the possession of specialized software.

A value of $p = 1$ for the analyzed variant indicates that the supporting elements available in the company have achieved the highest possible category for each of the four aspects described in the previous section. As a result, the company gains enhanced transport order execution capabilities at the highest level.

3.4 Transport Capabilities of the Company

To summarize the above considerations, it is necessary to compile all elements that influence a company's transport capabilities. These elements vary, and based on the analysis, a parameter has been formulated to reflect all discussed aspects while considering their importance in the transport process. To achieve this, the categories of individual parameters have been arranged and assigned respective weights. The formulated parameter c evaluating a company's transport capabilities based on fleet size and quality, personnel experience and availability, and the utility level of supporting elements, is expressed as follows:

$$c = 0.5 \cdot z + 0.3 \cdot e + 0.2 \cdot p \rightarrow 1 \quad (5)$$

where: c – parameter describing the transport capabilities of the company, z – parameter representing the size and quality of the transport fleet, e - parameter representing the workforce size and experience level related to the execution of oversized transport orders within the company, p – parameter representing the utility level of the available supporting elements.

For the purposes of this study, it has been assumed that the most critical aspect is the size and quality of the transport fleet, relative to the actual demand for transport.

Therefore, the parameter describing this component has been assigned a weight of 0.5. The second most important factor, given the high level of specialization in oversized transport, is personnel experience and availability, which has been assigned a weight of 0.3. The final factor affecting transport capabilities is the utility level of the supporting elements, which has been assigned a weight of 0.2.

Ultimately, a company will achieve a value of 1 for the parameter c if it possesses a high-quality transport fleet capable of fulfilling any incoming order, has personnel with the highest experience and availability categories, and owns all supporting elements with the highest possible parameters.

4. Research Results

To test the proposed method, three companies specializing in the transportation of oversized cargo, each with a different operational profile, were selected for analysis:

Scenario 1 – A small company equipped with high-quality equipment and experienced personnel but lacking supporting elements.

Scenario 2 – A medium-sized company with experienced personnel but suboptimal equipment.

Scenario 3 – A large company with a diverse and extensive fleet of vehicles and trailers, as well as in-house cargo handling and escorting capabilities. However, due to frequent staff turnover, the overall experience level of its workforce is relatively low.

Following the methodology outlined in this study, the designated parameters were assigned appropriate values, thereby assessing the significance of the resources available to each company. The evaluation results for the analyzed areas across the three enterprises are summarized in Table 11.

Table 11. *Summary of parameters describing the resources of the three selected companies*

	v_t	j_t	q_d	y_d	x	e_n	e_{exp}	p_{f_p}	p_{LC}	p_w	p_p
Company 1	1	5	0.79	2	0.71	0.25	1	0.25	0.5	0.25	0.25
			0.75	3							
Company 2	1	6	0.82	2	0.82	0.5	1	0.75	0.75	1	1
	0.5	11	0.79	3							
	0.25	3	0.71	7							

			0.68	5							
			0.57	5							
Company 3	1	22	0.86	12	0.89	1	0.25	1	1	1	1
	0.75	41	0.82	3							
	0.25	18	0.79	8							
			0.75	17							
			0.71	24							
			0.68	11							
			0.64	15							

Note: *v_t – parameter assigned to the reliability category v of tractor unit t, j_t – number of tractor units of type t, q_d – quality level (adaptability) of trailer d for transporting various types of cargo, y_d – number of trailers of type d, x – level of fulfillment of received transport orders on a monthly basis, e_n – parameter assigned to the e_n category, representing the number of employees specializing in oversized transport, e_{exp} – parameter assigned to the e_{exp} category, representing the experience of employees specializing in oversized transport, p_{f_P} – parameter assigned to the utility category p_{f_P} for pilot services, p_{LC} – parameter assigned to the utility category p_{LC} for securing elements, p_w – parameter assigned to the utility category p_w for cargo handling capabilities, p_p – parameter assigned to the utility category p_p for the possession of specialized software.*
Source: *Authors' research.*

The highest-quality equipment is owned by Company 1, which operates five tractor units with a quality level of 1 and five trailers with an average quality level of 0.77. Company 2 has a fleet of 20 tractor units and 22 trailers, with average quality levels of 0.61 and 0.69, respectively. Company 3 possesses 81 tractor units with an average quality level of 0.71 and 90 trailers with an average quality level of 0.73.

The study also considered the order fulfillment rate in assessing the size and quality of the transport fleet, as this metric significantly impacts a company's overall transport capabilities. The fleet performance parameter x for Company 1 was 0.71, for Company 2 it was 0.82, and for Company 3 it reached 0.89. These results indicate that Company 3 has the most extensive service offering and can handle more demanding, specialized cargo transport.

According to the predefined scenarios, Companies 1 and 2 employ experienced personnel, thus their experience parameter e_{exp} equals 1. In contrast, Company 3, experiencing high staff turnover, received a significantly lower value of 0.25. The workforce size parameter e_n is primarily influenced by company size, available equipment, and service scope. Large enterprises typically own in-house cargo handling and escorting equipment, along with other supporting elements, which smaller companies may lack. This disparity is reflected in the supporting elements parameter p assigned to the analyzed companies.

Based on Table 11 data and using the proposed formulas, parameters assessing the transport fleet, personnel, and supporting elements for each company were calculated. The final parameter values, summarizing the overall transport capabilities of the analyzed enterprises, are presented in Table 12.

Table 12. *Summary of transport capability assessments for the three selected companies*

	Company 1	Company 2	Company 3
z	0.63	0.54	0.64
e	0.63	0.75	0.63
p	0.38	0.81	1.00
c	0.58	0.66	0.71

Note: *c – parameter describing the transport capabilities of the company, z – parameter representing the size and quality of the transport fleet, e - parameter representing the workforce size and experience level related to the execution of oversized transport orders within the company, p – parameter representing the utility level of the available supporting elements.*
Source: *Authors' research.*

A comparison of fleet size and quality among the selected companies reveals that despite Company 1 having the highest-quality equipment, its fleet parameter z is lower than that of Company 3, which operates vehicles and trailers of lower average quality. This discrepancy arises from the lower order fulfillment rate of Company 1.

The analysis of workforce-related parameters e shows minor variations in the results. Company 1, despite employing highly experienced staff, only achieved a score of 0.63 because of its small workforce size. Furthermore, it lacks in-house cargo handling, escorting capabilities, and specialized route-planning software, leading to a significantly lower supporting elements parameter p compared to the other companies.

The application of the proposed methodology enabled an objective assessment of transport capabilities, highlighting differences between the companies and their shortcomings relative to an ideal scenario (where $c = 1$). The final results indicate that Company 3 possesses the greatest transport capabilities, with a c parameter of 0.71. In second place is Company 2, whose equipment is of the lowest quality but still enables a broad range of transport operations, resulting in only a minor disadvantage in the fleet assessment parameter compared to the other companies.

Company 1 ranked third, despite owning high-quality equipment. Due to its lower order fulfillment rate, the fleet parameter z received a relatively low score. The company's lack of supporting elements also had a significant impact on its overall transport capability, ultimately placing it last in the ranking.

5. Discussion

The adopted methodology is highly comprehensive, enabling the evaluation of all essential characteristics of the analyzed companies. This is evident in the formula for parameter z, which assesses the size and quality of the transport fleet and consists of multiple variables.

In particular, the quality of trailers is thoroughly examined, considering numerous detailed properties that directly influence the ability to transport the required cargo. When evaluating the technical specifications of selected trailers using the proposed method, it was found that none of them approached an ideal state, with the overall quality level ranging from 0.46 to 0.86. The obtained results are influenced by the conflicting nature of certain parameters.

For instance, while a higher maximum payload and trailer length are desirable features, they also result in an increased tare weight, which is assessed negatively. Consequently, no trailer achieved the maximum quality level of 1. Trailers with the lowest performance in specific categories always receive a minimum component score of 0.25, meaning that the minimum value of the q_d parameter, which evaluates trailer quality, can be as low as 0.32. Additionally, it should be noted that trailers with different properties may ultimately have the same q_d value if the average of all components is equal.

During the analysis, parameter x, which evaluates the degree of execution of received transport orders, proved to be highly significant. As an example, Company 1, despite possessing high-quality equipment, is unable to fulfill certain specialized orders due to the specific requirements of oversize transport and the diverse range of transport needs.

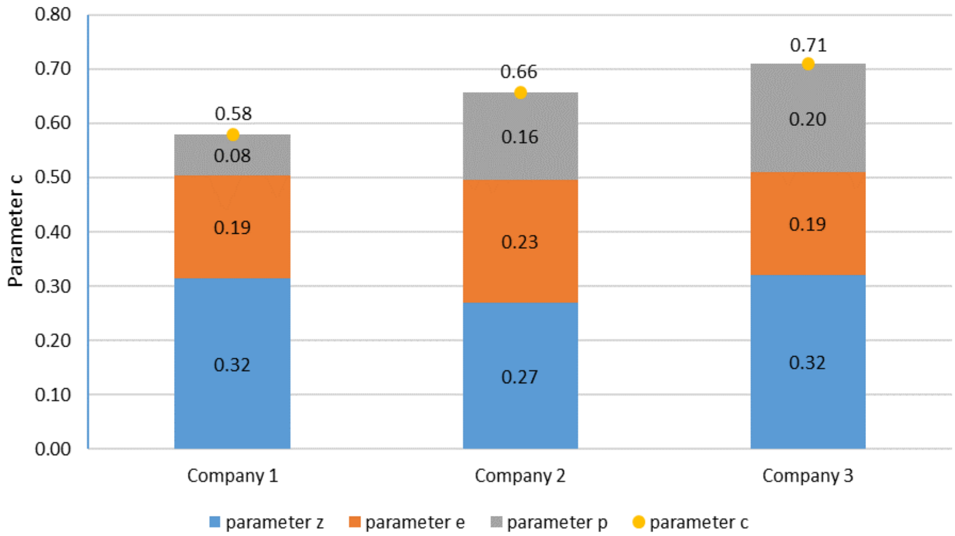
On the other hand, Company 3 owns a variety of trailers and tractor units, allowing it to assemble appropriate vehicle combinations to execute various orders, which ultimately leads to a high level of order fulfillment. If parameter x were not considered, Company 1 would have a significantly higher transport fleet quality score than Company 3, despite having fewer actual operational capabilities.

The calculated example demonstrates that incorporating parameter x is crucial. A company's ability to carry out more complex transport tasks, requiring specialized equipment and a tailored approach, significantly impacts its overall transport capacity as determined by the proposed methodology.

Analyzing the application of the method based on the example presented in the previous section also indicates that the weighting coefficients for individual areas were appropriately selected. The most influential factor in determining transport capabilities is the available equipment, specifically tractor units and trailers, considering their suitability for fulfilling incoming transport orders. The contribution of parameters assessing key areas to the overall transport capacity of selected companies is illustrated in Figure 3.

The variation in parameters z and e between the analyzed companies is relatively small, whereas significant differences are observed in parameter p. This may be due to the large number of components in the formulas used to calculate the first two parameters, as well as the limited number of available evaluations for supporting elements, where component values often take on binary values of 1 or 0.25.

Figure 3. *Contribution of parameters evaluating key areas to the overall transport capacity of selected companies from Section 3*



Source: *Authors' research.*

The conducted research indicates that transport capabilities in the field of oversize cargo movement depend on the company's size. This is because a larger fleet of diverse vehicles and trailers enables the execution of specialized orders according to customer requirements, reducing the percentage of tasks unfulfilled due to technical limitations.

Large enterprises also typically own their own pilot fleets and handling equipment, eliminating the need to rely on external companies and ensuring that operational quality and efficiency remain at the highest level. Additionally, they are equipped with high-quality supporting elements, such as securing devices and route optimization software, which facilitate transport planning and execution. All these factors contribute to overall transport capabilities, as demonstrated by calculations using the proposed methodology.

In summary, the method allows for an evaluation of companies specializing in oversize cargo transport by assessing specific parameters describing their capabilities. This provides a comprehensive picture of a company's transport capacity, which is the first step in evaluating its strategic decisions and development directions.

Compared to the methods presented in Section 2, the applied methodology is characterized by a hybrid approach, combining elements of multi-criteria analysis, resource assessment, and benchmarking-based comparative analysis.

The examination of three key areas relevant to oversize transport using numerous specialized parameters highlights the method's high level of comprehensiveness. A significant strength of this methodology is its ability to assess and compare different enterprises using indicators that aim for ideal values. Furthermore, the method is flexible and can be applied to evaluate companies of any size and scope of operations. Clearly defined parameters enable transparent assessment and easy interpretation of results, which in turn facilitates the identification of weak points that require optimization.

6. Conclusions, Proposals, Recommendations

The primary objective of most companies is to generate profit from their operations. Achieving this goal is impossible without continuous analysis of their activities, resources, and plans, followed by drawing conclusions on how to improve them.

One of the solutions that facilitate this process is the use of appropriate evaluation methods, which allow companies to assess ongoing processes and identify opportunities for optimization. In line with this philosophy, transport companies also conduct ongoing assessments of their potential and transport capabilities, requiring tools tailored to their specific industry. Therefore, research into new methods that enable a detailed evaluation of multiple factors affecting a company's operations is a promising direction.

The method proposed in this article assesses a company's transport capabilities by analyzing three fundamental areas: the size and quality of the transport fleet, the number and experience of personnel, and the supporting elements used in operations. The first and most significant area concerns the fleet of vehicles in both quantitative and qualitative terms.

For the purpose of this study, a survey was developed to evaluate the reliability of tractor units, along with a method for assessing the suitability of trailers for transporting various types of cargo, taking into account seven technical parameters. The evaluation of the transport fleet also considers a modifying factor—the degree of execution of received transport orders. The second area focuses on the number and experience of employees, as both competence and workforce potential play a crucial role in planning and executing transport operations. The adopted method also evaluates the supporting elements used by the company, which include pilot fleets, securing devices, loading and unloading equipment, and specialized software.

Applying the proposed method enables a comprehensive assessment of a company's transport capabilities in the oversize transport sector. It considers a wide range of detailed data that impact a company's transport potential, with each factor contributing to the final result.

The values calculated using this tool allow not only for comparing different companies but also for determining how far a given company is from an ideal state. Visualizing the current situation facilitates decision-making for management personnel regarding areas that require improvements and future development directions. A potential limitation of the method is the subjectivity of survey respondents when assessing vehicle reliability.

Additionally, the proposed method should be applied to a larger number of companies to expand the scope of the study. Future research should verify the suitability of the weighting coefficients assigned to individual factors influencing a company's transport capabilities. This could be achieved by comparing the results obtained with the proposed method against other existing methodologies and expert evaluations in the field.

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