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MULTI-ASPECT STUDY OF THE TRANSPORT, FORWARDING, AND LOGISTICS SECTOR

Summary. This article presents a novel, proprietary multi-aspect evaluation method designed specifically for assessing service in the transport, forwarding, and logistics (T&L) sector, with a focus on international road transport. Developed in 2023 in response to growing market volatility – including disruptions caused by the COVID-19 pandemic, geopolitical tensions such as the war in Ukraine, escalating energy prices, and regulatory changes like the EU Mobility Package – the method provides a robust framework for assessing and comparing service implementation across various market segments. It integrates economic, technical, qualitative, and environmental sustainability dimensions. Unlike existing methods, this approach facilitates precise service assessment comparisons between providers and clients, thereby uncovering substantial discrepancies in service perception. While both customers and companies identified faultless deliveries, reliability, and timeliness as key service selection criteria, companies consistently assigned higher importance ratings – particularly emphasizing completeness of service – revealing a tendency toward overestimation that suggests the need for more realistic self-assessment aligned with customer expectations. Empirical research conducted in 2023 using standardized questionnaires and interval-based evaluation techniques uncovered systematic overestimations by T&L companies regarding their service performance. Notably, companies frequently overestimate their service performance in areas such as reliability, technical standards, and reputation. The proposed method stands out for its integration of economic, technical, qualitative, and environmental sustainability parameters, along with its statistical rigor, as it applies tools such as Student's t-test, the Mann–Whitney U test, chi-square test, and Cramer's V coefficient. Its simplicity, low implementation cost, and adaptability make it suitable for repeated commercial use across different service segments. This innovative approach supports the development of rankings and forecasting trends. By offering a validated and scalable tool for comparative analysis, this innovative method fills a critical gap in the evaluation of T&L services and companies. It provides actionable insights for both internal management and external market positioning, with relevance extending beyond Poland to the broader EU context.

1. INTRODUCTION

Contemporary challenges faced by transport, forwarding, and logistics (T&L) companies are considerably more complex than those observed a dozen or so years ago [1-5]. These challenges stem primarily from the increasingly intricate operational environment and necessitate the implementation of advanced solutions, such as processing vast amounts of data, enhancing security protocols, optimizing

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IT systems, predicting customer expectations, and achieving both digital and physical integration with suppliers and the end recipients. A striking example of the influence of significant external factors on the sector in recent years is the COVID-19 pandemic, as well as the war in Ukraine. The scale and impact of these events have triggered profound structural changes across the sector and its subdomains, particularly within transport-related enterprises [5, 7-8]. In the initial phase, supply chains were disrupted and subsequently shortened, most notably in air and road forwarding, followed by road transport operations (Fig. 1) [4-5, 10-13].

Polish road carriers account for approximately one-third of all road freight within the European Union, meaning that any decline in their performance markedly affects the overall condition of the T&L sector. In the subsequent phase, the competitive position of Polish T&L companies deteriorated in comparison to the enterprises from non-EU Eastern European countries. These companies benefited from new EU regulations introduced in response to the war, enabling access to emerging transport routes while simultaneously remaining exempt from restrictions imposed on community market operations that apply to all EU-based businesses. This imbalance was further exacerbated by the weakening of international trade and the onset of a sector-wide crisis, first apparent in Germany near the end of 2022. From 2020–2021, Poland's road transport sector witnessed a decline of up to 62% (Fig. 1), while contract logistics fell by 31%. By 2023, the most significant fluctuations were observed across the broader transport services sector, as evidenced by the dynamic shifts in demand registered on a leading European transport exchange (Figs. 1-2) [1, 4-5].

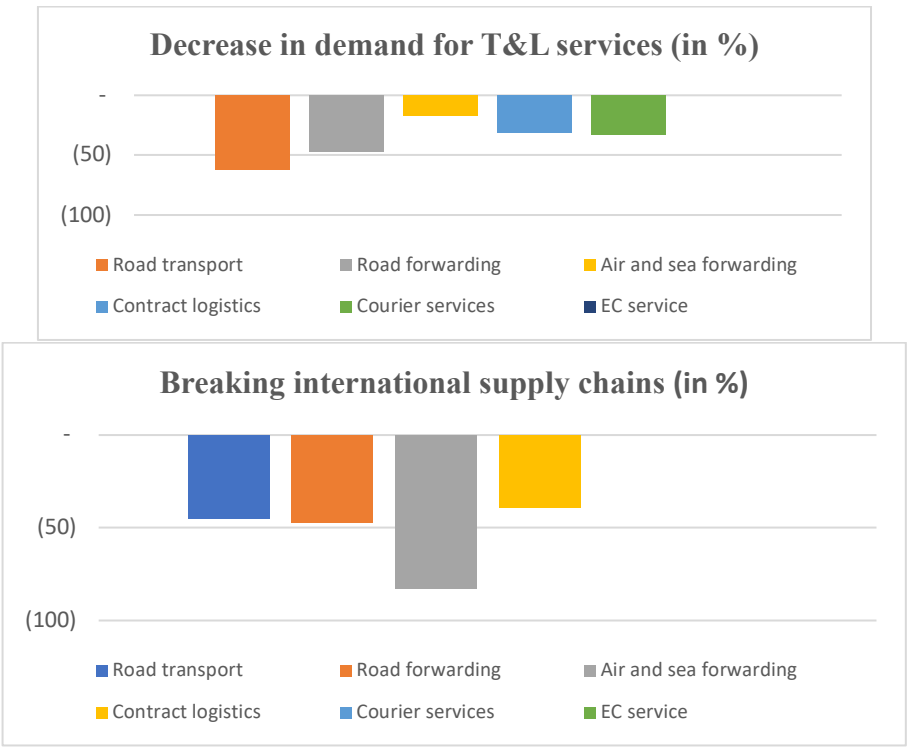

Fig. 1. Decreases in demand and breaking international supply chains for selected T&L services as a result of the COVID-19 pandemic based on a survey of T&L companies in Poland (2021). Source: own study [8-10]

The changes resulting from the global pandemic's impact were further compounded in Poland by the unfavorable effects of implementing the so-called Mobility Package provisions. It is forecast that new community regulations governing, for example, drivers' wages and working hours, as well as access to the market and the carrier's profession, will reduce the advantages of Polish freight transport, which, so far, have been relatively cheap labor costs and the high flexibility of carriers' operations. This is confirmed by the results of research conducted in 2023–2024 at the Motor Transport Institute regarding the impact of regulatory factors on the financial condition and market position of Polish transport companies operating in foreign markets (Fig. 3) [3-4, 7-9, 10-11].

2. BACKGROUND

The dominance of national road transport services is one of the main features that distinguishes the Polish T&L sector. In this respect, the Polish market differs from the German or Dutch markets, which are dominated by contract logistics services, with a greater share of modes of transport other than road [3-5].

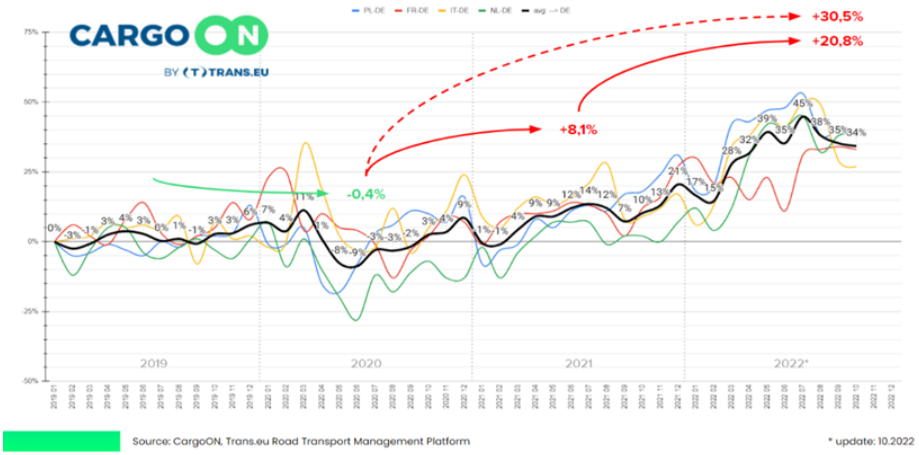

Fig. 2. Dynamics of changes in demand for T&L services - Trans.eu – accessed January 10, 2024 [11].

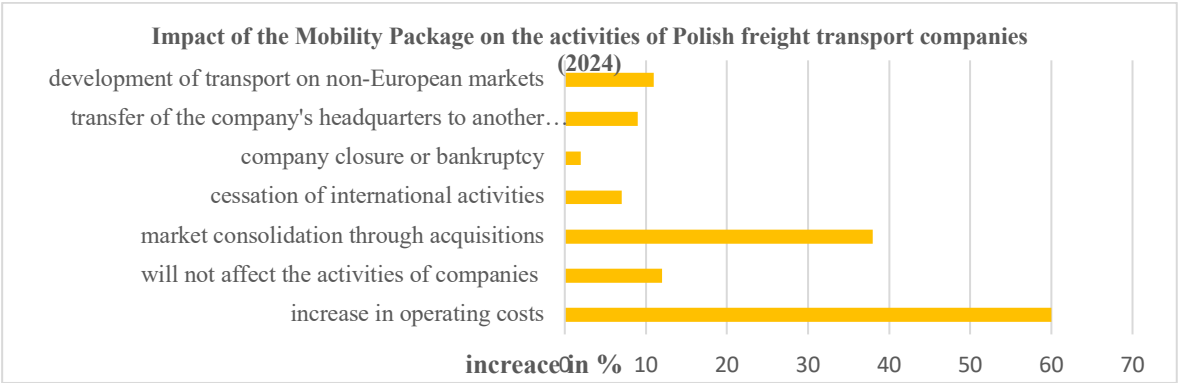

Fig. 3. Dynamics of changes in 2023-2024 among international road carriers as a result of the introduction of the so-called Mobility Package; own study based on [1-4, 6, 8, 12-13]

2.1. Assessment of the importance of the Polish T&L sector

Transport activities, especially those supporting production and industry sector, are of key importance for the co-creation of Polish GDP by T&L companies, [1-2, 7, 12]. There are approximately 125,000 companies in Poland that deal with road transport of goods, which is the largest segment of the T&L market in Poland. Companies belonging to it constitute 6.6% of all enterprises registered in the country. According to the Central Statistical Office, revenues from the sale of services in transport units in 2021 were 14.8% higher compared to 2020 and amounted to PLN 325.1 billion (in the public sector, they increased by 14.2% and in the private sector by 14.8%). In 2022, their growth dynamics in Poland were almost twice as high. Revenues from the sale of services in transport units in 2022 increased by 25.0% compared to 2021, amounting to PLN 415 billion. However, the Central Statistical Office data does not reflect the rapidly changing market situation. It is known that the sector slowed down in the second half of 2022, and one of its main sub-sectors—namely, international freight transport—is already struggling with the crisis. This is mainly due to the decline in cargo supply and freight prices in the EU. A similar breakdown is observed in Poland. Currently, Polish freight transport is estimated to be worth nearly PLN 200 billion and employs nearly 1 million people, with a fleet of over 3 million trucks [2-7, 10-13]. However, contract logistics

services on the Polish market are developing and becoming more dynamic, constituting a high-margin sector in the development phase. The Polish T&L sector is still highly fragmented, although less fragmented than it was 20 years ago [3, 6, 8, 10-13].

In 2002, the four largest entities in the T&L sector on the Polish market achieved average annual revenues at a level corresponding to only 5–6% of the market share. Moreover, two decades ago, the 100 largest T&L companies generated only 15% of the revenue of the entire sector, and this percentage is now 98%, reflecting significant consolidation. According to the latest statistics data [3, 10-13], the 10 largest T&L companies are currently responsible for 73% of the revenue of the entire sector, and the four largest ones are responsible for 40% of the sector's turnover (excluding the courier services sector) [10]. This trend is clear in the current market structure (Fig. 4), where the largest shares are held by Grupa Raben (14%), DSV and DB Schenker/Cargo (each 9%), and FM Logistics (7%). Other prominent players such as DPD, Ceva Logistics, Geodis, and Rhenus hold between 5% and 8% each. Despite this concentration, 21% of the market is still occupied by smaller or niche operators. However, the dispersion in terms of the number of employees in the T&L sector still dominates in the transport and forwarding sectors. They dominate small companies employing up to nine employees (68%), and constitute 47% of the entire sector (Fig. 5) [10-13].

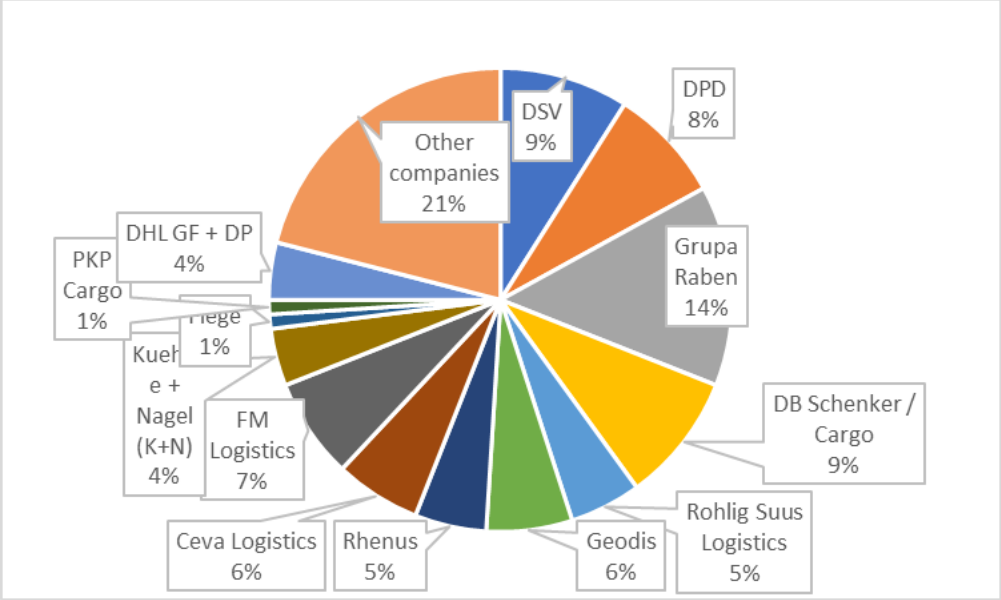

Fig. 4. Entity structure of the T&L market in Poland in 2024 (excluding courier services), including 13 key companies. Source: own study based on [11-13]

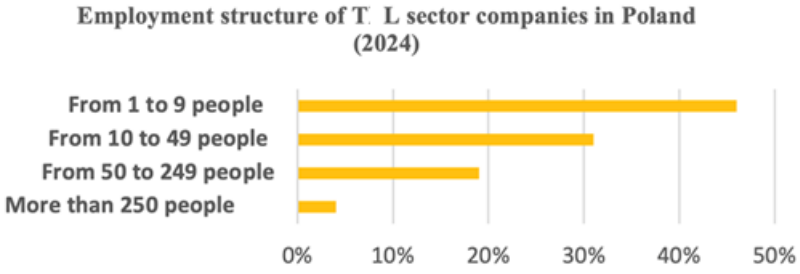

Fig. 5. Employment structure of T&L sector companies in Poland in 2023. Source: Own study based on [7, 12]

As shown by carrier research conducted by the Motor Transport Institute, the economic condition of 60% of transport companies deteriorated in the second half of 2021 and 2022 [3, 6-7, 10-13]. Similar conclusions are provided by the analysis of Timocom and Transeu freight exchange data for 2020-2022 (Figs. 3 and 6). The war in Ukraine had an unfavorable impact on the situation of the Polish T&L sector, the first of which was the loss of some orders (not only on the PL-UA/UA-PL route, but also, due to

sanctions, between Poland and Russia and Belarus). Due to the decline in demand and prolonged stagnation in road freight transport, it will be difficult to achieve a 2% increase in value in 2024-2025 [5].

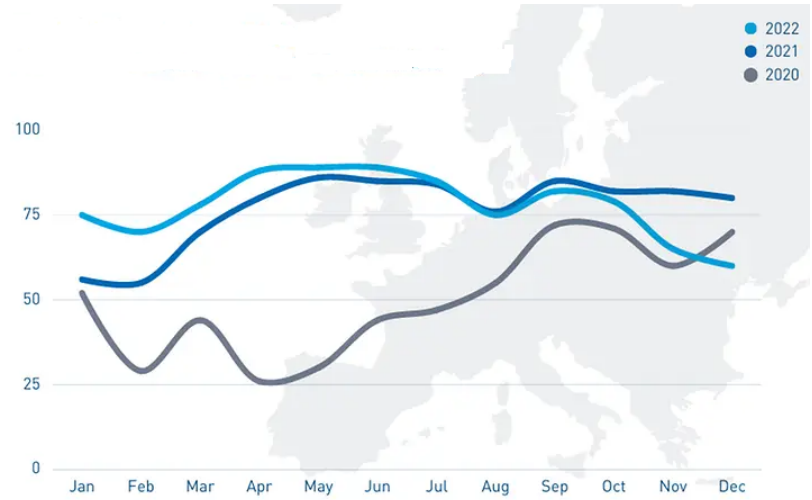

Fig. 6. International haulage of Polish carriers in the EU; Cargo supply in Europe – the ratio of the number of freight offers to the cargo spaces. Source: own study based on [7, 10]

Changes in the conditions for the sector's functioning mobilize management staff, owners, and investors to analyze related services to evaluate the condition of the enterprises providing them and conduct comparative analyses [2-3, 6-9]. The T&L sector in Poland is sufficiently mature that competing on prices and quality is no longer the only criterion for selecting services. The choice of a service provider in this sector is increasingly the result of an analysis of many aspects of the company's operations and the services it offers [5, 12-13]. The most common form of comparative research in this sector is benchmarking the quality of services using questionnaire research from the customers' perspective.

2.2. The research review

From the perspective of T&L service providers, it is now crucial to accurately and quickly identify the criteria for selecting and assessing customer services, and to compare them with one's approach in terms of the importance of individual parameters. This initiative aims to enhance areas that customers consider important but are currently underappreciated by the company, while also reducing involvement in areas deemed less important by customers if the company assigns them a high priority. The questionnaire is a helpful tool in solving this problem. Most often, they are based on customers' satisfaction or preferences. However, the problem lies in selecting assessment aspects, determining their importance, and determining the methods of measuring them.

Most often, a questionnaire assessment of suppliers and service recipients is performed in balanced proportions, within the scope of selected criteria, typically focusing on the evaluation of service quality. In turn, evaluation studies on the effectiveness of providing T&L services are most often carried out using the case study method, sometimes also employing questionnaire methods [2-6, 9-12]. Customers play a crucial role in evaluating the services provided by T&L companies. Among the wide range of instruments used to assess the quality level of T&L services, it is worth mentioning the quantitative SERVQUAL method. It has been developed over several decades and is universally recognized as the most popular method for quality assessments. This method can be supplemented by the study using SERVPERV, which involves assessing the quality of services based on customers' subjective observations without comparing them with expectations in particular dimensions. Currently, the most sought-after methods are those for comparing T&L companies and the services they provide, which do not consume excessive time and resources, and take into account sector-specific evaluation measures [1-2]. Similar conclusions are provided by research conducted in 2018–2019 by a team of Brazilian scientists C.O.L. Nascimentoa, R. Leise, and K. Oliveira [3, 4-6] and Italian experts specializing in assessments of this sector, N. Batarliene, E.M. Rocha, I. Belcavello, H. Ghiaraba, I. Mariottia, C. Silligba [1-4, 13]. Scientific works are dominated by the qualitative approach [1-4].

Meanwhile, company stakeholders (owners, managers, current and potential customers) indicate a greater need to use sustainable multi-factor methods, not focusing only on qualitative aspects or economic results and referring to the specific conditions of the T&L sector [4, 5-7, 9].

In practice, however, there are many evaluation methods that employ a single-criterion approach or have a narrow scope. Available methods do not answer the question about the level of adjustment that companies offer based on the changing expectations of their customers in individual market segments or in the entire sector. Given the growing demand for evaluations of services and companies in the T&L sector using many criteria, the developing nature of analyses, the shortage of research in the field of assessment of T&L's companies, and the simultaneous multitude of methods for describing T&L's services and companies, the authors decided to propose a novel method [2-5, 7-9].

3. EMPIRICAL STUDY METHOD

Given the needs and limitations in evaluating T&L services and companies presented in points 1 and 2, the authors developed, verified, and proposed their own multi-aspect method for assessing T&L services and companies. Although it is universal, it also enables evaluations to be carried out in selected service segments of the T&L sector (e.g., only within forwarding, transport, or logistics services). Additionally, it is possible to conduct assessments using this method within selected types of services, such as international road transport. Questionnaire studies were used in the empirical part, due to their standardized nature. They were then verified using an original tool for evaluating companies, based on the selected criteria, employing interval methods [10]. The main application advantages of the author's research method include:

- commonness of usage,
- objectivity,
- resilience to outlier observations,
- elimination of the need to involve representatives of company management boards in the research,
- low cost and low time consumption of the research,
- universality of application both in the assessment of individual companies and in conducting comparative assessments,
- ability to create rankings with a high level of credibility.

It should be emphasized that the data disclosed by respondents as part of the proprietary method do not violate competition rules or are legally protected, hence obtaining and processing them is simpler. The results of pilot research, obtained using a verified author's method, encourage individual and comparative evaluations of companies from the T&L sector and the continuation of research in the field of criteria and methods for assessing companies from the T&L sector. The research algorithm developed in this work has been proven useful for assessing the activities of T&L companies. The method involves examining six key dimensions of the service in order to identify the sources of problems related to the quality of processes, from the customer's perspective (expectations towards performance). It is based on several dozen questionnaire questions, constructed separately for each evaluation dimension [1-4, 6-10, 12]. This method is a relatively simple yet multi-stage scale that can be used to obtain many valuable tips on improving processes related to a given service. Its primary advantage is its universal applicability to various services [3-9, 13]. Tables 1–3 list the key dimensions and 22 subcriteria used for assessing the services provided by companies in the T&L sector. It includes both clients' and companies' perspective assessments, as well as commonly used statistical and quantitative methods.

3.1. Study Procedure

Based on the collected data, in-depth statistical analyses were performed using IBM SPSS Statistics 25 to assess various interdependencies. Statistical parameters for the entire research group, taking into account asymmetry measures and the degree of concentration of the results, indicated the validity of developing a single list of criteria, rather than separately for both groups. This was also supported by the higher representativeness of the sample. The use of the interval evaluation method in the

mathematical model enabled the verification of the traditional assessment method, which was performed based on statistical analyses. This provided the basis for approving the research procedure algorithm and the mathematical model adopted in the work. After verification, it was applied as part of a quasi-experiment among randomly selected T&L sector companies. Skewness and kurtosis are necessary for ranking criteria when assigning weights based on the mean or median value. They allow for the estimation of the extent to which and how much the results obtained in the study deviate from the mean or median values for a given research sample. In the event of significant asymmetry (right- or left-sided skewness) or significant scattering of results, it is necessary to correct the weight adopted based on the mean or median for a given criterion based on the direction of the disproportion observed. The information used to correct the weights for estimating values in the intervals is supplemented by observing the results of the standard deviation for the obtained mean values in individual criteria and sub-criteria and in the entire tested sample, also by variance analysis. Standard deviation and variance are measures commonly used in statistical inference to determine the probability of the results obtained. Standard deviation is a measure of the distance of individual results from the mean, while variance is the differentiation of the results in relation to each other within this sample. The more "distant" a given result is in units of standard deviation from the mean, the more atypical it is. Similar indications result from reading the variance value. The results obtained from the entire sample and its subgroups were consistent with a normal distribution; however, some subgroups exhibited higher-than-average kurtosis and asymmetry values. Therefore, the authors decided to conduct an in-depth study of compliance using t-Student and Mann-Whitney (for nonparametric assessment of the significance level of the diagnosed differences when comparing two independent samples of clients and companies), as well as the Chi-square test in individual cases. Analysis of variance was not necessary because no more than two groups were analysed simultaneously in the individual phases of the study. Due to the limitations of the interpretation possibilities of both tests, in some comparative evaluations, where an additional variable was considered, Cramer's coefficient (V) was used to examine the relationship between both nominal and dichotomous variables (e.g., in the study of the relationship between providing or not of transport services by the surveyed companies and the scope of their activities and the structure of their customers). When further specifying the questions, such as that of the dominant market for the provision of services in individual segments, it was necessary to use the chi-square test to observe the distribution of the variable (e.g., geographical scope of operation) among the companies without indicating a specific service activity and comparing it with the model distribution.

Table 1

Statistics of the quantitative variables studied – data for both groups (clients and T&L companies)

Subcriterion / Statistical measure	M	Me	SD	Sk.	Kurt.	Min.	Max.	W	P
Reputation									
Infrastructure, fleet, equipment	3.69	4.00	1.09	-0.69	0.01	1.00	5.00	0.87	<0.001
Communication and techniques used	3.98	4.00	1.05	-0.96	0.40	1.00	5.00	0.83	<0.001
Competitive experience, credibility	4.15	4.00	0.95	-1.04	0.89	1.00	5.00	0.80	<0.001
Financial situation	3.33	3.00	1.20	-0.24	-0.77	1.00	5.00	0.91	<0.001
Reliability									
Dependability	4.33	5.00	0.95	-1.49	1.61	1.00	5.00	0.71	<0.001
On-time deliveries	4.40	5.00	0.83	-1.20	0.50	2.00	5.00	0.72	<0.001
Error-free deliveries	4.43	5.00	0.86	-1.55	1.74	2.00	5.00	0.68	<0.001
Price									
Competitive value for money	4.24	4.00	0.92	-1.37	1.95	1.00	5.00	0.77	<0.001
Quality									
Customer-oriented flexibility	4.02	4.00	0.98	-1.14	1.52	1.00	5.00	0.81	<0.001

Subcriterion / Statistical measure	M	Me	SD	Sk.	Kurt.	Min.	Max.	W	P
Service progress information accessibility	3.99	4.00	0.89	-0.67	0.23	1.00	5.00	0.85	<0.001
IT technologies involvement level	3.44	4.00	1.08	-0.41	-0.40	1.00	5.00	0.90	<0.001
Completeness of service	4.19	4.00	0.91	-1.22	1.71	1.00	5.00	0.79	<0.001
Customer response efficiency	4.28	5.00	1.00	-1.53	2.10	1.00	5.00	0.73	<0.001
Competitive service standards	3.74	4.00	1.05	-0.79	0.21	1.00	5.00	0.86	<0.001
Technical aspects									
Cargo characteristics	3.60	4.00	1.12	-0.65	-0.16	1.00	5.00	0.88	<0.001
Packaging type	3.66	4.00	1.08	-0.97	0.42	1.00	5.00	0.83	<0.001
Fleet type	3.61	4.00	1.09	-0.50	-0.21	1.00	5.00	0.89	<0.001
Transport specificity	3.21	3.00	1.20	-0.31	-0.63	1.00	5.00	0.90	<0.001
Loading method	3.48	4.00	1.15	-0.50	-0.44	1.00	5.00	0.89	<0.001
	M	**Me**	**SD**	**Sk.**	**Kurt.**	**Min.**	**Max.**	**W**	**P**
Automation of services	3.79	4.00	1.17	-0.91	0.03	1.00	5.00	0.84	<0.001
Other aspects									
Geographical coverage	3.47	4.00	1.25	-0.65	-0.44	1.00	5.00	0.87	<0.001
Green-oriented solutions	3.13	3.00	1.18	-0.36	-0.60	1.00	5.00	0.90	<0.001

Table 2

Ranking of all 22 sub-criteria of service assessment (average value obtained for the entire research sample)

Lp.	Subcriterion / Statistical measure	M	Me	SD	Sk.	Kurt.	Min.	Maks.	W	P
1.	Error-free deliveries	4.43	5.00	0.86	**-1.55**	1.74	2.00	5.00	0.68	<0.001
2.	On-time deliveries	4.40	5.00	0.83	-1.20	0.50	2.00	5.00	0.72	<0.001
3.	Dependability	4.33	5.00	0.95	**-1.49**	1.61	1.00	5.00	0.71	<0.001
4.	Customer response efficiency	4.28	5.00	1.00	**-1.53**	2.10	1.00	5.00	0.73	<0.001
5.	Price (competitive value for money)	4.24	4.00	0.84	**-0.90**	0.09	2.00	5.00	0.79	<0.001
6.	Completeness of service	4.19	4.00	0.91	**-1.22**	1.71	1.00	5.00	0.79	<0.001
7.	Competitive experience, credibility	4.15	4.00	0.95	-1.04	0.89	1.00	5.00	0.80	<0.001
8.	Customer-oriented flexibility	4.02	4.00	0.98	-1.14	1.52	1.00	5.00	**0.81**	<0.001
9.	Service progress information accessibility	3.99	4.00	0.89	-0.67	0.23	1.00	5.00	**0.85**	<0.001
10.	Communication and techniques used	3.98	4.00	**1.05**	-0.96	0.40	1.00	5.00	**0.83**	<0.001
11.	Automation of services	3.79	4.00	**1.17**	-0.91	0.03	1.00	5.00	**0.84**	<0.001
12.	Competitive service standards	3.74	4.00	**1.05**	-0.79	0.21	1.00	5.00	**0.86**	<0.001
13.	Infrastructure, fleet, equipment	3.69	4.00	**1.09**	-0.69	0.01	1.00	5.00	**0.87**	<0.001
14.	Packaging type	3.66	4.00	**1.08**	-0.97	0.42	1.00	5.00	**0.83**	<0.001

15.	Fleet type	3.61	4.00	**1.09**	-0.50	-0.21	1.00	5.00	**0.89**	<0.001
16.	Cargo characteristics	3.60	4.00	**1.12**	-0.65	**-0.16**	1.00	5.00	**0.88**	<0.001
17.	Loading method	3.48	4.00	**1.15**	-0.50	**-0.44**	1.00	5.00	**0.89**	<0.001
18.	Geographical coverage	3.47	4.00	**1.25**	-0.65	**-0.44**	1.00	5.00	**0.87**	<0.001
19.	IT technologies involvement level	3.44	4.0019	**1.08**	-0.41	**-0.40**	1.00	5.00	**0.90**	<0.001
20.	Financial condition	3.33	3.00	**1.20**	-0.24	**-0.77**	1.00	5.00	**0.91**	<0.001
21.	Transport specificity	3.21	3.00	**1.20**	-0.31	**-0.63**	1.00	5.00	**0.90**	<0.001
22.	Green-oriented solutions	3.13	3.00	**1.18**	-0.36	**-0.60**	1.00	5.00	**0.90**	<0.001

4. RESULTS

The results obtained for the entire sample and its subgroups are characterized by distributions that are close to normal, but with varying levels of variability. In some cases, high values of positive kurtosis were observed, with rare negative values, as well as a clear asymmetry, where the majority of groups and subgroups studied showed a predominance of left-skew negative distributions. This indicated that most of the observed results were above average. In turn, the kurtosis, which assumes positive values for most observations in the group of companies, indicated that a significant part of the indications within the group were similar to each other, and a few observations clearly differed from the others – in particular observations regarding ecology, standards, technical aspects, and the geographical scope of the services provided. For these aspects, kurtosis took negative values in the range of <– 0,68;– 0,42>, confirming a clear scattering of results from the mean. Therefore, detailed tests were conducted, allowing for a more precise diagnosis.

The largest differences were observed in the evaluation of the importance of six criteria and their sub-criteria between the assessments obtained from the group of clients and the group of companies. The companies surveyed evaluate individual aspects of the implementation of T&L services excessively highly. They assess most of the criteria for selecting T&L services as higher than those of their clients. However, excessive optimism in the assessments of company representatives should encourage making more frequent comparisons with customer expectations to better adapt to them and effectively implement the assumed market goals. The proposed research method, along with the algorithm for conducting the research process, aims to facilitate such cyclically repeated comparative assessments.

The p-value derived from the Mann-Whitney test indicated significant differences in the assessment of the value of criteria, such as reputation (two statistically significant differences) and technical aspects (three statistically significant differences) between the studied group of clients and the group of T&L companies.

Evaluations in market segments provide a more precise diagnosis of the key criteria for selecting services, depending on their specificity, than the aggregate results obtained for the entire sample or in the group of all T&L companies. Studies on the frequency of indicating various aspects of the companies' activities depending on the market segment and the selected types of services implemented have provided additional conclusions on the specificity of the implementation of T&L services.

The studies of T&L companies have shown that the strongest correlations occur between areas of service provision, the scope of market activity, and the durability of customer relationships. Table 3 presents general comparisons of the results obtained for entrepreneurs and customers. Many correlations were observed in the in-depth analysis. Two statistically significant results were noted. Customers of entrepreneurs providing transportation services were characterized by a longer period of cooperation than in other areas of service. The strength of this effect, measured by the in-depth test and the r coefficient, was large. Another notable correlation observed in the group of transport companies was the significantly more frequent provision of services on international markets compared to companies

that did not offer transport services. The strength of this effect, measured by the V coefficient, was moderately high.

Table 3

Ranking of all the 22 sub-criteria of service assessment (value obtained separately in the group of customers and companies)

	Subcriterion / Statistical measure	Customers		Companies				95% *CI*		
		M	*SD*	*M*	*SD*	*T*	*p*	*LL*	*UL*	*d* Cohen
1.	Error-free deliveries	4.28	1.01	4.58	0.64	1.77	0.080	-0.04	0,64	0,35
2.	Dependability	4.2	1.05	4.46	0.84	1.37	0.174	-0.12	0,64	0,27
3.	Completeness of service	3.94	0.98	4.44	0.76	2.86	0.005	0.15	0,85	0,57
4.	Customer response efficiency	4.12	1.15	4.44	0.79	1.62	0.109	-0.07	0,71	0,32
5.	On-time deliveries	4.38	0.9	4.42	0.76	0.24	0.811	-0.29	0,37	0,05
6.	Price (competitive value for money)	4.12	0.92	4.36	0.75	1.43	0.155	-0.09	0,57	0,29
7.	Competitive experience, credibility	4.08	0.97	4.22	0.93	0.74	0.463	-0.24	0,52	0,15
8.	Customer-oriented flexibility	3.82	1	4.22	0.93	2.07	0.042	0.02	0,78	0,41
9.	Service progress information accessibility	3.84	0.96	4.14	0.81	1.70	0.093	-0.05	0,65	0,34
10.	Automation of services	3.46	1.23	4.12	1	2.94	0.004	0.21	1,11	0,59
11.	Communication and techniques used	3.86	1.14	4.1	0.95	1.14	0.257	-0.18	0,66	0,23
12.	Infrastructure, fleet, equipment	3.4	1.2	3.98	0.89	2.75	0.007	0.16	1,00	0,55
13.	Geographical coverage	2.82	1.38	3.9	0.95	3.93	0.000	0.53	1,63	0,95
14.	Fleet type	3.4	1.2	3.82	0.94	1.95	0.054	-0.01	0,85	0,39
15.	Competitive service standards	3.68	1.1	3.8	1.01	0.57	0.571	-0.30	0,54	0,11
16.	Packaging type	3.52	1.23	3.8	0.88	1.31	0.195	-0.15	0,71	0,26
17.	IT technologies involvement level	3.12	1.19	3.76	0.85	3.10	0.003	0.23	1,05	0,62
18.	Loading method	3.22	1.27	3.74	0.96	2.31	0.023	0.07	0,97	0,46
19.	Cargo characteristics	3.48	1.25	3.72	0.97	1.07	0.286	-0.20	0,68	0,21
20.	Financial condition	3.06	1.24	3.6	1.11	2.30	0.023	0.07	1,01	0,46
21.	Transport specificity	2.86	1.29	3.56	0.99	3.04	0.003	0.24	1.16	0.61
22.	Application of green solutions	3.45	1.18	2.92	1.14	-2.07	0.042	-1.05	-0.02	0.46

4.1. Customers

Customers considered the on-time deliveries (average rating = 4.38, with less than 1 standard deviation) and error-free deliveries (average rating = 4.28, with slightly higher than 1 standard deviation) as key sub-criteria of selection of T&L services. The third sub-criterion, which received the highest averages in the customer evaluation, was dependability -the supplier's ability to provide services in a reliable and fault-free manner (average score = 4.24, with a standard deviation slightly higher than 1). The fourth criterion determining the choice of T&L services from the perspective of customers was price (4.12). The lowest assessment was given to the importance of geographical coverage as a criterion for service selection (average score = 2.82, with a relatively high standard deviation of 1.38). Similarly, low scores were obtained for the criteria: type of transport in terms of cargo characteristics, financial condition of the

supplier, level of IT use, or type of fleet or infrastructure of the service provider. However, low average scores for these sub-criteria were accompanied by relatively high values of standard deviation (above 1.2), which indicates that the results are very diverse in relation to the average obtained in these sub-categories. The largest number of customers rated timeliness (31 indications for the "5" rating) and error-free deliveries (29 indications for the "5" rating) as the most important factors.

4.2. Companies

Companies considered error-free deliveries (average rating = 4.58), the dependability of the supplier to provide the service in a reliable and fault-free manner (average rating = 4.46), and completeness of the service (average rating = 4.44) as key sub-criteria of choosing T&L services. Companies rated other sub-criteria, not often indicated by customers, equally highly, including customer response efficiency (average rating = 4.44). Companies did not appreciate the importance of on-time deliveries (average rating = 4.42) as much as other criteria. Although the nominal evaluation of the importance of this criterion by entrepreneurs was high, it ranked only fifth. In the assessment of customers, it was the most important criterion. In turn, among the companies, price criteria ranked fifth and sixth, whereas among customers, they ranked fourth and fifth. It should be added that in the group of companies, higher average scores were obtained in almost all criteria than in the group of customers. Entrepreneurs also indicated a larger set of "key" criteria for the selection of T&L services, characterized by the nine sub-criteria with average values above 4.2, compared to three sub-criteria for customers. Most customers rated the importance of timeliness the highest (31 indications for the "5" score) and on-time deliveries (29 indications for the "5" score). Among companies, the distribution of the most frequently considered key variables for choosing T&L services was different as follows: error-free deliveries (32 indications for a rating of "5"), dependability - reliability of service (30 indications for a rating of "5"), customer response efficiency (28 indications for a rating of "5"), completeness of deliveries (27 indications for a rating of "5"). The research conducted on a group of companies suggests that separate rankings of criteria for assessing the implementation of T&L services should be created for specific packages of services or the T&L sector. For example, the key factors for the evaluation of transport and forwarding services, in order of their average values are the price of the service (4.46) and the reputation and reliability of the supplier (4.22); meanwhile, in logistics services, companies considered the price (4.52), as well as the geographical coverage of the service (4.00) and competitive service standards (4.00) to be critical. The distributions in these subgroups, however, showed excessive asymmetry and deconcentration, and their numbers limited further statistical inference. It would be reasonable to conduct the work in these subgroups, but only if a larger research sample were considered. In the courier services segment, entrepreneurs considered speed and on-time deliveries (average score = 4.78) to be the most important factor influencing their choice, followed by the price of the service (4.42) and service progress information accessibility (4.26). They should also be considered critical for the implementation of courier services since the highest correlation between service providers and service recipients was found between the assessments obtained in this respect.

4.3. Assessment of the correlation of results between subgroups (customers-companies)

Using the Student t-test, an analysis of descriptive statistics was performed for independent samples (Table 3). The classic threshold of $\alpha = 0.05$ was considered the level of significance. Additionally, the results of the probability of the test statistics in the range of $0.05 < p < 0.1$ were interpreted as significant at the level of statistical tendency, allowing for the formulation of generalized conclusions. If the p-value was less than 0.05, the result was considered statistically significant. The differences between means or some relationships between variables were statistically significant. When comparing two independent samples (50 customers and 50 companies), a p-value below 0.05 indicated a low correlation of results in both groups for the sub-criterion.

The results obtained for the entire sample and its subgroups were characterized by distributions that were close to normal, but with varying levels of variability. In some cases, high positive kurtosis values were observed, with rare negative values, as well as clear asymmetry, characterized by a predominance of left-skewed negative values in most of the groups and subgroups studied. This was one of the justifications for making corrections according to the Sigma rule using the interval evaluation method adopted in the

research work. A significant part of the indications in the group of companies were similar, and a few observations clearly differed. In particular, they concerned ecology, standards and technical aspects, and the geographic range of the services provided. For these aspects, kurtosis took on negative values, confirming a clear scattering of results around the average. Therefore, verification tests were conducted in several variants, enabling a more precise diagnosis.

5. CONCLUSIONS

The last few years have been challenging for the T&L industry. Among the problems affecting T&L companies are new EU regulations, the war in Ukraine, and the lack of specialized drivers. The shortage of qualified drivers on the market is not a new problem. In 2012, the European Parliament warned that the EU was short of 4.2% of truck drivers. The latest reports indicate that Poland is short of over 100,000 drivers, and Germany will be short of 150,000 drivers in three years [10-12]. The lack of professional drivers will slow down the development of transport companies, the T&L industry, and the entire economy. To survive, companies must effectively implement innovative solutions that enable them to operate in a constantly changing environment. To determine what to implement or change, companies should conduct regular comparative studies that enable a quick analysis and accurate diagnosis of areas requiring improvement. However, identifying which areas to optimize or transform requires reliable comparative studies. The evaluation of service implementation in the T&L sector remains a complex and critical issue. This article introduces a novel, multi-aspect evaluation method developed in 2023, specifically designed to assess and rank T&L companies. The method integrates economic, technical, qualitative, and environmental dimensions, enabling precise comparisons between service providers and clients. Its application in original empirical research revealed significant perception gaps between these groups. The analysis of theoretical and practical aspects of this issue presented in the article led to:

- a synthesis of criteria for assessing the provision of services by T&L sector companies along with their classification,
- a comparison of various methods for assigning weights to criteria within the conducted research,
- the proposal of a utilitarian method for ranking and assessing T&L companies,
- the presentation of possibilities for using various methods for measuring assessment criteria,
- an indication of the possibilities of conducting comparisons of companies and creating rankings.

Customers considered the following to be the most important sub-criteria for choosing T&L services: On-time deliveries, error-free deliveries, reliability - dependability of deliveries. Companies rated these sub-criteria similarly but with slightly higher average ratings for some sub-criteria, in the following order: error-free deliveries, reliability – dependability of deliveries, completeness of service. It should be noted that the companies rated the importance of almost all service selection criteria higher than their customers did, which should make them less optimistic in assessing their own activities.

The development prospects for T&L sector companies in Poland over the coming years are promising, although they will present numerous challenges in both the macro and micro environments. Specifically, this concerns the need to intensify the development of road, rail, and port infrastructure, aimed at improving the efficiency of T&L companies in the sector. Another challenge is the further digitization and automation of the sector and improvements in blockchain solutions, aimed at increasing operational efficiency and reducing costs. In turn, the growing importance of ecology will force companies to make greater investments in zero-emission vehicles. The research results presented in this article still indicate a low assessment of the importance of greening means of transport among T&L companies and clients. The continuous growth of international trade, especially driven by the development of the e-commerce market, will imply a further increase in demand for logistics and transport services in the scope of the so-called last-mile deliveries. Meanwhile, staffing shortages and market consolidation will intensify competition, creating a need for robust tools to assess service quality beyond economic indicators alone. The method presented in this article offers a scalable and cost-effective tool for making individual and comparative assessments of T&L companies that supports strategic decision-making and can be adapted for use in other EU countries. The research algorithm

developed by the authors provides a foundation for future studies on service evaluation in the transport and logistics sector.

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