Article

Sustainability Promotion by Digitalisation to Ensure the Quality of Less-Than-Truck Load Shipping

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Abstract: Freight transport by road is constantly increasing, therefore it is very important to ensure efficient distribution of flows by optimizing/reducing transport costs. With the recent increase in the demand for small loads, less-than-truckload transportation services are becoming increasingly popular among representatives of small and large businesses. This method of cargo transportation is more economically accessible and useful. The increasing competition between companies encourages the search for ways to improve the offered services, thereby reducing costs for customers. Digitization tools are among the most important in order to implement the principles of green logistics, ensure long-term competitive advantages by systematically improving logistics results and reducing costs. Automated service management, services based on customer data and intelligent solutions must help companies create a digital business model. The purpose of this article is the identification of problem areas in the service quality of companies carrying out less-than-truckload transportation on international routes and ways of solving them by applying digitization technologies. Research methods/methodology used: the work was carried out based on the analysis of scientific literature, statistical data analysis and survey methods, an expert survey was conducted by means of a questionnaire. The analysis of scientific literature made it possible to identify that the transportation of less-than-truckload shipments is not considered as a separate element, but included in the process of transportation of general loads. Considering the fact that less-than-truckload cargo transportation is becoming increasingly popular globally, this renders it possible to justify the novelty of the article and for a more detailed study. The result of the work is a conceptual model of service quality improvement based on digitization technologies.

Keywords: less-than-truckload shipments; sustainability; road transport; service quality; digitalisation

1. Introduction

Sustainability is one of the single most significant global issues the world faces [1,2]. The growing global focus on global warming and greenhouse gas emissions has led transport companies to become increasingly interested not only in alternative-fuel vehicle technologies that are more efficient than traditional options for reducing car greenhouse gas emissions and dependence on fossil fuels, but also in finding solutions for sustainable freight transport [3]. Less-than-truckload service is becoming an important part of the business, as it meets the needs of both large and small companies, not only to optimize transportation costs for small volumes, but also to address the relevant sustainability issues in the context of safety, convenience and economy [4,5]. The organization of partial freight transport on international routes involves a complex process that connects the work of various international terminals, customers and transport companies, where freight compatibility, transport efficiency, cost-effectiveness, optimal vehicle loading, carriers, logistics business partners and customers depend on it. Significant impact on the quality of services and thus on the promotion of sustainability [6]. Various research works are being carried out to improve the quality of less-than-truckload road haulage on international routes,

based on the quality-of-service criteria applied to customers transport companies and to the transport companies' own business partners who directly contribute to improving the quality of the joint service. However, more detailed research is lacking, especially concerning the organization of less-than-truckload transport in the context of sustainability.

However, it should be kept in mind that, assessing the quality of transport services is much more complex than the quality of the product, as it relates to the main features of the service or the set of characteristics that help to meet the identified or implied needs of customers. It is important to emphasize that the main criteria for assessing the quality of service are service flexibility, document management, reliable transportation, fast order fulfilment, additional services, cargo security, delivery to the recipient's door, cargo loading works, handling equipment for transhipment at international terminals, price presentation, and customs brokerage services [6]. With the current trend in global freight transport, public authorities are promoting the use of new technologies and science in the field of transport and presenting new opportunities. The growth of freight transport is causing congestion, leading to rising fuel consumption and environmental problems such as reduced air quality, global warming and limited resources [7]. A major challenge is that the bulk of the energy still comes from oil, which makes any reversal of this trend difficult to achieve [8]. As a result, transport planners are moving towards new transport options that support sustainability, based on clean and clean energy sources that will be used in the transport system, especially for the transport of partial loads on international routes. Sustainable transport within urban agglomerations creates conditions that ensure reliable satisfaction of transport needs and the functioning of individual transport systems. The aim is to ensure the smooth travel of the population, promote public passenger transport, improve the environment and increase safety and the flow of traffic [9]. Digital transformation in logistics and transportation helps companies from the sector to take advantage of new technologies and stay competitive in a market that is continuously expanding. These include the web, the cloud, sensors, data analytics, machine learning, blockchain technology, and the Internet of Things (IoT), which improve vertical and horizontal alignment around supply chain networks [10]. The role of new technologies in the optimization of logistics can be very diverse and can be applied in different solutions such as: intelligent transport system; real-time information system; alternative transportation means; crowdsourced delivery and transport solutions. Eco-logistics measures aim to promote eco-friendliness and sustainability among all transport systems [11].

Background identification of problem areas for the quality of service of companies engaged in international freight transport on partial routes demonstrate where solutions through the use of digitization technologies are aimed towards. Digitalisation provides both challenges and opportunities for quality management. The interest of shippers is to maximize quality of service in terms of costs and reliability of transport [12]. Freight carriers are usually mostly interested in minimizing their costs by maximizing the efficiency of their pick-up and delivery tours. Additionally, they are expected to provide a high level of service at a low cost [13].

International carriage of freight is a method of transport where the consignor or the consignee of the goods are located in different countries. International carriage of goods is different from local carriage in that the consignor and the consignee are located in different countries, which creates additional obstacles. Road freight transport dominates with regard to the amount of freight carried and its impact on the national economy. Many authors have highlighted the main advantages of road transport, which are: manoeuvrability, door-to-door delivery, speed of delivery, regularity and the possibility to transport small shipments. Modern road transport has to perform the task of optimisation and efficient flow distribution [14].

The logistics system could not exist without road transport and the means of transport it uses to carry out logistics operations, including the organisation of international carriage [15]. Successful collaboration between particular stakeholders can lead to the

preparation of high impact strategies that consider the needs of international businesses, transport operators and local residents [11].

Therefore, in the modern world, it is increasingly important for companies to follow the principles of green logistics in their activities and integrate as many of its components as possible (e.g., digitization, etc.). Currently, the development of the company's activities, considering the guidelines of green logistics, is a new factor determining the competitiveness of the organization and the provision of quality services. Given that reducing the harmful impact on the environment is one of the major challenges these days, this problem is being solved around the world in accordance with the principles of sustainable development. A reduction in the negative impact of transportation is possible and requires the creation of legal restrictions, investments and the implementation of sustainable solutions. Transport and logistics activities aim to be carried out using green logistics methods, as the issue of environmental sustainability has received an abundance of attention in recent years. Growing global competition forces many companies and institutions to reduce environmental pollution in their activities, and modern laws increasingly require companies to adopt environmentally friendly decisions in their activities and transportation processes. Part-load transport in every sense presents greater sustainability challenges than full-load transport.

It is important for companies seeking to improve the quality of their services to constantly focus on the importance of service quality, the problem areas of the quality of the services offered, and the specific quality assessment features and indicators. Companies organising international road freight transport face a high dependence on delivery times and the cost-effectiveness of a trip, the necessity of providing an integrated service, and the interdependence of different customers and various risks, which hinder the provision of the service in a quality manner and its continuous improvement. The direct impact of customers on the provision of the transport service and different perceptions of the quality of the service that customers expect have made it necessary to continuously examine customers' expectations and the requirements set for partners [16].

This article presents a scientific analysis in order to identify the specifics of carriage of less-than-truckload shipments on international routes, the peculiarities, the set service quality requirements, evaluation aspects, and the importance of digitalisation. The importance of the total quality management and the service quality management system based on the ISO standard was examined. The functions, principles and main advantages of quality management were studied. The method of expert survey was used to examine how the quality of services could be improved having evaluated the quality criteria of customers and partners.

2. Methods and Methodology

This Section consists of two parts. The first part "Literature overview" aims to assess the challenges and problems in the carriage of less-than-truckload shipments and the quality assurance of this process, and the second part describes the choice of the methodology used in the research.

2.1. Literature Overview

2.1.1. Theoretical Aspects of Carriage of Less-Than-Truckload Shipments

To minimise the risks associated with international carriage, which include delivery delays, security, and the speed of handling paperwork, companies must choose a reliable carrier. Clausen et al. [15] state that the carriage of less-than-truckload shipments is the best method of carriage for processing the maximum possible number of transport orders when transporting goods from the consignor to the consignee through the use of logistics centres. Other authors [16] believe that the carriage of less-than-truckload shipments is becoming an important part of business, as it meets the needs of various companies that are interested in optimising their transport costs carrying small shipments. The structure

of less-than-truckload shipments includes a less-than-truckload shipment line created by freight forwarders (Figure 1).
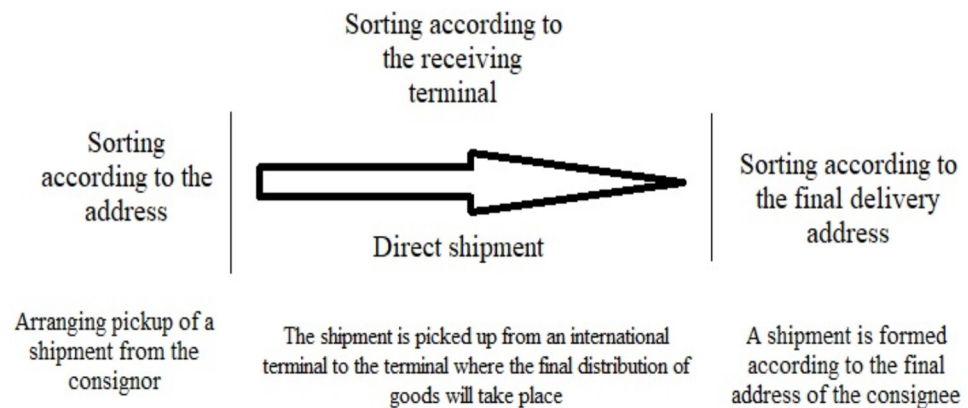

Figure 1. Example of the structure of carriage of less-than-truckload shipments compiled by the authors according to [16].

The main aspects of carrying less-than-truckload shipments include shipment compatibility, optimal loading of vehicles and efficiency of transportation.

When organizing the carriage of less-than-truckload shipments on international routes, the following stages of the carriage process are distinguished: (1) Receipt of orders; (2) Consolidation of shipments; (3) Terminal freight handling; (4) Arranging freight carriage, considering the parameters of shipments on hand and the delivery locations; (5) Preparation of documents and customs brokerage; (6) Delivery of goods [16].

In order to maximize the cost-effectiveness of a trip, companies extend delivery times. Customs clearance procedures at border checkpoints and customs offices at the destination not only extend delivery times, but also increase the likelihood of downtime. Various risks of loss of freight are related to staff errors when loading someone else's freight into a vehicle or when a load is stolen at a place of loading due to failures in labelling and loading equipment.

Therefore, ensuring the quality of the process is essential for safe transportation of less-than-truckload shipments [6].

2.1.2. Peculiarities in the Assessment of Quality of Less-Than-Truckload Shipment Service

The service must be assessed considering all its constituent indicators and cannot be assessed in advance to identify the peculiarities of the transport quality assessment [17,18].

Like all other services, the services provided by transport companies do not have a uniform assessment system due to their diversity; however, indicators of transport quality that help to assess the quality of the service provided can be identified, taking into account the range of specific services offered [17,18].

The quality indicators for less-than-truckload shipments include: minimum delivery time, adherence to departure schedules and on-time arrival of freight, ensuring the safety of freight during carriage and the carriage of larger shipments without splitting them into smaller shipments [1]. Safe and fast delivery, the ability to transport all of the customer's shipments and to offer a comprehensive service, observance of a high level of service, and prompt and courteous communication have become indicators in quality of freight carriage service [6].

Having examined the needs of customers of the transport sector Šimkova and Konečný [19–21] identified the main quality criteria, including the flexibility of service, the ability to provide assistance in preparing the necessary documents, reliable carriage, etc.

In order to understand what service quality is, the concepts of various researchers have been listed in chronological order in Table 1.

Table 1. Definitions of service quality found in scientific articles.

Definition of Service Quality	Author
Service quality is one of the main indicators which helps to keep the company competitive and meet customer needs	[22]
Service quality is a set of characteristics that help to meet the already identified or implied needs of customers	[23]
Service quality is a consumer's attitude to the provided services regardless of whether they did or did not meet expectations	[24]
Service quality is a comprehensive assessment of a specific customer service to understand whether it meets the customer's expectations and is satisfying	[25]
Service quality is everything that is related to meeting customer needs	[26]

Source: compiled by the authors.

Researchers note that service quality is directly related to meeting the needs of consumers or customers. Likhtanskaya and Belova [27] emphasise that quality must meet the defined and implicit customer needs. The quality of a transport service has a mutual benefit: it meets the needs of customers having ordered the service and increases the efficiency of transport companies [28]. Authors identify quality as one of the most important means of increasing the customer base and the company's profits. Huang et al. [29] say that the level of quality of the services offered is the most important factor affecting the customer's decision to choose the services of a particular company, because when choosing between the cheapest and the highest quality service, the customer will give preference to the service provider that can provide a service that meets their expectations at the price they expect. Customer satisfaction and loyalty become a competitive advantage among other market players.

Assessing transport service quality is a very complicated task. Assessing the quality of a service is much more difficult than assessing the quality of a product, because it relates to the key features of a service.

One of the most important problems in service quality assessment is the inapplicability of product quality assessment methods in assessing the service. Nasakina et al. [30] say that frequent customer dissatisfaction is associated with a wide range of risks, resulting in a loss of goods and delivery delays. The various risks and associated problems can be addressed by proper management and coordination of processes of a transport company.

Sprogytė and Zinkevičiūtė [31] name a failure to provide the necessary documents on time and various unforeseen risks that transport companies may encounter during carriage or before organising the provision of their service as other service quality problems.

Transport companies focus on turnover, control of freight volumes and profit, and cost-effectiveness. By focusing on these indicators, companies no longer devote sufficient time to quality management, which is the factor that directly determines their business efficiency and competitiveness.

It is therefore not only important to ensure quality service delivery, but to also manage that process successfully.

Arikkök [32] describes the total quality management (hereafter—TQM) as a set of practices for the management of a company designed to ensure that a company meets and exceeds the expectations of its customers.

In order to increase the efficiency of quality management, most transport companies take part in the certification process [27]. Quality management involves identifying customer needs, evaluating the quality provided, and developing, implementing, and organizing a variety of methods to improve service quality. No firms can achieve success by permanently relying on an existing business model, because they are under pressure from external forces to continuously reinvent it with the use of digital technologies. Meanwhile, many traditional organizations pursue the digitalization journey toward more digitalized

business models, and look forward to implementing digital technologies in every function to support their operations [33].

2.1.3. Problems Relating to Service Quality and Ways to Improve Service Quality through Digitalisation

The organisation of international carriage of less-than-truckload shipments is a complicated process involving the operation of different international terminals, compatibility of shipments, efficiency of carriage, optimal loading of vehicles, cost-effectiveness of a trip, and the interdependence of carriers, logistics business partners and customers, which bear a significant impact on the improvement of service quality [15].

Companies find improving service quality difficult, because a transport service is provided at the time of its production, customer perceptions of service quality vary and there is no uniform framework for assessing the quality of transport services [34].

Company management shows little interest in developing quality improvement models. After obtaining ISO 9001 quality certification, companies rarely carry out additional activities to improve service quality.

Service quality analysis pays little attention to the continuous assessment of service quality indicators, which customers and company business partners find most important [32,33,35].

Digitalisation involves increasing productivity and reducing costs in freight carriage processes [36]. Automated service management, services based on customer data and intelligent solutions should help companies to develop a digital business model. The main advantages of digital technologies include the possibility of more transparent business processes, lower likelihood of human error, etc. [37].

Romero et al. [38] argue that digital technologies can give a sense of tangibility to a service, which would affect how customers perceive the quality of the service.

Kim et al. [20] say that digitalisation improves the accessibility, functionality and security of a service, which affects the quality of the overall service.

Digital transformation in logistics and supply chain management involves changes in value creation by the use of digital transformation technologies (DTT), adaptation of strategies and processes, and application of enablers, such as innovation and leadership, to support the achievement of goals, such as an increase in agility, higher productivity, and a more customer-centric supply chain. The main driving forces behind manufacturers' investments in logistics and supply chain management include the achievement of real-time product visibility, faster innovation, lower service costs and the improvement of planning [37].

The integration of technologies with the supply network offers an easy access to customer needs by effectively sharing product tracking information or service deliveries. The integration of digital technologies can typically entail high costs with slow diffusion [39].

Digitalisation facilitates automation of workflows, accelerating preparation and distribution of documents [40].

A sustainable digital logistics ecosystem reveals how digitalisation can impact logistics from a sustainable economic, environmental, and social perspective [40,41].

Sustainability plays a pivotal role in dealing with the ascent of a business regarding speed and change [42].

After analysing the scientific literature, it became clear that the quality level of a company's service is among the most important indicators that increase competition. Valdislavlev [22], Kim et al. [20], Nikolskaya and Kharebova [23], Riorini and Widayati [24], Afthanorhan et al. [25], and Lilja et al. [26] note that service quality is directly related to the satisfaction of customer needs. Likhtanskaya and Belova [27] emphasize that service quality must satisfy defined customer needs. The quality of the transport service has a mutual benefit—it satisfies the needs of the customers of the service, and it increases the efficiency of the transport companies. Makashina [43] states that evaluating the quality of transport services is a very difficult task. All this is determined by the intangibility, volatility and

dependence of the service on the customer. Makashina [44] and Aristov [38] cite: delivery delays, low level of security, lack of storage space, necessity of cooperation with different transport companies, delays in providing tracking, problems with customs formalities, mismatch between price and quality and lack of an employee training system as factors affecting the quality of services. Faskhiev and Tselishchev [45], Daykhovsky and Kival [46] analysed the needs of customers and distinguished the main indicators of the quality of transport service: speed of service, the ability to provide assistance with the formation of the necessary documents, an operative way of presenting information using digitization technologies, fast order execution, the ability to provide additional services, ensuring cargo security, delivering cargo to the recipient's door, the possibility of repacking the cargo, having the necessary loading equipment at the transhipment terminals, providing the required price, and the possibility of offering the services of customs brokers.

2.2. Selecting the Research Methodology

Every research has its own inherent characteristics related to knowledge of the object and a variety of means and methods used to achieve the desired result [47–49]. Every research process consists of a series of steps that are necessary to obtain the desired result.

In order to investigate the topic, to identify problem areas and solutions, expert evaluation was used. This type of evaluation is used in various studies. Expert evaluation is an appropriate way to substantiate the data collected by assessing the opinions of experts, processing and validating the results obtained [44]. Expert evaluation is used to: compile a list of possible events and to determine the time interval of occurrence of the events; to arrange management goals and tasks in the order of importance; to provide alternative solutions to the problem; and to discover new areas of application of alternative solutions.

The following methods may be used to collect expert evaluations: experts may present their opinions in participation of all experts and discuss the problem at hand together, or each expert may present their opinion individually by means of a questionnaire or an interview. Interviewing each of the ten experts individually by means of a questionnaire prepared in advance was chosen in the research.

All research information was collected using a questionnaire. Questionnaires represent a standardized method with strict rules. Questions presented in a questionnaire are interrelated, have no strict standard and are in line with the purpose of the research. The aim of the questionnaire is to get answers from respondents. To achieve the main goal of the research, the structure of the questions, the number and the sequence of questions are determined. Augustinaitis et al. [50] say that the content of questions must be clear and understandable, and help experts to express their opinions as best as possible.

The best solution to a problem can be found by properly selecting a group of experts.

For a research work to be credible, an expert group must consist of five experts at the least, but most researchers believe that having seven to ten experts in the group would be most reliable [51]. Nielsen [52] believes that five experts are enough for a reliable research work, while Neal [53] recommends using fifteen experts. However, the majority of researchers believe that having a group of at least ten experts would be most appropriate. A total of ten experts were interviewed to identify the service quality criteria of different logistics companies.

One of the key criteria for setting up an expert group was the capability of experts to solve the scientific problem at hand in the most efficient and reliable way possible [54–56]. According to Augustinaitis et al. [50] experts must be able to understand the processes that take place during a study and to be able to explain them to non-professionals. Moreover, their ability to predict and provide recommendations can have a significant impact on research findings. Therefore, the following criteria were followed in the selection of experts: they work in companies carrying less-than-truckload shipments on international routes by road transport; they keep in touch with the company's customers or partners at least several times a quarter; they have been working with less-than-truckload shipments on

international road transport for a minimum of five years; and they have a higher education and hold senior positions.

Experts' opinions must be coordinated in order to make decisions. In the presence of two or more experts, the concordance of their opinions may be determined by applying a concordance coefficient. In the calculation of the Kendall's concordance coefficient (W), expert evaluations are ranked. Expert opinions are considered to be concordant when $W \rightarrow 1$ or conflicting when $W \rightarrow 0$ [55].

The concordance coefficient helps to check the consistency of expert opinions. Kendall proposed a method that helps to distinguish assessments that have not been concordant.

Several main factors used to compile a scheme of criterion of compatibility of each expert criterion can be distinguished: a measure of concordance for the expert opinions in the research is selected, then a sample model of conflicting opinions is created, and the distribution of measurements of the selected model is calculated making certain assumptions about the model parameters.

Each of the ten experts received a questionnaire describing the criteria for the fourth and fifth questions from B_1 to B_m. Experts were listed from E_1 to E_n. The highest score for the evaluation of the criteria was equal to the total number of criteria. The experts were asked to assign a significance score from 1 to the maximum for each of the provided criteria, awarding the highest score for the most important criterion and 1—for the least important criterion. Each criterion had to be scored and could not be equal to 0. Criterion m evaluated by expert n (Table 2).

Table 2. Kendall methodology. Criteria scores compiled by the authors according to [55].

Expert Sequence No.		Criteria, Where j = 1, 2, . . . , m			
		X_1	X_2	. . .	X_m
	E_1	B_{11}	B_{12}	. . .	B_{1m}
	E_2	B_{21}	B_{22}	. . .	B_{2m}
i = 1, 2, . . . , n	E_3	B_{31}	B_{32}	. . .	B_{3m}
	. . .	. . .	. . .	. . .	. . .
	E_n	B_{n1}	B_{n2}	. . .	B_{nm}
$\sum_{i=1}^{n} B_{ij} = B_j$		B_1	B_2	. . .	B_m

According to Kendall's methodology, experts can be asked to evaluate criteria in pieces, percent, or other units of measure. During the survey, experts were asked to evaluate assigning scores. Kendall's coefficient of concordance was used to check the consistency of experts' opinions. When calculating Kendall's concordance coefficient, expert evaluations were rated, i.e., assigning a score of 1 for the most important indicator and the score of m—for the least important last indicator. All calculations were performed according to the methodology provided in [56,57].

3. Results and Discussion

3.1. Expert Survey Results

Considerable attention has been paid to analysing the significance of service quality itself and its definition. The carriage of less-than-truckload shipments by road transport on international routes involves close cooperation with business partners of various logistics terminals in different countries. A company concerned with raising the quality level of its services finds it important for the perception of quality of its partners to meet the requirements which it is subject to itself. Transhipment of less-than-truckload shipments takes place not only in local logistics centres, but also in terminals of other countries.

The analysis of the questions included in the questionnaire emphasises that the first questions allow for the assessment of how often companies use the services of their logistics partners, the quality of their work, introducing the vision and objectives of quality of their company. All the experts answered that they often use the services of their partners, as this

relates to the specifics of less-than-truckload shipments. Arranging international carriage of less-than-truckload shipments without the assistance of partners would not only be unprofitable but also impossible, as covering absolutely all markets and building logistics centres in every country would be difficult for one company.

As many as 70% of the experts answered that they conduct a quality assessment once a year, while 20% of the companies surveyed conduct it twice a year. This is due to a shortage of time and the desire to save money by not having to hire quality experts from other companies. The companies' representatives stick to the opinion that only they can best assess the quality of their services, because they understand the specifics of the work they do and are interested in the requirements of their customers. The survey found that 40% of experts do not see the point of personally communicating quality indicators to their partners, because the company's employees, who interact with their partners every day, constantly set requirements for their work that are in line with their set quality criteria.

In total, 30% rated the work of their partners as good because companies of these experts in particular check the quality indicators of their partners and customers at least twice a year and try to keep up to date with new requirements from customers, also analysing changes in the market in terms of quality.

The expert evaluation sought to identify the quality criteria that affect the perception of quality of services that customers of their companies have. The following criteria were evaluated in the research: K1—flexibility of service, K2—ability to provide solutions and proposals, K3—ability to offer customs brokerage services, K4—ability to offer door-to-door carriage, K5—timely provision of information through digital technologies, K6—ability to provide additional services, K7—order execution within the set timeframe, K8—ensuring the security of shipments. The sum of the ranks, the mean of the ranks, the difference between the sum of the ranks and the fixed value, and the square of the difference were calculated for these criteria (Table 3).

Table 3. Rating expert evaluation of service quality criteria of customers.

Calculations	Criteria							
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**
Sum of ratings $\sum_{i=1}^{n} R_{ij} = R_{ij}$	43	31	64	60	15	65	37	19
Mean of ratings $\overline{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	4.3	3.1	6.4	6	1.5	6.5	3.7	1.9
Difference between the sum of ratings and the fixed value $\sum_{i=1}^{n} R_{ij} - \frac{1}{2}n(m+1)$	−2	−14	19	15	−30	20	−8	−26
Square of the difference $\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2}n(m+1)\right]^2$	4	196	361	225	900	400	64	676

Source: compiled by the authors according to [5].

Formulae were used to calculate the sum of the ratings and the means of the ratings for each of the quality criteria using a ranking method, thus obtaining the relationship between the scores and the ratings. The sum of the significance coefficient is equal to the sum of the mean of the ratings, which is 33.4. The difference between the fixed value and the sum of the ratings for each criterion and the square of the difference was calculated.

Since there are no correlated ranks, Kendall concordance coefficient was calculated, obtaining the value $W = 0.6729$. This coefficient is greater than 0.5, which allows concluding that the opinions of all experts interviewed are concordant.

Since the number of criteria in quality assessment is greater than 7, i.e., $m > 7$, the weight of the concordance coefficient is calculated using the $\mathcal{X}^2$(chi-quadrat) Pearson criterion.

$\mathcal{X}^2 = 47.1$ or more than $\mathcal{X}^{2kr}$ which is equal to 20.092, thus expert opinions are considered concordant.

The calculation of the lowest concordance coefficient $W_{min} = 0.2870 << 0.6729$ allows concluding that the opinions of the interviewed experts are concordant.

The calculations performed allow stating that the expert opinions of the provided eight criteria that affect the perception of service quality by company customers are concordant and summarised.

Subsequently, criteria importance indicators presented in Table 4 were calculated.

Table 4. Indicators of importance of customer service quality criteria.

Indicator Value	Criteria Encryption Symbol								Sum
	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	
$\bar{q} = \frac{\bar{R}_j}{\sum_{j=1}^{m} R_j}$	0.1287	0.0928	0.1916	0.1796	0.0449	0.1946	0.1108	0.0569	1
$d_j = 1 - \bar{q}_j = 1 - \frac{\bar{R}_j}{\sum_{j=1}^{m} R_j}$	0.8713	0.9072	0.8084	0.8204	0.9551	0.8054	0.8892	0.9431	7
$Q_j = \frac{d_j}{\sum_{j=1}^{m} d_j} = \frac{d_j}{m-1}$	0.1245	0.1296	0.1155	0.1172	0.1364	0.1151	0.1270	0.1347	1
$\overline{Q}_j = \frac{\sum_{i=1}^{n} B_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{m} B_{ij}}$	0.1407	0.1766	0.0778	0.0898	0.2246	0.0749	0.1587	0.2126	1
Arrangement of factors by importance	5	3	7	6	1	8	4	2	

The Q_j indicator not only measures the importance of one criterion over another, but also how many times one indicator is more important than others. K5 and K8 referring to timely provision of information and the security of freight were the most important factors, and K3 and K6, or the ability to provide customs brokerage services and additional services, such as freight insurance and labelling, were the least important factors.

However, in addition to determining the importance of a criterion, it is important to identify how the customer service quality criteria mutually influence each other's results (Figure 2).

As the results show, customer service quality criteria fell into two dependency groups, which can be evaluated as: **(1) The most correlated factors:** Flexibility of service and Ability to provide solutions and proposals are most correlated with Order execution within the set timeframe; Ability to offer customs brokerage services is most correlated with Ability to provide additional services and Ability to offer door-to-door carriage; Timely provision of information through digital technologies is most correlated with Ensuring the security of shipments; Order execution within the set timeframe is most correlated with Flexibility of service and Ability to provide solutions and proposals. **(2) Factors forming medium correlation relations**: all the rest, not mentioned in point 1.

In summary, it can be said that the obtained results show the closeness of the data and, at the same time, the causes.

The service quality criteria which partner companies are subject to were further analysed. Experts' answers are listed in Table 5 and their rating is presented in Table 6.
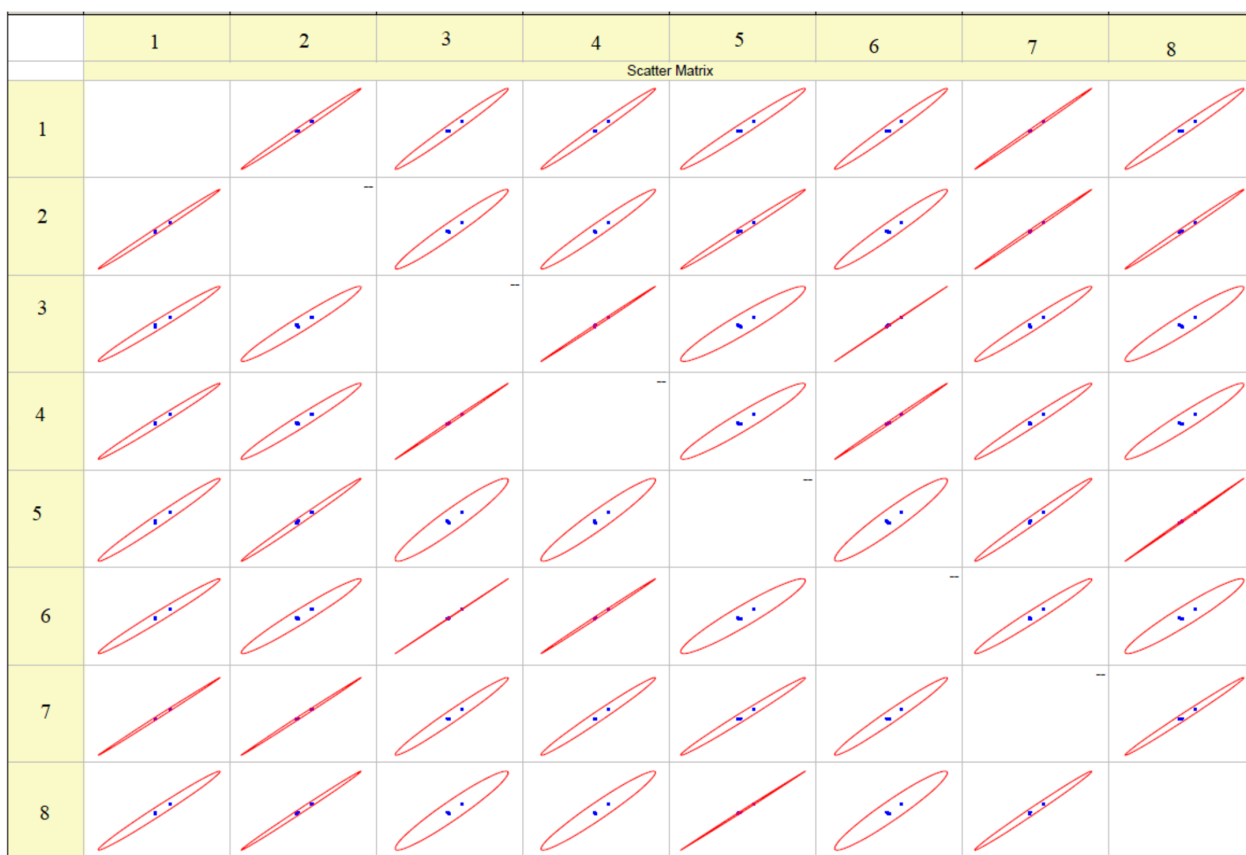
Figure 2. Interaction of customer service quality criteria. Names of numbers in the table: 1—Flexibility of service, 2—Ability to provide solutions and proposals, 3—Ability to offer customs brokerage services, 4—Ability to offer door-to-door carriage, 5—timely provision of information through digital technologies, 6—Ability to provide additional services, 7—Order execution within the set timeframe, 8—Ensuring the security of shipments.

Table 5. Evaluation of the criteria in the quality of services of partners by importance.

Expert Seq. No.	Factor * Encryption Model								
	A	B	C	D	E	F	G	H	I
E1	7	8	2	4	5	9	5	2	9
E2	8	9	2	5	3	7	6	1	8
E3	6	8	1	5	2	7	6	2	9
E4	6	7	3	6	5	8	7	3	7
E5	9	6	4	4	5	9	8	1	8
E6	6	8	4	6	4	6	7	2	7
E7	7	6	3	4	6	7	6	1	9
E8	7	8	2	4	3	8	7	3	8
E9	8	6	2	5	2	7	6	2	9
E10	9	8	1	5	4	9	8	3	7
$\sum_{i=1}^{n} B_{ij} = B_j$	73	74	24	48	39	77	66	20	81

* factor: A—flexibility of working hours, B—timely processing of new orders, C—fast transportation to the international logistics terminal, D—the agreed works performed on time, E—provision of solutions to the problem, F—employee professionalism, G—warehousing and handling services for servicing freight, H—ability to provide assistance for the necessary paperwork procedures, I—introduction of digital technologies.

Table 6. Rating expert evaluation of the criteria of quality of services of business partners.

Expert Sequence No.	Criterion Encryption Model								
E1	3	2	8	6	5	1	5	8	1
E2	2	1	8	5	7	3	4	9	2
E3	4	2	9	5	8	3	4	8	1
E4	4	3	7	4	5	2	3	7	3
E5	1	4	6	6	5	1	2	9	2
E6	4	2	6	4	6	4	3	8	3
E7	3	4	7	6	4	3	4	9	1
E8	3	2	8	6	7	2	3	7	2
E9	2	4	8	5	8	3	4	8	1
E10	1	2	9	5	6	1	2	7	3
Sum of ratings $\sum_{i=1}^{n} R_{ij} = R_{ij}$	27	26	76	52	61	23	34	80	19
Mean of ratings $\overline{R}_j = \frac{\sum_{i=1}^{n} R_{ij}}{n}$	2.7	2.6	7.6	5.2	6.1	2.3	3.4	8	1.9
Difference between the sum of ratings and the fixed value $\sum_{i=1}^{n} R_{ij} - \frac{1}{2}n(m+1)$	−23	−24	26	2	11	−27	−16	30	−31
$\left[\sum_{i=1}^{n} R_{ij} - \frac{1}{2}n(m+1)\right]^2$	529	576	676	4	121	729	256	900	961

Formulae were used to calculate the sum of the ratings and the mean of the ratings for each of the quality criteria using a ranking method, thus obtaining the relationship between the scores and the ratings. The sum of the significance coefficient is equal to the sum of the mean of the ratings, which is 39.8. The difference between the fixed value and the sum of the ratings for each criterion and the square of the difference was calculated.

The Kendall concordance coefficient calculation methodology was used In the analysis of the service quality criteria which business partners are subject to, obtaining the value of $W = 0.792$. This coefficient shows that the opinions of all experts interviewed are concordant.

Since the number of criteria in quality assessment is greater than 7, i.e., $m > 7$, the weight of the concordance coefficient is calculated using the $\mathcal{X}^2$ (chi-quadrat) Pearson criterion.

When $\mathcal{X}^2 = 63.36$ or more than $\mathcal{X}^{2kr}$, which is equal to 20.092, respondent opinions are considered concordant.

Having calculated the lowest concordance coefficient value of $W_{min} = 0.2511 << 0.6729$, the opinions of the experts interviewed are considered concordant.

The conducted calculations allow stating that expert opinions match on the nine presented criteria, which affect the service quality of company partners.

Subsequently calculated criteria importance indicators are presented in Table 7.

The Q_j indicator allows determining not only how much one indicator is more important than another, but also how many times one indicator is important than others.

Having assessed the service criteria that companies which frequently use services of their logistics partners to assist them with international freight carriage on international routes find important, the expert group concluded that the key quality criteria were I and F, or the introduction of digital technology and the professionalism of employees, while C and H, or a rapid carriage to their international logistics terminal and the ability to provide assistance in the processing of the necessary documentation, were less important.

After assessing the compatibility of business partners' leases, it was also important to identify how the service quality criteria set for company partners correlate with each other (Figure 3).

Table 7. Indicators of importance in the criteria of quality of services of business partners.

Indicator Value	Criteria Encryption Symbol									Sum
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	
$\bar{q} = \frac{\bar{R}_j}{\sum_{j=1}^m R_j}$	0.0678	0.0653	0.1910	0.1307	0.1533	0.0578	0.0854	0.2010	0.0477	1
$d_j = 1 - \bar{q}_j = 1 - \frac{\bar{R}_j}{\sum_{j=1}^m R_j}$	0.9322	0.9347	0.8090	0.8693	0.8467	0.9422	0.9146	0.7990	0.9523	8
$Q_j = \frac{d_j}{\sum_{j=1}^m d_j} = \frac{d_j}{m-1}$	0.1165	0.1168	0.1011	0.1087	0.1058	0.1178	0.1143	0.0999	0.1190	1
$\overline{Q}_j = \frac{\sum_{i=1}^n B_{ij}}{\sum_{i=1}^n \sum_{j=1}^m B_{ij}}$	0.1834	0.1859	0.0602	0.1206	0.0980	0.1935	0.1658	0.0503	0.2035	1
Arrangement of factors by importance	4	3	8	6	7	2	5	9	1	

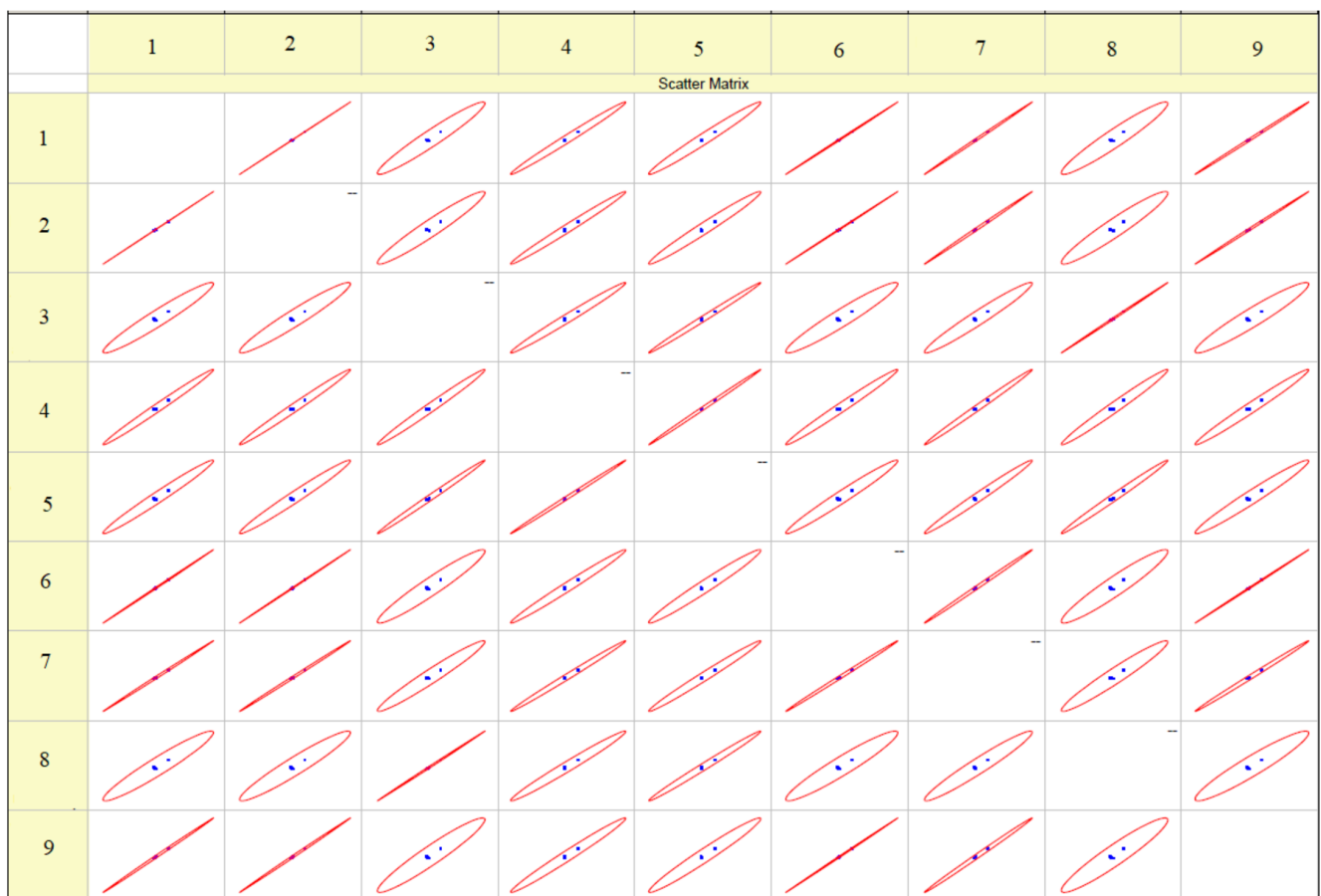Source: compiled by the authors.

Figure 3. Interaction of service quality criteria set for company partners. Names of numbers in the table: 1—Flexibility of working hours, 2—Timely processing of new orders, 3—Fast transportation to the international logistics terminal, 4—The agreed works performed on time, 5—Provision of solutions to the problem, 6—Employee professionalism, 7—Warehousing and handling services for servicing freight, 8—Ability to provide assistance for the necessary paperwork procedures, 9—Introduction of digital technologies.

These results also showed that the service quality criteria for corporate partners fell into two dependency groups, which can be evaluated as: **(1) The most correlated factors:** Flexibility of working hours is most correlated with Timely processing of new orders, Employee professionalism, Warehousing and handling services for servicing freight and Introduction of digital technologies; Fast transportation to the international logistics terminal is most correlated with Ability to provide assistance for the necessary paperwork

procedures; The agreed works performed on time is most correlated with Provision of solutions to the problem. **(2) Factors forming medium correlation relations:** all the rest, not mentioned in point 1.

In the analysis of the extent of implementation of digital technologies in companies involved in international carriage of less-than-truckload shipments, the majority of experts were found to use such technologies in their business. In total, 70% of experts agreed that they have been implementing such technologies and only 30% of experts said they did not use them. The experts, who comprise 30% of the respondents, represent small companies that are not capable of investing in digital technologies. Such investments would account for a significant share of their profits, thus they are not ready to invest in such technologies, even though they demand the adoption of such technologies from their business partners, most of whom represent large companies.

The assessment of digital technology measures which companies are implementing revealed extensive use of electronic documents and orders (70%), the planning of routes and freight loading (50%), and measures for determining vehicle location in real time (50%).

None of the experts chose an integrated electronic system involving customers and business partners (carriers and international logistics terminal partners) and an electronic application for the company's customers.

The conducted expert research revealed that companies organising less-than-truckload shipments on international routes have been improving the quality of their services through the use of digital technologies.

The research results revealed that companies' customers appreciate prompt provision of information through digital technologies the most.

3.2. Model for Improving the Quality of Services in the Carriage of Less-Than-Truckload Shipments on International Routes

The analysis of scientific sources revealed that it would be difficult for transport companies involved in international road carriage of less-than-truckload shipments to improve the quality of their services, because the service is provided at the time of its production, customers have different perceptions of the quality of the service and there is no uniform system for assessing the quality of transport services. The analysis of service quality features shows that little attention is paid to the continuous assessment of service quality indicators, which bears a major impact on the service customer and business partners of the company. The results of the conducted research after experts were interviewed distinguished the most important criteria for improving the quality of services and summarised the results received, revealing that transport companies are trying to improve the quality of their services by using digital technologies. The results show that there is no standardised service quality improvement model for less-than-truckload shipments.

Given the fact that customers who order international carriage of less-than-truckload shipments find it important to receive all information about their order in the fastest possible way with the help of digital technologies, and the requirement for business partners to implement digital technologies as one of the measures to ensure the quality of a joint service, a conceptual model for improving the quality of service was developed, bringing together all participants in the carriage process with the help of digital technologies (Figure 4). The assessment of the specificities in the international road transport of less-than-truckload shipments shows that it is not enough to organise the work by simply equipping transport company's employees and customers with digital technologies. This also requires connecting as many participants in the process as possible into a unified system of quality improvement.
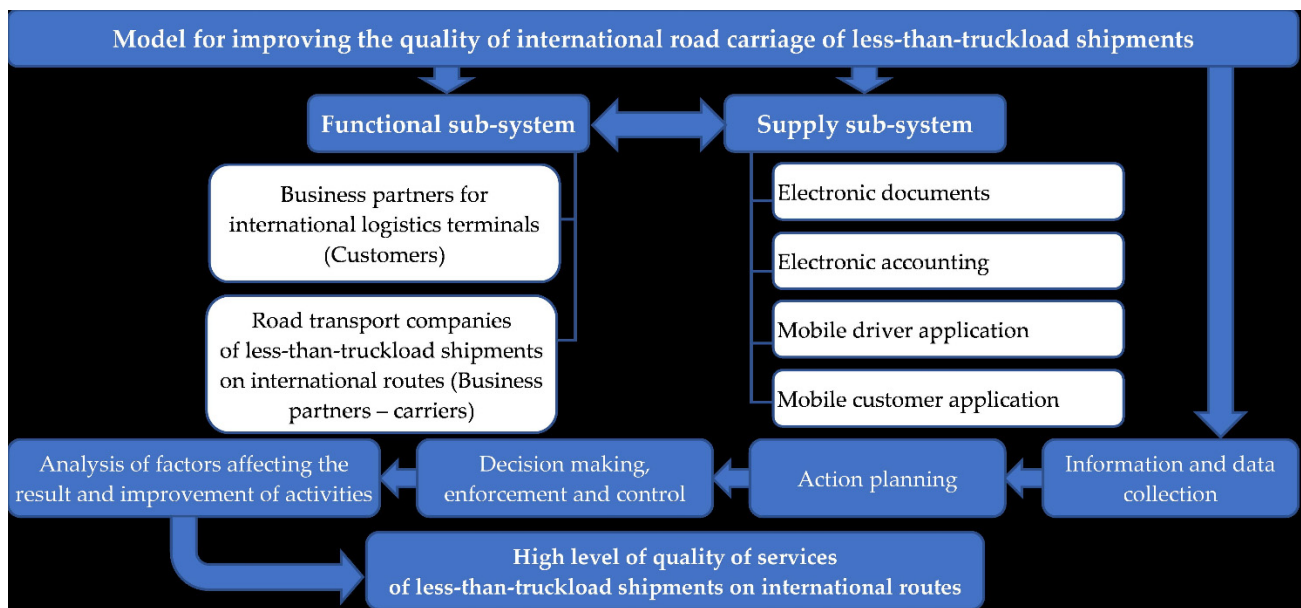
Figure 4. Conceptual model for improving the quality of international road carriage of less-than-truckload shipments. Source: compiled by the authors.

One of the biggest advantages of digitalisation is that it reduces the amount of manual work, which creates the greatest added value not only for the end user of the service, but also for all the companies involved in the carriage process. Digitalisation technologies improve the accessibility, functionality and security of the service, which impacts the overall quality of the service.

4. Sub-System

There are two important sub-systems in the conceptual model: functional and supply sub-systems. The functional sub-system consists of all participants in the carriage process. In order to improve the quality of services, managing the flow of information between the companies organising the carriage of less-than-truckload shipments, customers and logistics partners in various international terminals, and the carriers, who will deliver shipments by road to the international logistics centre or to the end consignee in different countries is important.

At the same time, the effectiveness of this model is inextricably linked to the supply sub-system, which is based on a digitalised working system of the transport company having received an order, with various tools, including electronic documents, electronic accounting, and mobile applications for drivers and customers.

Information flows between the functional and the supply subsystems are accessible via individual channels for each participant in the carriage process. The creation of service areas for each process participant, i.e., for customers, employees of a less-than-truckload shipment carriage company, business partners of logistics terminals, and hired carriers, allows not only real-time monitoring and management of transport processes, but also ensures that work is more transparent. Each party involved in the carriage process passes on the relevant information to the company arranging carriage of less-than-truckload shipments, which then uses digitalisation technologies to distribute information for its intended purpose and to improve the quality of its service during its provision.

The creation of new tasks and decision-making rely on incoming information flows, which affects productivity and efficiency. Automated collection of data and information allows planning the actions. Every process requires not only making standard decisions, which are a result of proper planning, but also making unplanned decisions promptly and their overall enforcement and control, which affect the quality of the service provided.

Since the service cannot be evaluated in advance, companies improving the quality of their service pay attention to the analysis of the factors affecting the final result. This analysis is carried out not only by assessing the customer's level of satisfaction with the service, but also by assessing the performance of business partners in the carriage process. Everyone involved in the carriage process can be concluded to receive their own benefits: customer's needs are met, logistics terminal partners and carriers receive a faster payment and optimize paperwork and accounting, transport companies gain a competitive advantage and various business development opportunities.

All commercial companies pursue financial benefits, but the aim of this model is to show how companies organising international carriage of less-than-truckload shipments by road can use digital technologies to improve their quality of service and competitive advantage.

Moreover, an expert evaluation was chosen to investigate the applicability of the model. The group of experts hired to conduct research for the improvement of quality of international carriage of less-than-truckload shipments by road were asked to evaluate the selected model.

The experts interviewed welcomed the model of the quality improvement system for international road carriage of less-than-truckload shipments. They found all the sub-systems of the model to be clear and understandable. Improving service quality is important for any company seeking to survive in the market, to attract the greatest possible number of customers, to reduce the likelihood of errors and create a service that is more unique than that of its competitors. None of the experts doubt that digital technologies can help to improve the quality of services.

Digital technologies affect the work of every company, but there are still problems with their implementation. The following figure shows the implementation problems identified by experts, which they believe companies may encounter in adopting the proposed model (Figure 5).
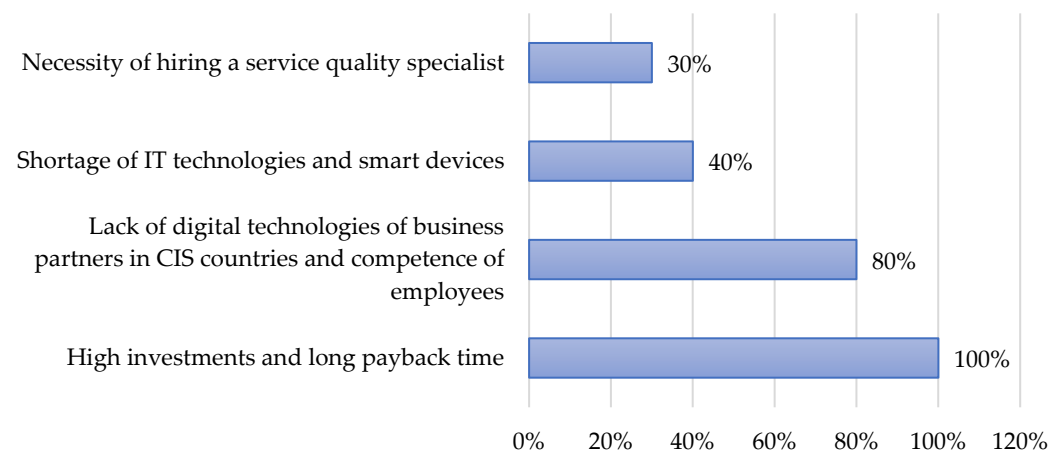

Figure 5. Distribution of expert opinions on the problems which transport companies may face in adopting the proposed conceptual model. Source: compiled by the authors.

Not all transport companies are able to improve the quality of their services by digitalising all or most of their processes. All interviewed experts identified the risk of high investment and long payback time as the main problems with applicability of the proposed model. Some experts have noted that the introduction of digital technologies is constantly facing higher-than-expected costs. IT professionals offer shared use systems that need to be improved according to the specifics of the company's work. All this requires additional financial investment and time for transport companies to submit proposals to increase the adaptability of the system. Some companies need newer IT technology tools, the absence of which would make connecting to a single digital system very difficult. Equipping drivers with smart tools requires not only additional funding, but also the necessary training to use such tools. As most of the experts represent carriers of less-than-truckload shipments

that work with the CIS countries, they noted that applying the conceptual model may be difficult due to the lack of digital technologies in the CIS countries and staff competence. Some workers lack working skills with digital technologies, especially in companies that have up to five employees, including drivers and the business owner. Digital systems can highlight the problem of business transparency in the CIS transport companies, so their implementation is much slower than in EU states. Of the experts, 30% noted that it may be necessary to hire a service quality specialist to adapt the model, and not all transport companies may be prepared for that. While most companies understand the importance of service quality, they are reluctant to spend extra money on service quality assessment.

Every expert understands digital technologies and the advantages of their implementation. Of the respondents, 10% said that digitalisation has already solved a number of problems faced by transport companies which previously prevented them from improving the demand and the quality of their offered services. Improving service quality is accepted as one of the integral processes behind a company's strategy. Competition between different companies encourages them to seek out new opportunities to improve the quality of their services in the shortest possible time. Digital technologies can help to identify all the factors that affect the level of service quality.

Experts noted that in order to improve the quality of international carriage of less-than-truckload shipments by road, company managers must be able to involve company employees in the service quality of processes. All employees of a transport company must understand their company's quality standards and be able to assess how business partners comply with those standards. Unfortunately, the choice of business partners is still affected by the level of prices offered. Companies that invest little in technology and in recruiting staff with required skills can offer lower service prices. Given the higher requirements that customers have for the level of service quality, there is a high chance of losing customers having hired business partners offering low service levels. In order to improve the quality of service, companies carrying less-than-truckload shipments must not only adopt digital technologies and use skilled staff, but also take a responsible approach to the choice of business partners. Digitalisation has made analysing the delivery of service at every stage possible, thus service quality can be improved in the quickest and the best way.

Experts saw this model as one of the options for improving the quality of service of transport companies, adapting it for transport companies handling large amounts of less-than-truckload shipments on international road transport routes. The COVID-19 pandemic adjusted the investment opportunities of companies carrying less-than-truckload shipments, leaving only a few companies able to invest even more in improving the quality of their services by adopting the proposed model. The model reflects the need for close cooperation between all participants involved in the transport process, using digital technologies in order to improve the quality of the integrated service.

5. Conclusions

The conducted scientific literature analysis revealed that the organisation of international carriage of less-than-truckload shipments presents a complicated process involving the work of different international terminals, customers and transport companies. There is a dependency between the compatibility of freight, effectiveness of carriage, trip cost-efficiency, optimal loading of vehicles, carriers, and logistics business partners and customers, which has a significant impact on the quality of service.

Therefore, an assessment of the quality of transport services is much more complicated than an assessment of the quality of goods, as it relates to the main features of the service or the set of characteristics that contribute to meeting the identified or perceived needs of customers.

The results of the conducted study show that companies organising international carriage of less-than-truckload shipments have been improving the quality of their services through the use of digital technologies. Digital technologies have been adopted faster by large companies engaged in the carriage of less-than-truckload shipments due to their

greater financial capacity and the need to service large volumes of freight. Small transport companies rely on digitalisation systems of their large business partners and expect to be able to digitalise their in-house processes in the near future. The survey found that 60% expect their business partners to contribute more to the overall service quality. This relates to the lack of time and investment to systematically assess the work they do and the strategy of most companies, which focuses on assessing the quality of the service from the customer's perspective.

Customers of these companies assign the most value to the quality criteria of timely sharing of information through digital technology and safe transport. Meanwhile, transport companies consider the ability of their partners to implement digital technologies and the professionalism of their staff to be the key criteria. It was determined that the digitalisation of electronic documents, orders, planning the routes and freight loading, as well as real-time vehicle location technologies were widely used by companies engaged in international carriage of less-than-truckload shipments by road transport. Mobile applications for customers and digitalisation systems involving all participants in the transport process are still not widespread. The proposed model for improving the quality of international road carriage of less-than-truckload shipments is based on a set of key service quality criteria which customer transport companies are subject to, and business partners of transport companies themselves, who directly contribute to improving the quality of the joint service and can ensure the sustainable execution of the process. The model consists of functional and supply sub-systems, whose continuous and uninterrupted work through the key service quality processes results in a high level of service quality.

Therefore, the proposed model can be applied not only in companies organizing the sustainable carriage of less-than-truckload shipments, but also in companies providing other services, both nationally and globally, which could be identified as a direction for further research.

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