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THE OVERVIEW OF APPLIED METHODS FOR MEASUREMENT AND EVALUATION OF QUALITY OF ROAD TRANSPORT SERVICES

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1. Introduction

In the process of providing a carriage service it is important to understand the carriage service of road haulage as a whole, i. e. as a final process of impacts of inputs, sources, risks and process outputs of the carriage service. The above mentioned shows that the carriage service characterized by required features represents a set of mutually organized activities that using inputs, resources and appropriate risk management convert to certain outputs with specific properties.

Manufacturers as well as organizations providing services are getting under pressure of customers as primary partners that require perfect product or fast, effective services managed efficiently and in high quality. But this requires the existence of perfectly mastered system of activities in the organization, resulting in satisfied customers.

The person assigned to evaluate the carrier or forwarder assesses it in terms of degree of compliance or non-compliance with their own requirements on the quality of the consignment shipment. The emphasis is primarily put on compliance with the agreed delivery term, undamaged consignments and their packaging.

2. Measurement and Assessment of Quality

The result of evaluation is the evaluation report, which recommends (or does not recommend) further cooperation with the forwarder or road hauler (carrier). Methods for evaluation can be developed by the organization itself or may be completely taken or taken methods can be modified to their own conditions - just in terms of importance of selected requirements.

Several methods are used. Some are based on set importance weights of individual requirements (absolute or relative) and the degree of compliance with these requirements by the carrier for each carriage. Others are based on scoring of selected requirements in terms of the degree of the carrier compliance with them. Points has been applied to the number of shipments performed during a certain period, i. e. the index of satisfaction with transport services will be determined. Based on the calculated indices of satisfaction carriers are divided into groups.

The process of quality assessment of activities of road haulers must be approached comprehensively. Quality assessment of activities of road haulers cannot be based solely on quality assessment of performed consignment shipments. It is important to review, examine and analyse a number of factors and indicators that precede the very process of consignment carriage since the previous cooperation with a particular carrier. The reason is selection of carriage services of high quality, designed to perform the carriage on the required level. Without these steps and measures the quality assessment of a particular shipment would look

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alibistic and pointless, as the expected long-term follow-up cooperation of the customer with the carrier (based on quality relationships) rather than a cooperation for one shipment, after which when review the cooperation will be interrupted, or terminated (due to the negative assessment of the carrier). The forwarder cannot afford to take risks and to entrust goods to the carrier, which is not verified even though the responsibility is transferred to the carrier, as it risks losing trust of the sender (client). In case of recurrence of such events that leads to economic losses.

Appliecation of evaluation methods, methods for classification of road haulers, their scale of division, qualification and requirements for the person performing the evaluation under the organizational structure of the organization, everything should be governed by binding regulations (such as internal directives) to comply with the objective approach when evaluating suppliers.

Quality signs are criteria to express certain characteristics of a product, service or performance in relation to its quality and meeting of requirements imposed on it by the customer. ***One-criterion assessment*** – the type of quality assessment, where the result is a quality value obtained with observing and measuring one selected quality characteristic.

Multi-criteria assessment – the type of quality assessment, where the result is a quality value obtained with observing and measuring a group of quality signs characterizing the consignment shipment quality performed by road haulage.

Table 1 Comparison of one-criterion and multi-criteria assessment methods

Types of assessment methods	Positives	Negatives
One-criterion assessment	• simplicity • easiness - monitoring only one selected indicator	• lower expressing power about the character of carriage quality • possibility to obtain positive results in assessment even when some quality requirements are not met (hidden wrong quality) • a possibility of linking of several indicators exists so selection and monitoring of one indicator not respecting of mutual relations may result in distorted results
Multi criteria assessment	• higher expressing power about the character of carriage quality • monitoring of more criteria allows complex view to quality of provided carriage service • respecting of mutual relations between monitored indicators	• complexity related to monitoring of several indicators

2.1 Model of multi-criteria assessment

The approach is based on the creation of binary relations (called also classification relations) to express preferences of the assessor. Prior to classification relations are created, distinctive thresholds (higher and lower levels of compliance with the requirements of the criteria) and the importance weight of the criteria must be established locally in the preference template of the assessor for each criterion. The importance weights must respect the priority of each criterion. The overall assessment is calculated on the basis of the organized pairs consisting of the importance weight of a particular criterion and the level of compliance with the requirements established for that specific criterion [13].

$$QV = \sum_{i=1}^{n} v_i . s_i \qquad (1)$$

where QV is quality value in total,

v_i is importance weight of quality criterion "i";

s_i is the level of compliance with the requirements of the quality criteria "i" by the provider of the service.

The assessment method proposals should ***propose objective methods of quality assessment***, based on measuring objective indicators in extreme conditions.

Of course, in the implementation of the quality assessment of service provided by road haulers in particular terms of a manufacturer or trading company, the assessor shall define his own specific quality signs that reflect his business objectives, often declared in the quality policy of the organization.

The assessor often tries to find in his own methodology a compromise between the range of quality signs included in the methodology to reach maximum explanatory power about the quality of carriage services and demands (of time and funds) of the proposed methodology for its application. Especially in the case when it is a company with a large number of shipments that decided to assess each individual shipment.

In last years, quality changes to be a factor increasingly affecting competitiveness of organizations. It inspires confidence of customers; the provided is able to guarantee the quality of his product or provided services. Proof of quality based only on the high qualifications of employees is already inadequate and is continuously broadened to all activities that affect the quality level. In practice this means that the organization is forced to show creation and implementation of a system that includes all of these activities. We say that the organization has implemented its quality management system.

2.2 Index methods of measurement and assessment of quality

For index methods the number of shipments made by the particular road hauler for a period with meeting the quality sign is compared with the total number of shipments made with the carrier during this period. The same procedure is applied in assessing the quality of forwarding services, for example, for carriages procured by the forwarder.

To comply with the requirements of the multi-criteria approach to the assessment it is necessary to monitor several quality signs for carriages to calculate either several indicators (e. g. the indicator of compliance with delivery time, indicator of not damaged consignments etc.) or to calculate one indicator, which reflects several quality signs.

2.2.1 Individual indexes of quality assessment

Of course, in conditions of a particular forwarding organization, it is required to measure specific quality indicators, depending on objectives and the quality policy of the organization. Some samples of quality assessment indicators:

a) Indicator of compliance with delivery time

If a manufacturer works with the Just In Time system, the most important requirement in assessing carriers is considered compliance with the delivery time. The monitored quality sign is compliance with the agreed delivery period by the carrier.

Indicator of compliance with delivery time by the carrier (U_1) can be calculated under the following formula:

$$U_1 = \frac{\sum F_d}{\sum F_p} \tag{2}$$

where $\sum F_d$ is number of shipments for a particular period where the carrier met delivery terms,

$\sum F_p$ is total number of consignments performed by a particular forwarder within a certain period.

The indicator can be a value from interval <0; 1>; carrier services are considered to be of high quality when it reaches a value of 1 or close to number 1. Differentiation of carriers based on the values of the indicator directly depends on the assessor.

The indicator of compliance with the delivery time is also important for the forwarder as they are responsible for the delivery of the consignment at the right time, assume the responsibility and in case of a loss of or delay of the consignment, carriers claim compensation of damages directly at them.. Then a question of liability of the forwarder and road hauler is put on the table.

b) Indicator of not damaged consignments

For all manufacturers and trading organizations the requirement not to damage consignments is important, according to the requirement it is possible to assess the quality of services of carriers. The monitored quality sign is the consignment not damaged by the carrier.

Indicator of consignments not damaged by the carrier (U_2) can be calculated under the following formula:

$$U_2 = \frac{\sum F_n}{\sum F_p} \tag{3}$$

where $\sum F_n$ is number of not damaged consignments shipped by a particular forwarder within a certain period;

$\sum F_p$ is total number of consignments shipped by a particular forwarder within a certain period.

The indicator can be a value from interval <0; 1>; carrier services are considered to be of high quality when it reaches a value of 1 or close to number 1. Differentiation of carriers based on the values of the indicator directly depends on the assessor. In relation to this indicator, the question arises, when the consignment is damaged and when not.

c) Indicator of consignments damaged by the carrier

It allows us to quantify the extent of damage of consignments by a road carrier in respect of performed carriages during a particular period. The monitored quality sign is damage of the consignment by the carrier during the period when the consignment in their hands in respect to the carriage.

The indicator of damaged consignments is an inverse indicator of the indicator of not damaged consignments. ***Indicator of damaged consignments*** (U_3) can be calculated under the following formula:

$$U_3 = \frac{\sum F_{poš}}{\sum F_p} \tag{4}$$

where $\sum F_{poš}$ is number of damaged consignments shipped by a particular forwarder within a certain period;

$\sum F_p$ is total number of consignments shipped by a particular forwarder within certain period.

To specify the **indicator of damaged consignments** in detail we can use the following formula:

$$U_3 = \frac{\sum F_{poš}}{\sum F_p} = \frac{\sum p.Q_p}{\sum p.Q} \tag{5}$$

where p is unit price of the particular consignment [€/kg, €/m^3, €/pc, €/l,...],

Q_p is rate of consignment and package damages [kg, m^3, pc, l,...],

Q is volume of the whole consignment [kg, m^3, pc, l,...].

Note: The price is based on the unit depending on the transported commodity group

The indicator reaches the values within <0; 1>. Services of the road hauler are considered of high quality if the value of this ratio is as small as possible, i. e. close to or equal to number 0.

Application of indicators of damaged/not damaged consignments must be considered sensitively. Their use and the results depend on the particular commodity group and used technology for carriage.

If any of the above indicators is multiplied by 100, we get a percentage of compliance with the indicator by the carrier.

2.2.2 Cumulative index of quality assessment

As several quality signs are respected simultaneously, this method of quality assessment has a high explanatory power and can be useful in the assessment of carriages performed by road haulers having concluded long-term cooperation contracts with the forwarder (the assessment can be carried out for a period, each individual shipment is not needed to be

assessed). Monitored quality signs may have different importance weights, standardized relative importance weights of quality signs can be determined using the Saaty method or the forced decision matrix method.

How to implement this method:

Monitored quality signs may have different importance weights, standardized relative importance weights of quality signs can be determined using the Saaty method or the forced decision matrix method.

The extent of compliance with a quality sign is determined in a index manner i. e. the number of shipments is determined when the quality sign was met and its proportion of the total number of shipments should be determined during the assessed period. It is thus a ratio indicator.

$$s_i = \frac{P_i}{X} \tag{6}$$

Where: s_i is the level of compliance with the quality sign "i" by the service provider

P_i is number of performed shipments during the assessed period where the requirements for the "i" quality sign were met

X is total number of shipments made by the evaluated carrier during the evaluated period.

Carriage quality value can be calculated as follows:

$$QV = (\sum_{i=1}^{n} v_i.s_i).100(\%) = (\sum_{i=1}^{n} v_i.\frac{P_i}{X}).100(\%) \tag{7}$$

$$\sum_{i=1}^{n} v_i = 1 \tag{8}$$

Where: QV is carriage quality value for the evaluated period,

v_i is relative importance weight of the quality sign "i", i = 1 ... n,

n is number of quality signs.

Maximum available carriage quality value (QV_{max}):

In case all quality signs are met at the same time for all performed shipments during the assessed period, in the formula (3.16) the variable P_i can be replaced by the variable X. For the sum of standardized importance weight is valid as follows:

$$QV_{\max} = (\sum_{i=1}^{n} v_i.s_i).100(\%) = (\sum_{i=1}^{n} v_i.\frac{P_i}{X}).100(\%) = (\sum_{i=1}^{n} v_i.\frac{X}{X}).100(\%) = 100\%$$

Minimum available carriage quality value (QV_{min}):

In case no quality sign is met in all performed shipments during the assessed period, in the formula (3.16) the variable P_i can be replaced by 0. For the sum of standardized importance weight the formula (3.17 is also valid.

$$QV_{\min} = (\sum_{i=1}^{n} v_i . s_i).100(\%) = (\sum_{i=1}^{n} v_i . \frac{P_i}{X}).100(\%) = (\sum_{i=1}^{n} v_i . \frac{0}{X}).100(\%) = 0\%$$

The range of the value scale:

$QV_{max} – QV_{min} = 100\ \% - 0\ \% = 100\ \%$

It is necessary to choose the number of assessment levels and determine the interfaces between the various assessment levels (percentage intervals) depending on the individual requirements of the assessor organization. Based on the achieved number of points, the providers of transport services are divided into categories (levels) according to the quality value of provided services. An example of such an arrangement of assessment levels of service providers is shown in Table 2.

Table 2 Classification of possible results of quality assessment

Category	Evaluation	Points range
A	reliable	100 – 96
B	satisfactory	95,9 – 90
C	unsatisfactory	89,9 – 1

The results of the assessment must be known by the carriage service provider, in addition the assessment of their competition must be delivered to them. This is a stimulus for growth and continuous improvement of quality of the provided services in order to reach or overcome the competition or to be permanently better than they are.

3. Measurement of Customer Satisfaction in Road Transport and Forwarding

The future of any organization depends on customer behaviour. Increasing the extent of their satisfaction has to be one of the main objectives of the quality policy of each organization. This is also one of the goals of quality management system built under the set of standards ISO 9000.

There is a very close relationship between provided service quality assessment and measurement of satisfaction with these services (see Fig. 1). Measurement of satisfaction is actually a feedback to quality assessment.

The reason for measuring satisfaction of customers is quantification of their views on the level of compliance with their needs and expectations in relation to the provision of carriage and forwarding services. Measuring of customer satisfaction is linked also to continuous improvement of quality management systems according to STN EN ISO 9001:2009. Measuring of customer satisfaction is a tool for getting a feedback to improve product quality levels.

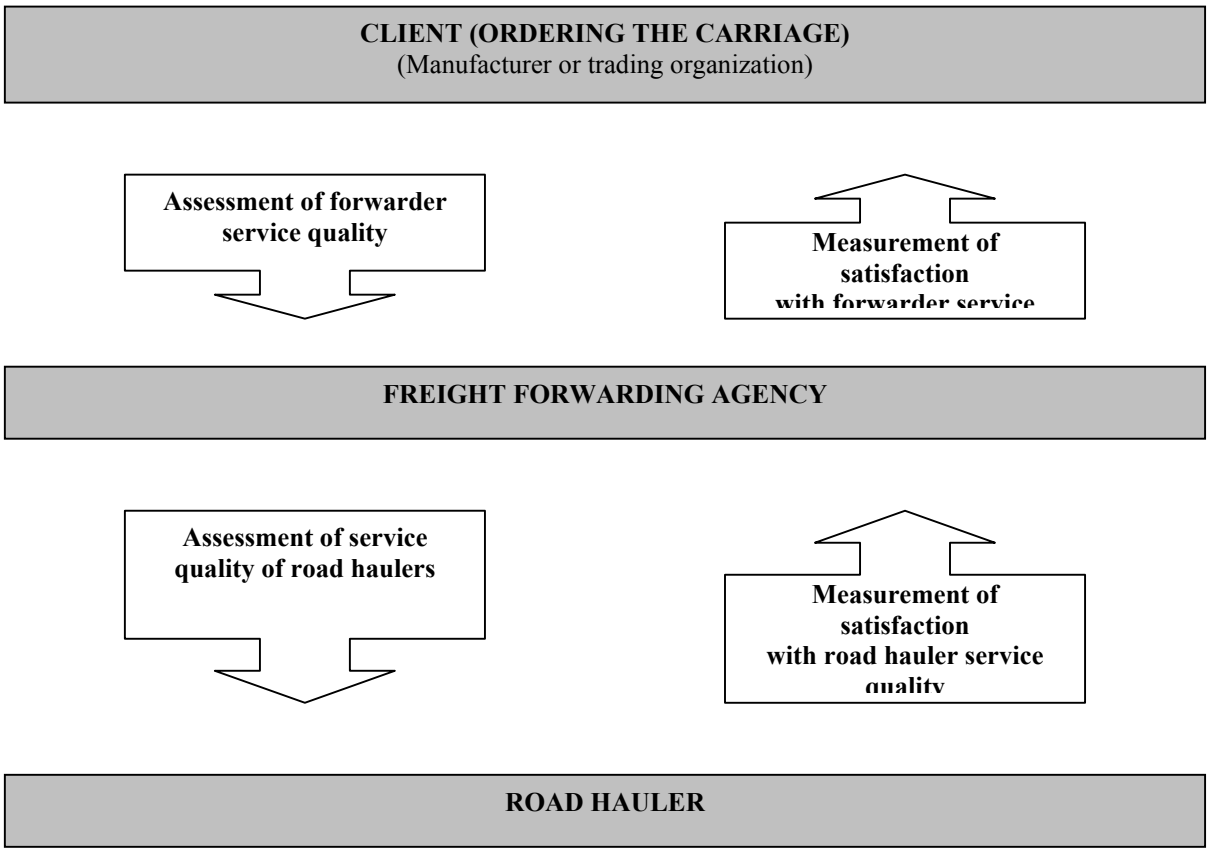

Fig. 1 Relationship between quality assessments and satisfaction measurements

3.1 Methods of measurements of customer satisfaction with quality of provided services

There are several approaches to measurement of customer satisfaction.

Passive measurement of customer satisfaction

Sometimes the method is called as *indirect measurement*. We talk about the passive measurement of customer satisfaction if the carrier or forwarder has implemented no method for measurement of customer satisfaction and is not trying to measure customer satisfaction actively. He obtains information on satisfaction or dissatisfaction only from complaints, claims or compliments of customers voluntarily made.

Active measurement of customer satisfaction

Sometimes the method is called as direct measurement**.** The true and typical customers should be asked who have real experiences with levels of provided service quality.

a) surveys, which can be carried out by telephone, e-mail, personal contacts, where satisfaction investigation does not have a standard form. Any such investigation has its own specifics, we could say that its character is approximate. Therefore, the results obtained this way cannot be generalized, and it is difficult to compare the measured results of satisfaction from different customer. It is actually controlled interview, which is based on asking targeted questions to a respondent, whose content is related to the level of satisfaction with specific quality criteria.

b) questionnaires of a standardized form, it is possible to evaluate the obtained results easily. As a tool for grading the level of satisfaction we can be use point scales, grading or verbal assessment.

3.1.1 Index of satisfaction with transport and forwarding services

The Index of Satisfaction is an objective form of expression of the level satisfaction with the characteristic/characteristics of the transport or forwarding services (9).

$$I_S = \sum_{i=1}^{n} I_{si}.w_{si} \tag{9}$$

$$\sum_{i=1}^{n} w_{si} = w_s \tag{10}$$

Importance weights of different aspects of satisfaction (service characteristics) applied in the formulas (9) and (10) are standardized.

Partial Indexes of Satisfaction (I_{si}) express satisfaction with specific criteria. Customer requirements to meet individual aspects may be different, therefore the degree of importance to the customer is expressed by its weight. For each individual satisfaction indexes the relationship between perception and expectation of service quality is investigated as follows:

- ***for positive characteristics*** it is the ratio of perceived and expected levels of service quality. Positive characteristics can be, for example, compliance with delivery terms, not damaged consignments, driver courtesy, compliance with the timetable, etc. It can be calculated using the formula:

$$I = \frac{\text{perceived characteristics}}{\text{expected characteristics}} \text{ (-)} \tag{11}$$

- ***for negative characteristics*** it is the ratio of expected and perceived service quality levels; negative characteristics may be a failure to meet the delivery time, damages of consignment, failure to comply with the timetable, etc. It can be calculated using the formula:

$$I = \frac{\text{expected characteristics}}{\text{perceived characteristics}} \text{ (-)} \tag{12}$$

When applying indexes of satisfaction it is recommended to use scoring scales available to express also a pleasant surprise, the expected value may not be in the middle of the scale. It is also recommended that while the customer satisfaction is investigated, its importance (significance) for the customer should also be investigated.

The purpose of the investigation of the index of satisfaction is gradual increase in its value (improving of the service quality) by reducing the difference between the expected and perceived service quality. It is important to examine the relationship between the indexes of specific quality criteria and their importance (significance).

The purpose of the satisfaction measurement is to identify deficiencies in quality of provided services and their using to take corrective actions. Increasing customer satisfaction can be divided to the following areas:

- better understanding of expectations;
- more correct and accurate enforcement of customer expectations in specifications of technological processes of transport and forwarding services;
- better level of service performance;
- better "visibility," in connection with the provided services;
- elimination of "distorted view" of customers, i. e. customer expectations are close to reality.

4. Conclusion

Quality product needs quality transport services too. Transport services suppliers are under pressure of manufacturers and commercial companies. Requirements for quality and range of supplied transport services are dependent on quality and price of transported products.

Measure of quality process, where goods movement realized by road freight transport comprehends too, means attribute complex that is related with process functionality in real time. Attribute complex includes responsibility, accuracy, flexibility, safety, environmental impact etc.

Road freight transport companies are the most important suppliers for forwarders. Whereupon selection and evaluation of road carriers influences quality of supplied service and its operative part – transport process.

In term of manufacturing or commercial company transport is only one of many aspects that influence quality of supplied product. However the mistakes and quality absence of transport process can confound the manufacturer´ s efforts and impair or cancel business relation.

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