LOGI – Scientific Journal on Transport and Logistics
Vol. 9 No. 2 2018 DOI: 10.2478/logi-2018-0019

Evaluation of Transport Processes Quality with Servqual and TUL Methods

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Abstract

The theoretical part of this article presents knowledge of selected methods used to study the quality level of basic processes. Authors paid particular attention to the Servqual method, which shows the differences that exist between the perceived and delivered quality of services provided by enterprises and the TUL method. The research part will show the Servqual and TUL analysis based on the processes of the existing transport company. The article is based on well-known methodology of Servqual and TUL analysis, which was adjusted to observation of transport processes of logistics service provider. The main scientific goal of the paper was to examine the effectiveness of the methodology used on the example of a transport company and comparison of methods utility. The improvement of the transport process will increase the level of customer satisfaction, and this is the first step to increase the number of transport orders received.

Keywords: Servqual method, transport process evaluation, transport process quality

1. Introduction

The necessity to ensure and maintain a competitive advantage in the market of transport services makes customer requirements are constantly increasing. Factors such as flexibility and speed of action play an increasingly important role in the overall assessment of the quality of transport services. Transport companies are increasingly using various types of research to measure the level of services provided, which allows them to receive information on which areas of the process they need to improve. In connection with the current high competition on the transport services market, researching the quality of services is of particular importance.

Good knowledge of a functioning logistic system is necessary for the effective and efficient implementation of logistics activities in goods trade [1]. The constant search for tools to improve logistics processes is an inseparable element of the modern global market. The level of customer service, reasons for failures and mistakes, for which corrective actions are subsequently developed, is also examined. The theoretical part of this article will introduce to the present knowledge of selected methods used to study the quality level of basic processes in logistics. Authors have

selected the Servqual method, which shows the differences that exist between the perceived and delivered quality of services provided by enterprises to make a research on existing company in transport services market.

2. Servqual Method

One of the tools used to test customer satisfaction is the Servqual model. The initial model was developed in 1985 by a group of scientists A. Parasurman, V.A. Zeithaml and L. Berry [2]. The creators of the method assumed that the quality of the service is determined by the discrepancy between the perception of the consumer and his expectations of the service [1]. This method was also created as a consequence of using in practice the service quality model (five gaps model) created by the same team of researchers - the Servqual method basically refers to the last gap - the difference between the consumer's expectations and the perception of the product or service [3]. It can be used to measure quality of different public services, connected with education [4] or healthcare [5,6] and others like bank [7] or air transport [8]. Some of them even have an original name, like for example measuring quality performance of restaurants with DINESERV method [9]. Fig. 1 shows a schematic model of the five vulnerabilities, gaps [10], which is the basis of the Servqual analysis [2].

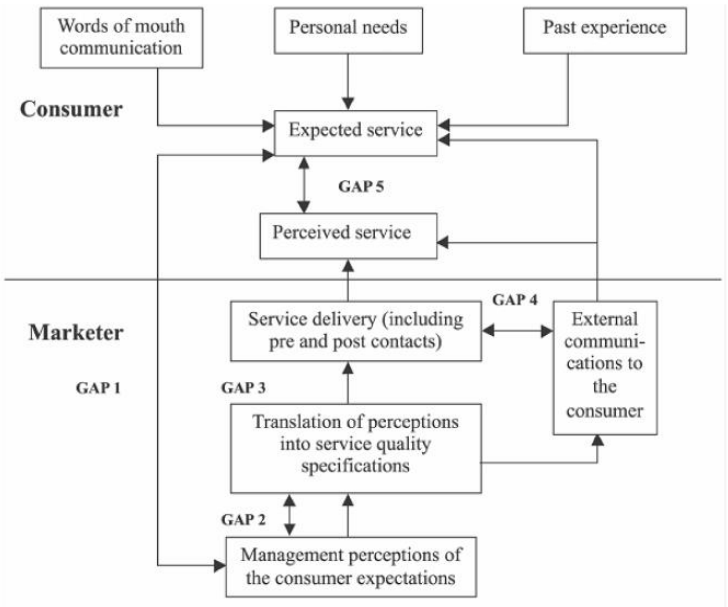

Fig. 1 Extended gap model of service quality in SERVQUAL method. Source: [10]

The literature on the subject recognizes this method as a universal tool that is used to examine the perceived quality of various types of services. It is a convenient and simple, multi-level scale, allowing to gain many suggestions as to the direction of quality improvement. Based on the results of Servqual, the logistics department can determine its level of transport services and can get accurate information on the sources of problems related to the quality of processes [2]. It is worth

mentioning that there are also different varieties of the method, such as Servperf [11] known in literature [12]. Sometimes Servqual method is used simultaneously with other methods, like Importance Performance Analysis (IPA) [13] to confirm the test results. Initial scale of Servqual consisted of ten dimensions, which after further tests carried out by Parasuraman and Zeithaml [14] reduced to five key dimensions. These dimensions are then evaluated and compared [4]. The dimensions should be strictly considered according to the process analyzed [14]. As a result, the company's management is able to determine the level of service provision. These dimensions are:

- tangibles - appearance of physical facilities, equipment, personnel, and communication materials,
- reliability - ability to perform the promised service dependably and accurately,
- responsiveness - willingness to help customers and provide prompt service,
- assurance - knowledge and courtesy of employees and their ability to convey trust and confidence,
- empathy - caring, individualized attention the firm provides its customers.

3. TUL Method

The TUL analysis is a method that helps to evaluate processes in accordance with the acronym of the German words: *Transport, Umschlag, Lagerung* (transport, transshipment and storage). These are typical elements of logistics processes. It is a method showing differences between the course of each activity planned by the forwarder and the actual time of its execution [15].

The organizer of the logistic service is responsible for the analysis of the order and determining the route of the goods transport. In addition, his tasks include estimating the time of performing each activity in the transport process. Thanks to the calculations carried out before the service, the differences between the planned time of the activity and its actual execution can be noticed. The TUL analysis allows to assess the deviations of the forwarder's indications from the actual time of each activity and allows to determine which activities are the least and which are the most time-consuming ones. The TUL method was used in [16,17] where the examined transport service was associated with a perishable cargo such as frozen fish in the form of fillets. It is a commodity that requires a very demanding transport technology system, where in addition carriers must adapt to meet many special transport conditions that are imposed by legal conditions and economic specification.

4. Evaluation of Transport Process Quality in a Company

In the research part of this article, the quality of transport services according to client's order were analyzed. The work was created basing on the cooperation model of a small transport enterprise and

a production company specializing in the production of heaters. Transport services performed for this company are irregular. In the moment of lack of free carriage from permanent carriers, the sender sends offer inquiries to other carriers by e-mail. The local transport market is characterized by very high market competition, and transport services are offered by over 30 companies.

Due to the declining number of orders reported from local manufacturing companies the decision was made to examine the quality of the service with known qualitative methods, and to propose corrective actions. The quality of service surveys allowed to identify areas that prevent greater use of the potential and strengths of the analyzed transport service provider.

4.1 Servqual Methodology

The Servqual method was used to assess the quality of the transport service, which enabled the measurement of service quality from the customer's point of view and indicates which areas need improvement. This method showed the difference between the quality expected and provided by the company. For each of five quality dimensions twenty-two quality attributes were assigned, characteristic for transport services offered grouped as follows:

1) Tangibles (1. Modern equipment and supplies; 2. Friendly company environment; 3. High personal culture of the employees ; 4. Attractive advertising materials);
2) Reliability (5. Execution of orders on the promised time; 6. Interest in solving customer problems; 7. Flawless performance of the service at first time; 8. The company has a good reputation in the market; 9. The company cares for completeness and error-free documentation);
3) Responsiveness (10. Employees constantly inform the client about the status of the service; 11. Services are performed efficiently and on time; 12. Employees never refuse help; 13. Employees always answer questions);
4) Assurance (14. Employees inspire confidence in their approach to the customer; 15. Transactions proceed with a sense of security; 16. Staff kindness; 17. Employees are educated, experienced and competent people);
5) Empathy (18. Individual approach to client; 19. Customer service at convenient hours; 20. Paying much attention to customers; 21. Taking care of clients' interests; 22. Understanding the special needs of customers).

Eighteen companies which regularly report their demand for transport services took part in the survey. In each of the company research was conducted on the services provided by the transport company and expected services and using surveys, in which each of these elements were assessed by customers on a Likert scale of 1-5, where 1- is insufficient, 2 - poor, 3 - average, 4 - good and 5- very good. At each question, the subject could only circle one answer. In addition, the average weight for each Servqual dimension was evaluated. The task of the clients was to divide 100 points

between the five areas, according to the subjective validity rating for each of them. The average of these weights is the arithmetic mean of the weights obtained divided by 100.

4.2 Servqual Results

A comparison of the average quality assessment results of the service perceived (SQP_{ki}) and service expected (SQE_{ki}) is shown in Table 1. Basing on the results of the questionnaire, the Servqual score was calculated, the SQ_{ki} factor according to opinions of the clients with following formula:

$$SQ_{ki} = SQP_{ki} - SQE_{ki} \quad (1)$$

SQ_{ki} - service quality for *k* - client and *i* - attribute,

SQP_{ki} - service quality perceived by *k* - client in *i* - attribute,

SQE_{ki} - service quality expected by *k* - client in *i* - attribute.

These results show that clients evaluate the implementation of customer services very well, where the company is distinguished by reliability and punctuality. The lowest average rating, equal to 2.83, obtained the attribute referring to the company's modern equipment and supplies. According to customers, the equipment used by the transport company is unattractive and outdated. Slightly higher average value received the attribute related to the company's environment - 3.67. The visual environment is, according to the clients, unattractive. The first dimension, associated with tangibility (the appearance of the environment, equipment, advertising materials, employees) was rated the worst by the company's clients.

The attribute referring to the attractiveness of advertising materials of the company obtained in this case the smallest average - 4.11. This means that for the company's clients, the appearance of advertising materials is the least important element. Discrepancy between the largest and smallest estimate of this attribute (from 3 to 5) informs about divided opinions of clients. For some, this attribute was larger, and less important for others. The attributes related to the attractiveness of the company's environment, whose average was 4.33 and the modernity of the company's equipment, were rated a little better - 4.5. In relation to the above, it can be concluded that the dimension of tangibility is the least important dimension for the clients of transport operator. Each of the attributes of the reliability dimension and the speed of the reaction received an average rating of 5. This shows the importance of reliability and speed of the service for the client.

Table 2 provides information on the quality of ratings by Servqual areas for the analyzed transport company. In order to provide estimates for a particular dimension results obtained from Servqual statements relating to individual dimensions were added and then divided by the number of attitudes in each dimension according to the formula:

$$SQ_{ko} = \frac{\sum_{i=a}^{b} SQ_{ki}}{c} \quad , \quad (2)$$

o - Servqual dimention,

c - sum of statements in each Servqual dimension,

SQ_{ko} - the Servqual result for the *k*-client and the o dimension.

Coefficients *a* and *b* (which determine, respectively, the coefficient *a* first theorem included in a given dimension, factor *b* - the last theorem included in a given dimension).

Table 1 Parametrization of transport service quality attributes by clients. Source: authors

Attribute *i*	Quality perceived average $\overline{SQP_{ki}}$	Quality expected average $\overline{SQE_{ki}}$	Service quality (SQ_{ki}) level according to clients (*k*) opinion																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	2.83	4.50	-3	-2	0	-2	-1	-2	-1	0	-3	-3	-2	-1	-1	-3	1	-3	-2	-2
2	3.67	4.33	0	-1	0	-1	-1	-1	-1	-1	-1	0	-1	-1	0	-1	0	0	-1	-1
3	4.61	4.61	0	0	-1	0	1	0	1	1	1	0	0	-1	-2	0	0	0	1	-1
4	4.22	4.11	0	1	0	0	0	0	1	0	0	0	-2	0	1	1	0	1	0	-1
5	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	4.89	5.00	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0	0	0	0	0
7	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	4.94	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0
10	4.89	5.00	0	0	0	0	0	0	0	0	-1	0	0	0	0	-1	0	0	0	0
11	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	4.94	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0
13	4.89	5.00	-1	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0
14	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	4.78	5.00	-1	0	0	-1	0	-1	0	0	0	0	0	0	0	-1	0	0	0	0
16	5.00	5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	4.17	4.78	-1	1	0	-2	0	-1	0	-1	-1	-2	0	-2	-1	0	1	0	-2	0
18	4.89	5.00	-1	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0
19	5.00	4.89	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
20	5.00	4.72	0	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	1
21	4.83	5.00	-1	0	0	0	0	0	0	0	-1	0	0	0	-1	0	0	0	0	0
22	4.89	5.00	-1	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0

The total result of assessments of service quality areas is the arithmetic average of individual ratings. The following formula was used for this:

$$SQ_o = \frac{\sum_{k=1}^{n} SQ_{ko}}{n} \quad , \tag{3}$$

n - number of clients.

The combined result allows you to determine whether the service provided by the transport company meets the expectations of customers (total score = 0), is higher than their expectations (total score> 0), or is below customer expectations (total score <0). In addition, a standard deviation from the following formula was calculated to check the discrepancy in customer ratings:

$$s_o = \sqrt{\frac{\sum_{k=1}^{n}(SQ_{ko}-SQ_o)^2}{n-1}} \tag{4}$$

The dimension of reliability, which average weight was 0.46, proved to be the most important dimension for customers. The least important is empathy with the average weight of 0.08. The standard deviations obtained for each attribute show that the greatest diversity of customer ratings is

in the tangibility ($s_o=0.38$) and in the assurance ($s_o=0.27$). In the dimension of reliability, the respondents were almost unanimous ($s_o=0.07$).

Table 2 List of quality area assessments for a transport company. Source: authors

Servqual dimension	Average wage	Total result SQ_o	Standard deviation s_o
Tangibles	0.09	-0.56	0.38
Reliability	0.46	-0.03	0.07
Responsiveness	0.15	-0.07	0.18
Assurance	0.22	-0.21	0.27
Empathy	0.08	0.00	0.23

The study allows to determine the strengths and weaknesses of the company, which then gave the opportunity to formulate activities aimed at streamlining the entire process. The reliability and assurance of the service is the most important for the surveyed. The average weights of these dimensions were respectively 0.46 and 0.22. Dimensions of the least importance were tangible and empathy - 0.09 and 0.08. Empathy is the dimension in which there was a large spread between ratings, as indicated by a standard deviation coefficient of 0.23. The study allows to determine the strengths and weaknesses of the company, which then gave the opportunity to formulate activities aimed at streamlining the entire process. The reliability and assurance of the service is the most important for the surveyed. The average weights of these dimensions were respectively 0.46 and 0.22. Dimensions of the least importance were tangible and empathy - 0.09 and 0.08.

4.3 TUL Analysis

The analyzed transport service concerns the transport of radiators with total weight is 11 tons on the route from Rybnik (Poland) to Ghent (Belgium). The loading takes place at the customer's warehouse - in the production company Rettig Heating located in the city of Rybnik. The service under consideration does not provide cargo carriage on the way back. The studied process can be divided into four stages. The first stage concerns activities that precede the transport service. The second phase is activities related to preparation for the service. After these activities, the carrier can collect the cargo from the place of loading. The third stage is the most important part of the transport service - delivery of goods to the recipient. The last phase is the activities performed after the transport service.. The TUL analysis concerns the second and third phases of order fulfillment allowing to examine the time of order completion from the moment the order is accepted until the delivery of the goods. The forwarder in phase II is responsible for determining the route of transport simultaneously estimating the time of performing each operation in the process. The modified TUL analysis enables the assessment of deviations of the estimated forwarder times from real time.

The data contained in the tables below (Table 4, Table 5) were input by one of the drivers of the analyzed company during the transport process on the Rybnik (Poland) - Ghent (Belgium) route.

The work card, specially prepared for this purpose, allowed to record the start and end times of each activity. All company cars are equipped with tachographs, so that it was possible to confirm the data provided by the driver. Figure 2 shows a summary of the activities performed during delivery, including their duration and the number of repetitions for the transport service.

Fig. 2 TUL analysis for the selected transport service. Source: [18]

No.	What?	Where?	Who?	How?	Symbol	Description	Distance [km]	Weight [t]	Duration [min]				
									○	⇨	△	⬠	▢
1	truck	mechanical plant	mechanic	computer	○	technical control			92				
2	truck	base	driver	manually	○	vehicle cleaning			70				
3	truck	gas station	driver	vehicle	○	fueling	6		28				
4	truck	base	driver	vehicle	⇨	departure to loading place	10			30			
5	truck	parking	driver	vehicle	▢	waiting for loading							45
6	truck	warehouse	storekeeper	forklift	△	loading	0.04	15			60		
7	truck	warehouse	driver	visually	○	freight control		15	10				
8	truck	road	driver	vehicle	⇨	departure to unloading place	266	15		200			
9	truck	parking	driver	-	⬠	stop		15				660	
10	truck	road	driver	vehicle	⇨	transport continuation	360	15		270			
11	truck	parking	driver	-	⬠	stop		15				45	
12	truck	road	driver	vehicle	⇨	transport continuation	385	15		270			
13	truck	parking	driver	-	⬠	stop		15				660	
14	truck	road	driver	vehicle	⇨	transport continuation	233	15		270			
15	truck	parking	driver	vehicle	▢	waiting for unloading		15					55
16	truck	warehouse	storekeeper	forklift	△	unloading	0.04	15			35		
							1260.08		200	1040	95	1365	100

The first element affecting the time of the process is the transport process itself. It was 1040 minutes and it is about 37% of the total delivery time. In this case, the difference between the scheduled time of delivery service, and the actual time was 60 minutes - the driver was driving shorter than forwarder predicted. Thanks to the ride in the evening and night, the driver avoided many traffic jams, which allowed him to reach the destination 60 minutes earlier. The second possible solution to shorten the time of carriage is the two-seater cast of drivers, which allows for continuous driving without interruption. This involves a much higher cost of transport services. The analyzed company uses this solution very rarely. Shortening the time by setting a faster route was impossible in this case due to the preferred route of the client.

Therefore, in order to shorten the process time presents options relating in particular to the operations of loading and unloading, waiting and control. Comparing the actual and planned time of the transport process, it can be noticed that the time of rest and stops of the driver took the most time - 1560 minutes. It has a direct connection with Polish law. The regulations say that the driver must perform a 45-minute stop every 4.5 hours. Within a day, the driver can drive a maximum of 9 hours, but twice a week it can be extended to 10 hours.

The above restrictions have a bearing on the length of the transport process and do not allow for its shortening. The sum of breaks and stops is 56% (1,560 minutes) of the total number of minutes needed to complete the process. The comparative analysis shows that the driver's rest lasted 20 minutes less than the forwarder planned. This is a deviation that falls within the limits of the company's standard.

Table 3 List of quality area assessments for a transport company. Source: authors

Process element	Real time		Planned time		Difference
	duration [min]	repetition number	duration [min]	repetition number	duration [min]
Transshipment	95	2	94	2	-1
Transport	1040	5	1100	5	60
Controls	200	4	192	4	-8
Waiting	100	2	74	2	-26
Stops	1365	4	1385	4	20
TOTAL	2800		2845		45

Activities related to loading, unloading and control take the least time, which means that they have the least impact on the time of the service. They lasted only 10% (295 minutes) of the entire process implementation time. This does not mean, however, that they do not require changes. This time can be shortened by performing a check-up during the loading process - without waiting for it to be completed. Covering the time allowed for checking the goods with the loading time would shorten the time of the entire process.

4.4 Comparison of Selected Quality Service Analysis Methods

In the analyzed case, the analysis of the quality of transport services has been provided, taking into account several methods commonly used in quality management. It is worth pointing out the most important determinants of each of these methods, which allow the use of the most important features of the methods used. The summary table is shown in Table 6.

The comparison of methods used to analyze different elements of transport process quality show a large range of possibilities of using methods depending on the needs for which they are performed. The issues may be analyzed from different perspectives: from point of view of the recipient (in order to gain knowledge about the opinions) or from the inside of the company, which allows to improve internal management procedures used in the company.

Table 4 Comparison of selected process quality analysis methods. Source: [18]

Dimension	Servqual method	Mapping method	TUL method
research perspective	recipient	service provider	service provider
objectivism	subjective	objective	subjective and objective
differentiation	differentiating 5 Servqual dimensions	division of the process into phases	division of the process into activities
personal responsibility	no	yes	yes
research scope	overall	overall or partial	overall or partial

Some methods are objective, when concrete data are being collected and some are subjective as Servqual is being based on respondents' questionnaire. Process mapping and TUL model allow to indicate personally people responsible for specific element of the transport process which can have a positive effect on improving working conditions and standards. Depending on the research scope of the methods, they may be used either to improve management in a given area or to entire company, when the improvements are being used to develop a new vision, mission or strategy.

It is also worth emphasizing that future analysis of the quality of processes may include additional factors, such as Failure Mode and Effect Analysis (p-FMEA), which additionally allows for analytical determination of cause-and-effect relationships of potential process defects and consideration of the criticality factor (risk) and other methods.

5. Conclusion

The theoretical part has allowed to deepen the knowledge of selected methods used to study the quality level of processes in logistics. The acquired knowledge was the basis for conducting the analysis of the quality of the transport process in the selected company. The Servqual method was used to examine the service quality of the examined transport operator. The Servqual method identified quality dimensions that need improvement and those that meet the expectations of the transport company's customers. The improvements can become new procedures or standards implemented in the company in future [17]. The method showed the differences that exist between the perceived and delivered quality of service performed by the research subject.

The most important quality dimensions in the implementation of the surveyed service were the dimensions of reliability and assurance of the services provided. For the analyzed example, mean weights were successively 0.46 and 0.22. Empathy and reliability of the services provided are the strengths of the transport company. The results for these dimensions were 0.00 and -0.03, respectively. Dimensions of tangibility and assurance turned out to be the weakest sides of the company, as indicated by the results of -0.56 and -0.21, respectively. These ratings indicate a high dissatisfaction of the client and it is necessary to apply corrective actions. In terms of tangibility, customers rated the attribute of outdated rolling stock the worst, and therefore options for financing the new rolling stock, such as cash loans and various types of operating leasing, were proposed for

the company. The dimension of confidence turned out to be the most important for the surveyed clients. It is also distinguished by a large standard deviation - 0.27, which means that not all clients are treated in the same way. Insufficient staff kindness on the part reflects a sense of security clients. Therefore, appropriate training was proposed to improve the quality of customer service. Unweighted and weighted Servqual values were -0.17 and -0.12, respectively. It means that the client's expectations have been met in 88%, which is a good result.

Analysis of the quality of the transport process from the logistics operator perspective was made using the TUL analysis method. The key factor affecting the delivery time is the transport process. In the example, the time of transport took 37% of the service time. In order to shorten the order processing time, it was proposed, for example, to employ an additional driver, so that one order would be carried out by two drivers and by carrying out cargo distribution control during the loading process. The actual time of the entire process turned out to be 45 minutes shorter than the time the forwarder set up. The difference of 45 minutes is a small value compared to the entire transport process.

The analysis conducted on the subject of the study of the expected and appreciable customer satisfaction with the quality of the service provided allowed to propose solutions to improve service quality. Improvement of the transport process will contribute to the increase of customer satisfaction, and this is the first step to increase the number of transport orders received.

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