SERVICE QUALITY IN RIVER TRANSPORTATION: BELGRADE CASE STUDY

Katarina Vukadinović, Stanko Kantar, Danijela Pjevčević, Ivana Vukićević Biševac, Ivana Jovanović

[a]University of Belgrade Faculty of Transport and Traffic Engineering, Belgrade, Serbia
[b]City of Belgrade Directorate for public transportation

Abstract: *In this study the authors analyze users' perception of the service quality of river transportation in Belgrade. The users' reasoning was polled and modeled by approximate reasoning. The developed fuzzy system was tested on the polled users' answers and a very good results match was noticed. In future it could be used by service provider when investing in the river transportation characteristics which should influence improvement of the service quality.*
Key words: *River transportation in Belgrade, Approximate reasoning, Service quality*

1. INTRODUCTION

Evaluation of service quality is vital to improve productivity, increase profits and users satisfaction. Since service is not a physical item, but an experience, service quality is strictly linked to user satisfaction. Actually, user's perception of quality is an antecedent of his/her satisfaction level with the service (Falk et al., 2010). Developing valid and accurate measures of service quality is not a simple task since these measures deal with abstract and intangible services. Researchers have attempted to develop such measures over the years, none of which has been completely successful. This lack of success indicates that there is no single best measure for service quality. On the other hand, service quality assessment is closely related to the type of a transportation process, so existing approaches and measures which are used in passenger and freight transportation usually differ. In this context Rudel (2005), and Beuthe and Bouffioux (2008) present different performance indicators in freight transportation, while Nathanail (2008) considers passenger transportation case. One of the most important methods for evaluating the service quality using users' perceptions is the survey methods because detailed information is provided about user comments, it makes clear the concept of service, it shows the problems, and it offers possible solutions. In realistic situations, users may not provide quantitative or numerical evaluations. Rather, they may be comfortable providing qualitative assessments such as good, very good, poor, very poor, etc.

In this study service quality of river transportation in Belgrade is analyzed. Although we present possible performance measures for the assessment of service quality in a freight transportation, modeling of service quality is tested on the passenger transportation system, as a consequence of data availability. The assessment of service quality was obtained by users' poll during the summer of 2008 (Ivankovic, 2008). The analysis of the poll results showed which characteristics of the river transportation, in users opinion, influence most the service quality. The objective of our study is to develop the model which would imitate the poll results and could be used for assessment of service quality of future river transportation. The input variables which describe the service quality, as well as the service quality itself are suitable for the modeling by linguistic

or fuzzy variables. Application of approximate reasoning for modeling of human reasoning and decision making in presence of uncertainty is justified (Teodorovic and Vukadinovic, 2012).

The paper consists of five sections. The first section is the introduction. The second one introduces concept of a service quality and basic measures for evaluation within freight and passenger transportation systems. In the third section authors presented the considered case study. They selected the characteristics which, in users' opinion most influence the service quality. Also, the section gives short description of the poll process. The model in form of fuzzy system was developed and the service quality of river transportation was evaluated in section four. The proposed model was tested. The analysis of results and the conclusive considerations were given in the fifth section.

2. SERVICE QUALITY EVALUATION

The main objective of the river transportation is to reduce the environmental impacts of road traffic. The intense usage of river transportation contributes to reduction of pollution and noise rate. However, ports are constantly exposed to the challenge of improving quality of service offered to users and, on the other hand, managing all processes efficiently with the aim of reducing the costs. In general, cost analysis is relevant to logistics management. It can be used to understand the level of resources that are required to operate a transportation system, with the goal of maximizing service quality of the system while minimizing the cost of resources (Abdallah, 2004). The transport of users, as a service activity has its principal objective: to satisfy the users' needs. It is impossible to accomplish this without thoroughly knowing users' wishes, attitudes and interests and the way they perceive them. One of the methods to assess whether the users are satisfied with the service provided is the direct interview or the poll of the users. Examples of mentioned approaches for the case of freight transportation can be found in Rudel (2005) and Beuthe and Bouffioux (2008), as well as in Nathanail (2007), for passenger transportation.

Due to the need to evaluate to what extent the users of river transportation were satisfied with the service, different measures are proposed. In the freight transportation, the following measures are usually used: *frequency* of service per week actually supplied by the carrier or the forwarder; *time*, as door-to-door transport time, including loading and unloading; reliability as percentage of on-time deliveries; *flexibility* as percentage of non-programmed shipments that are executed without undue delay; *loss* as percentage of commercial value lost from damages, stealing and accidents; *cost* as out-of-pocket door-to-door transport cost (Beuthe and Bouffioux, 2008). In case of passenger transportation, standard EN 13816 defines a set of eight qualitative criteria for evaluation of public passenger transportation*: availability, accessibility, information, time, customer care, comfort, security, and environmental impact*, where each criterion comprises more detailed sub-criteria.

To assess in which way and in what extent those characteristics influence the service quality is the subject of different analysis of data collected usually through interviews or pools. The main purpose is in better understanding of the role played by these factors, but also in assessing its relative importance in providing transportation service. Then, the answer based on those findings may indicate needed improvements, or can be served as an estimate of the position of the transportation service provider on the market.

However, availability of representative data is in practice, not rarely, very limited, particularly in case of new services, and application of certain modeling approaches which can imitate users' perception and attitudes. Development of one such modeling approach, based on fuzzy logic approach, is the objective of this study. Although the idea followed in the process of the fuzzy logic model creation is general, values of input variables were based on the set of service quality measures similar to above given standardized criteria of the passenger transportation quality, because of availability of data used to test the model.

3. CASE STUDY OF RIVER TRANSPORTATION IN BELGRADE

Due to the need to evaluate to what extent the users of river transportation were satisfied with the service, the poll was carried out. The poll lasted four weekdays and one weekend day. During that period 130 users of the river transportation were polled within three river boats. The lines are: New Belgrade-Branko's Bridge and New Belgrade-Ada. Three river boats were employed in these two lines: two in the first and one in the second line. The boats were the catamaran type, registered for 56 users. The interval between the boat departures at both lines was 35 minutes.

The poll consisted of twelve questions divided in two groups. The first group of questions requested the river transportation users' information according to relations, sex, age, type of the tickets bought: the initial and the final point of their journey, reasons for the service usage and frequency of river transportation usage.

The second group referred to the evaluation of certain characteristics of river transportation and service quality of the entire system. In addition, the users had the possibility to give their suggestions and remarks according to their own needs and attitudes.

The polled users evaluated the characteristics of the river transportation and service quality itself in numerical scale from 1 to 5 (Ivankovic, 2008). In this study, the authors represent the evaluation of the characteristics of the river transportation by fuzzy sets to which the following linguistic values were assigned: 'small', 'medium', 'large'; 'bad', 'good', 'very good', 'excellent', 'low', 'medium' and 'high'. The river transportation characteristics are modeled by fuzzy variables: how well informed, accessibility, punctuality of boat schedule, staff kindness, safety, comfort, connection to city public transportation bus and tram lines and service quality, because it is impossible to imagine strict limits between different categories, that is, values of input and output variables.

The processed results of the poll showed which characteristics of the river transportation should be reconsidered and improved in order to make the service quality better: how well informed, port accessibility and connection to city public transportation lines. These characteristics were differently evaluated by the users (Figure 1).

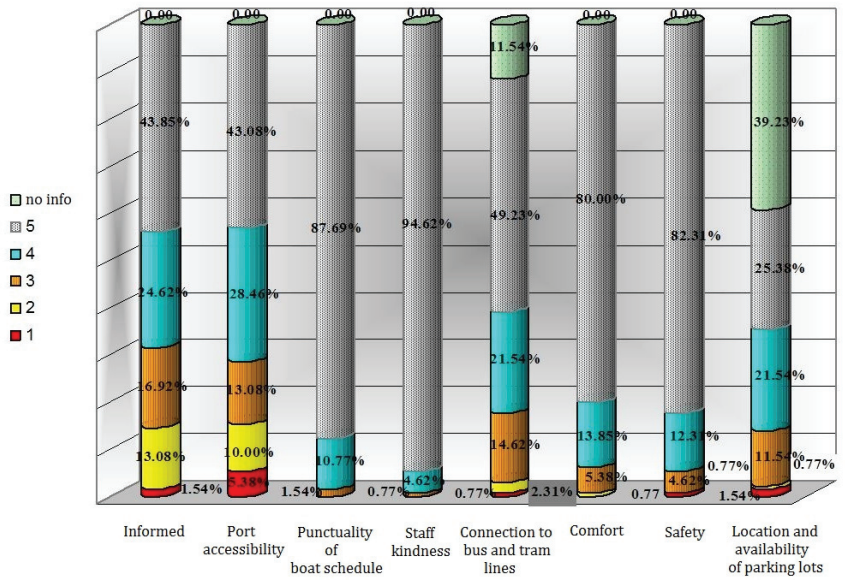
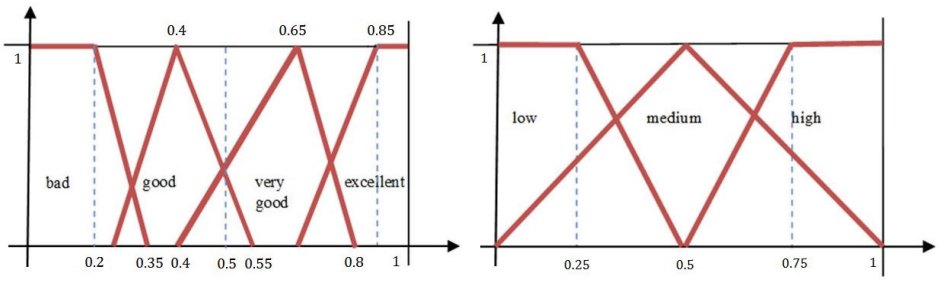


Figure 3. Graph of the evaluations of river transportation characteristics by users

4. MODELING OF USERS' REASONING

In this study, the authors developed a model in form of fuzzy system to determine service quality of river transportation in Belgrade. Most characteristics of river transportation on which the entire service quality depends, as well as the service quality itself, can be considered as fuzzy variables due to the presence of uncertainty and the way the users perceive them. The first step in design of a fuzzy system is fuzzyfication. In this study the experts' subjective opinions as well as analysis of the answers obtained by the poll, influenced the positions and shapes of the membership functions of fuzzy sets of input and output variables.

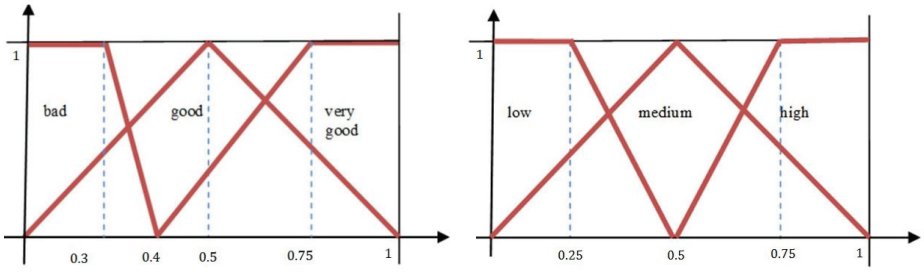
How well informed, port accessibility and connection to city public transportation lines are considered as input variables which describe service quality of the river transportation. Final shapes of fuzzy sets are obtained by tuning initial shapes using the trial and error method.



a) b)

Figure 4. Membership functions of fuzzy sets: a) "bad", "good", "very good" and "excellent" "Level of information", b) "low", "medium" and "high" "Port accessibility"

It is supposed that the users distinguished and subjectively evaluated four categories, that is values of the first fuzzy variable "Level of information": "bad", "good", "very good" and "excellent" which are represented by fuzzy sets with the corresponding membership functions (Figure 2a). The "Port accessibility" was described by three values: "low","medium", and "high" (Figure 2b).



a) b)

Figure 3. Membership functions of fuzzy sets: a) "bad", "good" and "very good" "Connection to city public transportation lines", b) "low", "medium" and "high" "Service quality of river transportation in Belgrade"

The users distinguished three categories of input variable "Connection to city public transportation lines": "bad", "good" and "very good" (Figure 3a). The users evaluated the output variable "Service quality of river transportation in Belgrade" in three categories modeled by fuzzy sets: "low", "medium" and "high" (Figure 3b).

Approximate or fuzzy reasoning is the deduction procedure or the way conclusions are made from assumptions within a set of fuzzy rules. In this study the authors defined the set of "IF THEN" rules which are used to determine the Service quality of river transportation in Belgrade. The tables below show the conclusions of fuzzy rules, in other words, values of output variable

"low", "medium" and "high" "Service quality of river transportation in Belgrade" (LSQ - Low Service quality; MQ - Medium Service quality; HQ – High Service quality). For example, IF the "Connection to city public transportation lines" is very good AND IF "Port accessibility" is low AND IF "Level of information" is bad THEN the "Service quality" is low.

IF CONNECTION TO CITY PUBLIC TRANSPORTATION LINES IS BAD AND IF

Information / Port accessibility	bad	good	very good	excellent
low	LSQ	LSQ	MSQ	MSQ
medium	LSQ	MSQ	MSQ	MSQ
high	MSQ	MSQ	MSQ	MSQ

OR

IF CONNECTION TO CITY PUBLIC TRANSPORTATION LINES IS GOOD AND IF

Information / Port accessibility	bad	good	very good	excellent
low	LSQ	MSQ	MSQ	MSQ
medium	MSQ	MSQ	MSQ	MSQ
high	MQ	MSQ	HSQ	HSQ

OR

IF CONNECTION TO CITY PUBLIC TRANSPORTATION LINES IS VERY GOOD AND IF

Information / Port accessibility	bad	good	very good	excellent
low	LSQ	MSQ	MSQ	MSQ
medium	MSQ	MSQ	HSQ	HSQ
high	MSQ	HSQ	HSQ	HSQ

In this study the approximate reasoning is carried out with "Max-Min composition", that is, the Mamdani's model of fuzzy system is used (Teodorovic and Vukadinovic, 2012). By the algorithm of approximate reasoning the fuzzy set with determined degrees of membership of possible numerical values of the output variable is obtained as a result. Defuzzyfication makes the fuzzy information restricted and represented by numerical information. In this study, the Center of gravity method is used to determine a single output numerical value from the resulting fuzzy set.

5. RESULTS AND CONCLUSION

The developed model of fuzzy system was tested. The comparison of the results obtained by the fuzzy system and the evaluation of the service quality of the polled users was done. The whole sample was included in the testing. The results of the fuzzy system match 80% with the poll results. The difference between the results obtained by fuzzy system and the poll results was created because the users were not consistent, in other words they did not make decision about the service quality assessment based on the grades they gave to the same characteristics of the river transportation system. On the other hand, the poll included more characteristics of the river transportation in Belgrade than it is case with fuzzy system (and perhaps for some users of the service those were the parameters which most influenced the service quality). In the future research the proposed fuzzy system can be expanded and it can include more characteristics of the river transportation in Belgrade, in other words it can provide better results. The proposed model of fuzzy system largely imitates the poll results and therefore it is considered to be

acceptable. The opinion of the river transportation users about quality of service provided is important for evaluation of the system in year 2008 as well as for its improvement. By processing the poll results authors concluded which characteristics of river transportation influence most the service quality of the studied system. Based on the poll results the model of fuzzy system was developed with the aim to determine service quality of river transportation in Belgrade. The proposed fuzzy system was tested on the answers of all polled users and a very good match was noticed. The fuzzy system shown and the results it provides could be applied in future with the objective to maintain service quality and its improvement. It is also possible to apply and use the developed model in larger number of lines and ports (in the initial phase there were only two lines and three ports). Finally, very important future application of the presented concept, based on slightly adjusted fuzzy logic system, with modified qualitative criteria, will be related to assessment of the service quality in river freight transportation. Since the proposed model of fuzzy system presented here largely imitates the poll results, it can be concluded that obtained results are also very promising for the case of freight transportation analysis.

ACKNOWLEDGMENT

This work has been supported by Serbian Ministry of Education, Science and Technological Development, Grant No. TR36002.

REFERENCES

[1] Abdallah, Hany. (2004). Guidelines for Assessing Costs in a Logistics System: An Example of Transport Cost Analysis. Arlington, Va.: John Snow, Inc./DELIVER, for the U.S. Agency for International Development.

[2] Beuthe, M., Bouffioux, Ch. (2008). Analysing Qualitative Attributes of Freight Transport from stated Orders of Preference Experiment. Journal of Transport Economics and Policy, Volume 42, Part 1, 105-128.

[3] Falk, T., Hammerschmidt, M., Schepers, J. J. L. (2010). The service quality-satisfaction link revisited: exploring asymmetries and dynamics. Journal of the Academy of Marketing Science, 38(3), 288–302.

[4] Ivankovic, S. (2008). Analysis of the quality of passenger traffic on the river Sava in Belgrade, Undergraduate thesis. University of Belgrade Faculty of Transport and Traffic Engineering.

[5] Ivankovic, S., Pjevcevic, D., Kantar, S., Vukadinovic, K. (2009). Fuzzy system for the asessment of service quality of river passenger traffic in Belgrade. Proceedings of the XXXVI SYMOPIS, Ivanjica, 683-686, In Serbian.

[6] Nathanail, E. (2008). Measuring the quality of service for passengers on the hellenic railways. Transportation Research Part A: Policy and Practice, 42(1), 48–66.

[7] Rudel, R. (2005). Evaluation of quality attributes in the freight transport market. Stated preference experiments in Switzerland. European Transport 25-26, 52-60.

[8] Teodorovic, D., Vukadinovic, K. (2012). Traffic Control and Transport Planning: A Fuzzy Sets and Neural Networks Approach. Springer Science & Business Media.