

## APPLICATION OF ADVANCED QUALITY MANAGEMENT TOOLS IN THE TRANSPORT SECTOR

Mariana Strenitzerova, Tatiana Corejova

[mariana.strenitzerova@uniza.sk](mailto:mariana.strenitzerova@uniza.sk), [tatiana.corejova@uniza.sk](mailto:tatiana.corejova@uniza.sk)

University of Žilina, Univerzitná 8215/1, 010 26 Žilina  
SLOVAKIA

**Key words:** transport sector, urban public transport, customer requirements, quality management tools, CTQ method, QFD method, critical to quality, house of quality

**Abstract:** Today's pressure to reduce emissions, eliminate passenger car travel and the efforts of local governments and society to attract people to use urban public transport is leading by transport companies to seek the right forms of passenger motivation. Improving the quality of travel by urban public transport with innovations, such as a full-value mobile application, is an effective motivational tool to support the use of public transport in cities. The objective of this paper is to determine passengers' requirements and their satisfaction with the quality of urban public transport by application of advanced quality management tools.

### SECTION TITLE

Technology, Organization and Management of Transport

### INTRODUCTION

Transport is a constantly developing and evolving sector in which customer satisfaction is a very important factor. A condition for achieving quality in this sector is continuous development in the area of customer solutions. The transport sector's particularity lies in the fact that the quality of provided services is the main factor in distinguishing a company from its competitors. Services in this sector are too homogenous. The one who offers quality for the best price is the winner.

There are various views and perspectives of quality perception in the literature. The notion of quality is used in many meanings and depending on them, various definitions are used. It is, therefore, necessary to define relevant dimensions of the quality of services, thus various characteristics of services perceived according to the internal and external target groups. Marketing literature pays attention to 3 dimensions of service quality: potential dimension, process dimension and result dimension. Potential dimension relates to the structures and potentials of the service provider (management, resources - material, information, human), e.g. specification of service, technical possibilities, organisation and systemic relations, qualification and motivation of staff. Process dimension captures the service as a sequence of activities (processes) consisting of the marketing process, design process and process of service provision. Result dimension relates to the assessment of the result of a service (customer satisfaction/dissatisfaction with the service or with the service provider) [1].

Professional literature highlights especially these two dimensions: the technical and functional dimension of quality (Table 1) [2, 3].

**Table 1. Dimension of service quality**

Dimension of quality	Characteristics of dimension
Technical dimension of quality	Includes the extent of the programme, i.e. “what” is offered to the customer. In this case, quality is understood as the sum or level of the existing characteristics of a product. It is measured on the basis of objective criteria.
Functional dimension of quality	It interprets “how” a particular service is offered. Thus, quality is defined as the characteristics of a product as perceived by the customer. Quality is measured on the basis of subjective criteria.

The aim of the paper is to diagnose the quality of urban public transport from the customers' point of view by applying advanced quality management tools (CTQ method, QFD method).

In the Slovakia the framework for urban public transport field goes from the European norm 13816:2002. The Slovak version has the same identification numbers, and it is named: *Transportation. Logistics and services. Public passenger transport. Service quality definition, targeting and measurement*. According to this framework, the service quality is divided into eight categories and each category of the service quality is specified to details - in fact, these eight categories cover 103 service attributes. The overall quality of public passenger transport (PPT) contains a large number of criteria. The criteria represent the customer view of the service provided, and in this standard, they have been divided into 8 categories:

1. availability: extent of the service offered in terms of geography, time, frequency and transport mode
2. accessibility: access to the PPT system including interface with other transport modes
3. information: systematic provision of knowledge about a PPT system to assist the planning and execution of journeys
4. time: aspects of time relevant to the planning and execution of journeys
5. customer care: service elements introduced to effect the closest practicable match between the standard service and the requirements of any individual customer
6. comfort: service elements introduced for the purpose of making PPT journeys relaxing and fun
7. security: sense of personal protection experienced by customers, derived from the actual measures implemented and from activity designed to ensure that customers are aware of those measures
8. environmental impact: effect on the environment resulting from the provision of a PPT service.

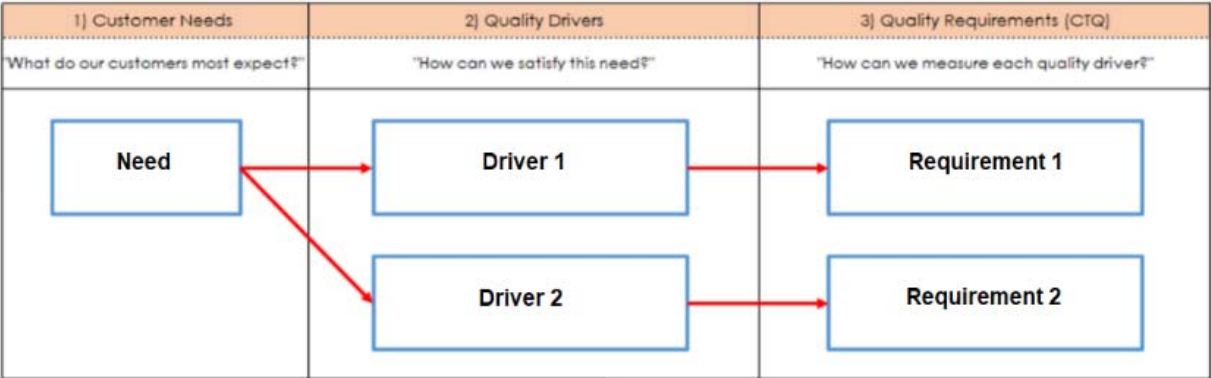
## **METHODOLOGY**

We used CTQ and QFD methods' application to evaluate quality of public passenger transport services in term of customer satisfaction. We focused on the quality of urban public transport in the city of Žilina provided by DPMZ and on its comparison with other cities in the Slovak Republic.

The diagnostic method CTQ (Critical to Quality) helps to identify the customers' needs and requirements for urban public transport. Customers perceive product levels differently. What is an expected product for one person is an augmented product for another. The bigger customer expectations, the more difficult for the company to meet them [4]. The method CTQ helps understand what drives quality in the eyes of customers so that we can deliver a service

that they are genuinely pleased with [5]. The CTQ Tree is diagram-based tool that help develop and deliver high-quality products and services. It is using to transforming general customer needs into specific, actionable, measurable requirements. The process for developing a CTQ Tree we can be summarized in three steps (Figure 1):

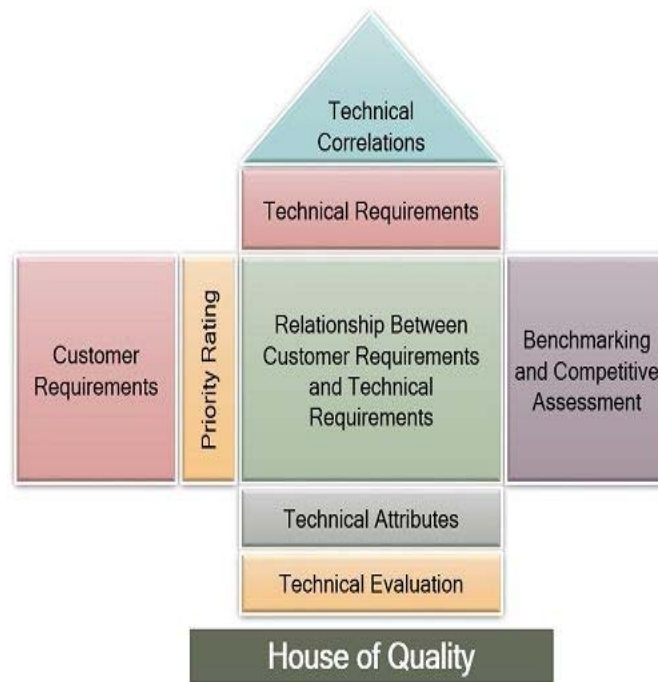
1. Identify Quality Needs. We first need to identify the critical needs that the DPMZ services have to meet. During this first step, we are essentially asking, “What is quality need for the passenger using the urban public transport?”
2. Identify Quality Drivers. Next, we need to identify the specific quality drivers that have to be in place to meet the needs that we identified in the previous step. These are the factors that must be present for passengers to think that DPMZ is delivering a high-quality service. It’s important to identify all of the drivers that are important to passengers used urban public transport app. In our case, the drivers are general requirements for the quality of services: availability, price, functionality, clarity, speed, security, customer care, up-to-date information and awareness.
3. Identify Quality Requirements (CTQ). Finally, is needed to identify the requirements that must be satisfied for each quality driver, in order to actually provide a quality service.



**Fig. 1. CTQ tree**

After completed a CTQ Tree for the critical need, we’ll have a list of measurable requirements that we must meet to deliver to passengers a high quality urban public transport. Creating an effective CTQ tree can help to understand what the customers truly desire and help to improve quality with which the customer will be satisfied.

Method Quality Function Deployment (QFD) is a process and set of tools used to effectively define customer requirements and convert them into the technical parameters of the products or services that fulfil those requirements. Method QFD determines what you need to accomplish to satisfy or even delight your customers. The House of Quality is a very complex diagnostic support tool. It combines multiple sub-analyses which differ from each other in difficulty of processing, in types of data input (primary research/secondary research) and in the total time needed for their successful building (Figure 2) [6, 7].



**Fig. 2. House of Quality**

Primary research was conducted to obtain input data. The primary research was conducted by electronic inquiry in the form of an online questionnaire among Žilina inhabitants. The descriptive research questions were asked. The questionnaire survey aimed to determine whether respondents use urban public transport in Žilina, and how they are satisfied. Respondents had a space for suggestions regarding its optimization, their requirements for a quality urban public transport.

For this research, 173 respondents were contacted, of which 78 % of respondents use urban public transport services in Žilina. Respondents not using the Žilina city transport stated the following reasons: travelling by car is more convenient, the insufficient network of public transport lines, low intervals between individual connections, low speed of public transport vehicles, limited payment options for travel tickets, non-existent mobile smartphone application, travel tickets prices.

## RESULTS

The first part of primary research deals with Customers Requirements. The essential and most important step was to identify customers' requirements they have when thinking about quality of urban public transport. It was done by applying the CTQ method which comes from the Voice of Customers. Customers identified fifteen key requirements which represent drivers of satisfaction when talking about delivered service quality (Table 2).

After identifying drivers of satisfaction and their significance (weight) the technical parameters of service which affect the fulfilment of requirements were assigned to each. When rating the service quality, four key technical parameters of service affect customers most:

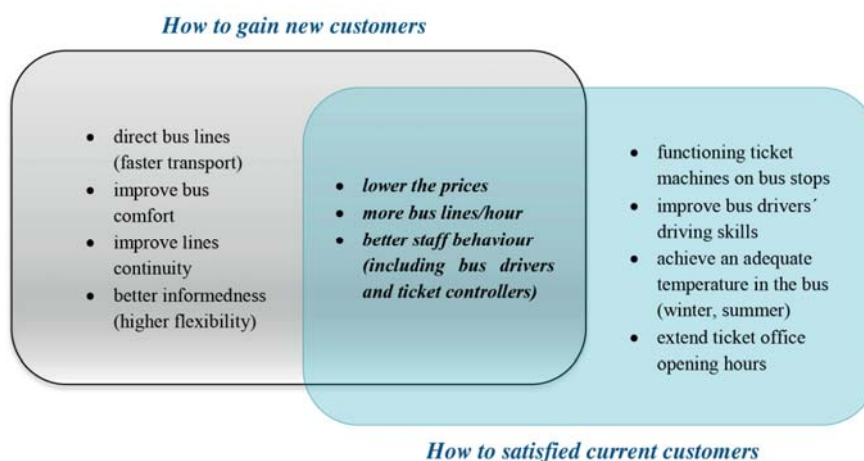
1. number of line connection/hour,
2. time waiting for the next line connection in minutes,
3. delay in seconds,
4. tariff in €/km.

**Table 2. Drivers of satisfaction score**

SATISFIED WITH		Score	DISSATISFIED WITH		Score
Timetable keeping		2.90	Frequency of peak		2.49
Frequency in rush hours		2.84	Bus driver driving skills		2.49
Barrier-free access		2.81	Functioning ticket machines on bus stops		2.45
Travel time		2.78	Ticket office opening hours		2.41
Reliability		2.77	Bus indoor temperature adequacy		2.38
Bus cleanliness		2.68	Staff behaviour		2.19
Bus stop condition		2.68	Price		1.96
Lines continuity		2.54			
strongly agree (4.00 – 3.26)		agree (3.25 - 2.51)	disagree (2.50 – 1.76)		strongly disagree (1.75 – 1.00)

They play a major part in deciding about using the urban public transport or individual car transport. If the customer rates them with high satisfactory score, he prefers the urban public transport. If the score is low, he turns his preferences to individual transport. The second part of primary research deals with Customer competitive assessment. The customers' 15 drivers of satisfaction were compared to the service quality delivered in other four Slovak cities. Thanks to this rating we are able to see the customer satisfaction score with each requirement even in each city, to define overall satisfaction and calculate total quality service perceived by customers in each city separately. Zilina took the fourth place. Complete order of cities according to descending level of satisfaction is as follows: Banska Bystrica – the most satisfied customers, Bratislava, Kosice, Zilina, Povazska Bystrica – the least satisfied customers.

Based on results of primary research, we built a complete House of Quality (Figure 3), which transforms customer requirements into the technical parameters of urban public transport services [8]. The service delivered does not match the sought service quality and this leads to preferring the individual car transport. Each of rated requirements is important for current customers but some of them are significant for people preferring individual car transport only. The research has detected the factors important when deciding whether to choose urban public transport or individual car transport. Figure 4 detects the improving service possibilities for routine commuters and for people preferring cars. The conjunction of two parts is in the middle of the figure. These factors are important for both categories. However, the current customers' satisfaction would also increase after improving the factors significant to customers preferring the individual car transport.



**Fig. 4 Possibilities for improving the quality of urban public transport**

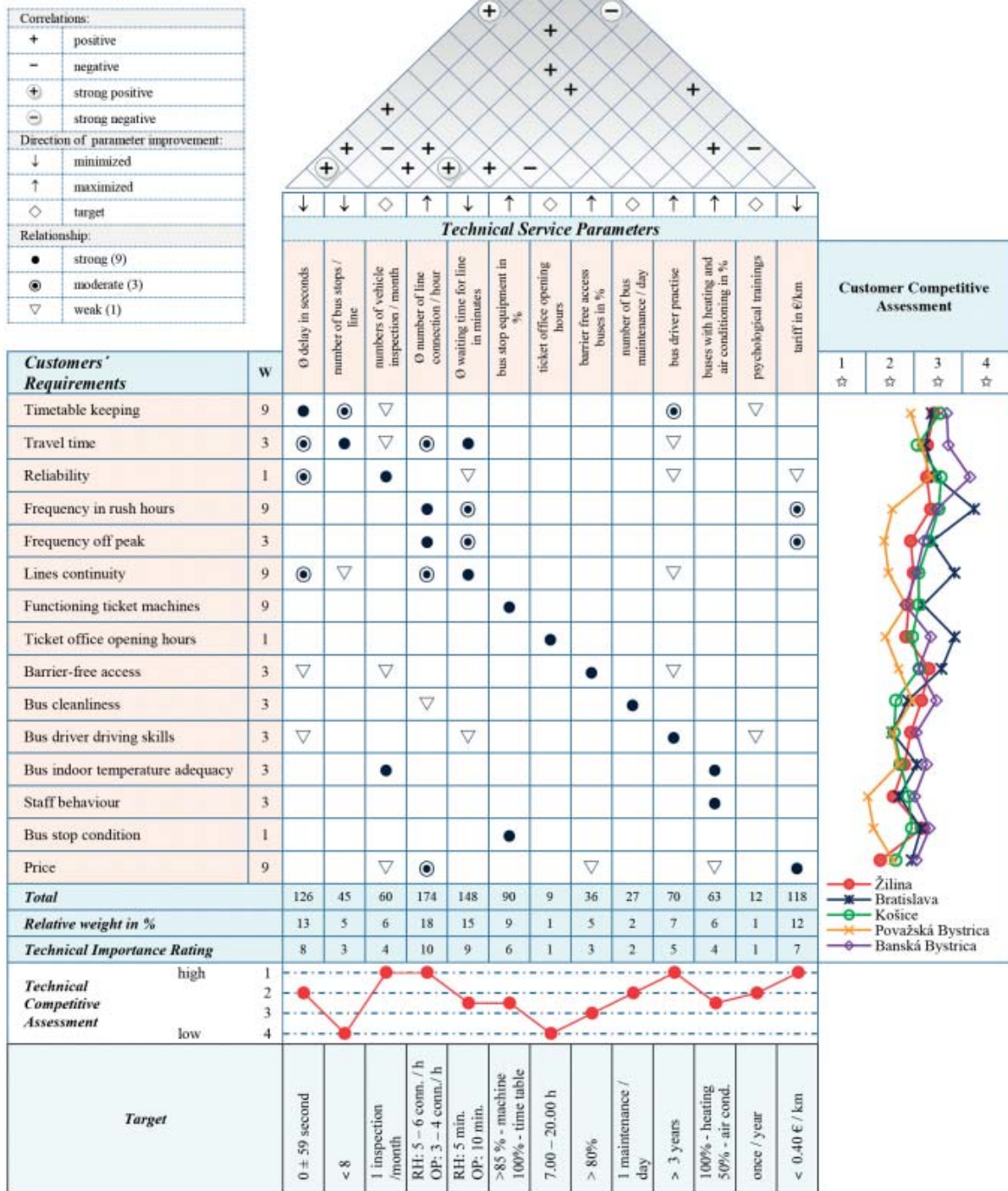


Fig. 3 Complete House of Quality

## CONCLUSION

The quality management system in DPMZ is not sufficient for the market needs and, therefore, the service operator should pay more attention to customers. In the deciding process, the reducing passenger numbers symbolize a bifurcation point. For both sakes (the operator and customers), it is necessary to upgrade the quality management system with the diagnostic support tools focused on customers and their requirements. Higher transport ticket prices along with higher quality of services - but still adequate to the ticket price - would affect the

customers' willingness to pay. It is necessary to increase the quality of the services provided, which would lead to higher customers' loyalty. When selecting an innovation, the major purpose to have in mind should be following:

- stabilisation of the quantity of passengers,
- improving the quality service provided,
- enhancing the customers' satisfaction.

The dynamic development of mobile technologies daily use and applications can support the level of quality services. The transport industry may be regarded as early adopters of new technology. Many researchers are realizing surveys oriented to the application of ICT in area of public transport. The development of technological tools and ICT platforms to support the emergence of Intelligent Transport Systems (ITS) penetrate the public transport sector. With high-quality urban public transport mobile applications, travelling can be not only a quick and easy way to move from A to B but also fun.

Worldwide, including Slovakia, there is increasing use of smartphones, and people are increasingly looking to use mobile applications rather than using websites to get the necessary service or purchase a product. Innovative technologies can contribute to increasing the interest of both citizens and passengers in using urban public transport. Today's pressure to reduce emissions, eliminate passenger car travel and the efforts of local governments and society to attract people to use urban public transport is leading by transport companies to seek the right forms of passenger motivation. Creating a full-value mobile application that offers interesting benefits to users is an effective motivational tool to support the use of public transport in cities.

#### REFERENCES:

- [1] Jankalova, M. Service Quality - Object of Business Excellence Measuring. In *Review of European Studies*. 2016, ISSN 1918-7173. - Vol. 8, no. 2 (2016), pp. 71-84.
- [2] Rostasova, M. *Kvalita služieb vnímaná zákazníkmi*. EDIS: Žilina, Slovakia, 2008; p. 74, ISBN 978-80-8070-894-8.
- [3] Mateides, A.; Dado, J. *Manažérstvo kvality*. Epos: Bratislava, Slovakia, 2006; p. 751, ISBN 80-8057-656-4.
- [4] Madlenak, R., Madlenakova, L., 2014. Digital advertising system in urban transport system of Žilina town. *Transport and Telecommunication Journal*, Vol. 15, no 3, 215 – 226.
- [5] Strenitzerova, M., Stalmachova, K. Customer requirements for urban public transport mobile application. In: 14th International scientific conference on sustainable, modern and safe transport - ISSN 2352-1465 (online). - 1. vyd. - Amsterdam: Elsevier, 2021. pp. 95-102.
- [6] Han, S. B., Ebrahimpour, M., & Chen, S. K. (1998). A hierarchical framework for QFD planning process. *DECISION SCIENCES INSTITUTE 1998 PROCEEDINGS, VOLS 1-3*, 1749–1749. <https://www.webofscience.com/wos/woscc/full-record/WOS:000083105000754>
- [7] Hari, A., & Zonnenshain, A. (1994). QFD for Service Improvement. V I. Sheps, H. Horwitz, & A. Lewis (Ed.), *TENTH INTERNATIONAL CONFERENCE OF THE ISRAEL SOCIETY FOR QUALITY, PROCEEDINGS, PTS I AND II* (s. 563–563). Isas International Seminars. <https://www.webofscience.com/wos/woscc/full-record/WOS:A1994BC60U00113>
- [8] Andriskova, I., Strenitzerova, M., 2014. The diagnostic support tool-quality function deployment and its implementation possibilities to urban public transport quality management. *Communications: scientific letters of the University of Žilina*. ISSN 13354205. Vol. 16, no 2, 63 – 69.

#### ACKNOWLEDGEMENTS:

VEGA 1/0333/24 Innovative business models in the urban circular economy