

Budapest University of Technology and Economics
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**EVALUATION POSSIBILITIES OF PERSONAL
TRANSPORTATION SYSTEMS IN URBAN AND
CONURBATION TRANSPORT**

Overview of PhD Thesis

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1. The precedents of research work

1.1 Actuality of the research work

The quality of public transport and quality evaluation are more and more highlighted in the case of urban and conurbation transport. Along with a growth in the motorisation level, car traffic has also risen, resulting in significant traffic congestion in urban areas. In parallel, the number of inhabitants in the commuter belt has also significantly gone up, which means an increase in the average length of journeys. Longer distance journeys have further raised the number of cars in urban and conurbation transport. Since the capacity of roads in urban areas cannot be raised in general, or even if capacity increase can be realised, a drop in traffic congestion has not been observed, that is why a wider use of public transport can give a solution. However, to achieve this goal, public transport should guarantee an adequate service level and an attractive quality.

To improve the quality level of urban and conurbation transport an obvious (clear, basic) solution could be the formation of transport associations. Good examples in several European cities and towns prove that without significant developments in infrastructure, but with an adequate legal background and a good cooperation of service providers, the service level of public transport can be highly raised. The first step should be to set up a tariff community of service providers. In this case passengers can already use transport means of any service provider in the same pricing and fare system. This should be followed by the harmonisation of timetables and the rationalisation of separate transport networks.

The use of marketing means can be a tool for raising the service level of public transport services. To achieve this goal an appropriate application of marketing tools is necessary, which cannot substitute the application of sufficient technical means. For this reason, public transport as a service must be examined, and marketing tools specified for these services must be used.

The evaluation of passenger transport systems means the examination of the quality of such systems. The quality of transport is often examined in several research projects and scientific publications. Most of these, however, examine some parts of the quality spectrum. In general, most of the quality evaluations are restricted to the comparison of numeral parameters. Their advantage is that comparisons can be relatively simply done with the analysis of relatively easily accessible data. In my dissertation I present the whole spectrum of transport quality, considering the aspects of all the groups participating in transport, by applying the ISO 2004.2 quality loop, taking into account the specialities of the built environment and the economic barriers. The quality loop presents gaps on the expected – targeted

– delivered – perceived qualities and the gaps between them. The relation between the targeted and delivered quality can be illustrated with the simplest tools. Mapping of the expected as well as the perceived quality can be done only with the analysis of the opinions of passengers and experts. Passengers, however, cannot be considered as a homogenous group, their expectations vary according to their revenues or ages. However, in the case of urban and conurbation transport there is no possibility to provide significantly different quality level services. At the most, it can be provided in case of long distance transport. That is why the evaluation and quality examination of urban and conurbation transport systems must be done with due foresight.

In case of urban and conurbation public transport, financing is also a problem. Neither the in-city transport nor some parts of conurbation transport are profitable activities. It cannot be made purely profit-oriented since several other social, city-planning, city operational and societal aspects must be considered. These make the realisation of an adequate public transport quality level more difficult. In case of urban transport, city self governments are in charge, while in case of conurbation transport the state is responsible for public transport between cities and towns, and local self governments are in charge of public transport within their cities and townships. Furthermore, the state (as well as a given self government) can give certain social political subsidies for passengers in need. Self governments as well as the state set the possible subsidies given by them on a yearly base, there is no unified financing model set up for local and regional public transport. That is why public transport is controlled by the society, where in line with the interest of service providers and passengers, the interest of the society (or any of its groups) also appears.

My dissertation aims to set up a unified system made from comparative methods used in other fields of the economy, and to examine the potentials of their application in the evaluation of personal transport systems, focusing on urban and conurbation transport systems. On the basis of the above, I considered outlining such applications that can be used with good result in practice, for this reason I give some specific examples to illustrate their real adaptability. With the help of this methods it is possible to analyse the vehicles of urban and conurbation transport from the aspect of passenger flow; as well as the evaluation of the targeted quality on the network (or sub network) of service provider is possible. It is also possible to compare the targeted and delivered quality.

In my dissertation I evaluate the results of a three-year research about the opinions of the perceived quality of public transport, which was done among the passengers who travel in the Budapest public transport system, and I analyse the results and the deducted consequences. With the evaluation data it is possible to compare the delivered and perceived quality. Furthermore, I present the comparative examinations nowadays used in international practice.

1.2 The method and results of the research

Quality can be evaluated in numerous respects in case of urban and conurbation transport. The three „participants” of urban public transportation are the service provider, the passenger and the society (or any of its groups). All the three participants set up different requirements regarding public transport quality (chapter 1). The actual and the future or possible users of the service have different quality requirements. That is why I grouped the users considering several types of aspects (residency, car owners and jobs) and I defined the requirements set for public transport quality. Afterwards, I set up a quality evaluation system of urban and conurbation public transport, and I drew a figure to present those barriers that impede the rising of service quality. This figure comprises all the factors in connection with quality.

In order to compare urban and conurbation individual transport systems I presented the evaluation methods already existing and used in other fields of the economy, and I pointed out its utilisation in public transport in Chapter 3.

In chapter 4 I revealed the marketing specifications of the services and I examined the main differences between services and physical goods, and I stated what kind of marketing specifications public transport service has. I revealed the relations between quality and marketing and I defined those reasons that most often lead to the loss of passengers. I found that due to the service providing nature of transport – since there is no possibility of piling up reserves, and external conditions mean significant influential factors – there is no possibility of providing a constantly same quality service.

In the European Union only England monitors the quality parameters of the bus and coach transport in London and nationwide. [16]. In Germany public opinion polls are made in Nürnberg, [23], and some examinations were made in Aachen regarding certain measures [22]. In chapter 5 the EQUIP (Extending the Quality of Public Transport) is also presented, which gives an opportunity for self evaluation of a service provider.

Taking the results published abroad into consideration, I elaborated two methods in chapter 6 of my dissertation, which evaluate the most important parameters of public transport systems. The first comparative method, elaborated in chapter 6.1., makes the comparison of the network, the operational and traffic features of a given public transport service provider possible. The elaborated method evaluates:

- the spatial availability
- the temporal availability
- the transport speed

- the travelling comfort
- the network features of the examined lines of a given public transport network.

After this, quality parameters are surveyed, which means a comparison to the targeted parameters, an examination of the actual quality parameters and of the manageability of the network. On the basis of these, the next step is the complex evaluation of the examined lines and network. If cross sectional traffic-count data are also available for the evaluation then the average value of both the targeted and the delivered quality can be determined.

The second method (6.2 chapter) evaluates the vehicles of urban and conurbation transport from the aspect of passenger flow. Usually the technical parameters (capacity of engines, energy consumption, maintenance costs etc.) are easily comparable numerals and figures. However, it is much more difficult to create figures regarding the use by passengers. Of course, numerical parameters are available here as well, like fleet level, number of doors, width of doors, number of seats and standing places, however, these figures on their own do not indicate the comfort of the vehicle. That is why aggregated figures must be made. I split the valid parameters into five groups:

- Door permeability, passenger swap speed, door order and distribution,
- Bottleneck rate and location in the vehicle,
- Seat quantity rate and location,
- Inner standing places, its quantity and location in the vehicle,
- Quality of satisfaction of peak hour transport demands,

Then I listed fifteen different quality factors in the above five groups. Out of these fifteen indicators an aggregated parameter can be calculated by two evaluation methods; one of the indicators will be a sum of marks while the other will be a sum of rates between 0 and 1. When comparing certain vehicles both methods can be used. In the case of the first method marks appear ranging on a clear scale of 1 to 5 linked to fifteen evaluation factors, and that is why this solution can be well surveyed, however, it does not reveal the either 6-8% differences in evaluation, which means the second method is more precise.

Evaluation of the perceived quality can be done only with questioning the passengers. That is why I carried out opinion polls among the passengers of the Budapest Transport Limited (BKV Rt.) at the same period of time of the year between 2002 and 2004 for three years. More than 3100 valid replies have come back. Passengers had to answer thirteen questions, in which quality criteria have been grouped in the categories below:

- Stops
- Vehicles
- Personnel

- General opinion.

The statistical analysis and evaluation of the obtained results are shown in chapter 7. During the evaluation I analyse the data according to sub-branches, the location of certain lines related to the city-centre, the types of vehicles, and in relation with elapsed time.

In chapter 8 of my dissertation I analyse each element of urban transport policies. This chapter aims to present those long term goals and objectives, with the help of which public transport can be provided at a high quality level and the total area of a city or town becomes an attractive job and dwelling place for the inhabitants.

2. Review of literature

The question of transport quality is dealt with in each transport policy that is nowadays used or exists only in the form of a plan. According to the European Transport Policy [6] „public transport should provide such comfort, quality and speed that people expect from it”, and mentions, that public transport should adapt to social changes and should meet the requirements at an adequate quality level in case if new residential areas and shopping centres built at the edge of a city. according to the European Union Committee a road toll system in urban areas can be introduced with a greather acceptance, if competitive alternatives are offered regarding public transport and infrastructure. A separate chapter of the transport development program of the Hungarian Transport Policy deals with transport quality titled „more modern transport, better service”. In the framework of this it aims to preserve the share of public transport in individual traffic by raising the quality level of its fleets, infrastructure and service. The Governmental Urban Transport policy Concept [30], which is under dispute mentions the development of quality and service level as one of the goals of urban transport policy.

The ECMT, European Conference of Ministers of Transport, also deals with quality [26], [27]. The „sustainable urban transport” project gives recommendations how to adapt urban transport strategies with success. It proposes priority to community cooperation and communication, and recommends the establishment of an adequate legal background, the establishment of accurate financial structures and the review and checking of data collection linked to transport.

In German speech area Rüger, professor of the Drezda Technical University, dealt with the quality of transport [97-100]. Cerwenka, professor at the Vienna Technical University, examines transport demand flexibility [18], [19]. Hertel and Fischer did research in the field of quality insurance and service quality [28], [29]. Lohse deals with theoretical transport planning and its computer simulation [101].

In Hungary Kövesné, head of the Department of Transport Operation at the Budapest University of Technology and Economics (BUTE) has done research in the questions of transport quality for more than a decade. Her work and results can be found in several conference proceedings and publications abroad [57-59], and in several publications and book chapters [47-56], [60], [61], [100] in Hungary. Tánczosné working at the Department of Transport Economics of the Budapest University of Technology and Economics (BUTE) both evaluates transport systems on a multi-criterion basis [107], [111] and does research in the field of social costs of transport [105], [108]. Her international research points out the necessary developments to be carried out in Hungary in order to integrate into the European Union [109], [110].

In connection with several practical projects Monigl examines the possibilities and conditions to set up a Budapest Transport Association, and also examines its pricing and fare system – in special regard to electronic fare paying systems - [77-79]. Above this he elaborates a necessary methodology to survey the features of transport habits [75]. He is the Hungarian participant in the QUATTRO (Quality approach in tendering/contacting urban public transport operations) project by doing research on the quality of individual transportation systems. [76] His work is also significant in connection with urban transport policy, and in the field of financing and managing of urban and conurbation transport [80-82], [84].

Prileszky at the István Széchenyi University in Győr examines the relations between service providing level and efficiency [90], and works out an evaluation methodology for a complex efficiency examination of public transport developments [h120].

Bősze from the side of a public transport operator, working at the Budapest Transport Limited (KV Rt.) analyses the practical realisation of the transport development concept of the Capital as well as describes the possibility of the realisation of an adequate quality level public transport service in practice [12], [13]. Jangel also examines quality from the service provider's side [38].

Rixer deals with quality questions about rail transport in several of his publications, furthermore he does research in the quality management of individual transportation public services [96]. He also deals with the questions of forming transport associations mainly presenting examples from the European Union [95].

Havas publishes about drawing up features of travelling habits on the lines of Hungarian Railway Limited (MÁV Rt.) and VOLÁN (nationwide coach lines) as well as publishes the results of questioning passengers [33], [34].

The author joined the research going on at the Department of Transport Operation of the Budapest University of Technology and Economics (BUTE), his research results have been published in two book chapters in Hungary [69], [70]; in national and foreign articles and conference proceedings [66-68], [72], [73].

General marketing features of the services have been dealt with by Veress, tutor at the Corvinus University of Budapest. He gives a detailed analysis of the service features from the aspect of marketing and presents those methods that improve the already existing service level with the help of marketing tools [119]. Marketing features are also examined by Chikán [20] and Grönroos [31].

The multi-criterion comparative methods are surveyed by Kindler and Papp [42]. They establish a common method, which has been frequently used so far in case of multi factored evaluation. Kaufmann [40] deals with the economy of optimal decisions. The comparative methods and their adaptability in practice and their software support are discussed by Rapcsák from the Computer and Automation Research Institute of the Hungarian Academy of Sciences [94].

3. New scientific achievements and thesis

The new scientific results elaborated in my dissertation are summarised in the theses below:

1. I elaborated an evaluation method to assess operational and transport features of a public transport service provider.

The elaboration of a model to compare targeted and delivered quality makes the comparison of targeted and the actually delivered services of a provider possible. In order to test the model the current parameters have been examined first. In this framework, the examination of the spatial and temporal availability of certain lines, and the complex evaluation and verification of transport speed, travelling comfort as well as network features of an examined line is also carried out. Then this model analyses the relation between targeted and delivered quality. With the help of this model each line can be characterised by a number, which enables both the evaluation of lines compared to each other and the evaluation of each network. Thus the comparison of transport networks of cities, townships and their regions becomes possible. I also presented the typical service level values in the European Union, thus useful information can be obtained not only in comparison with other service providers, but also in case of one service provider (Subsection 6.1).

2. I developed a complex methodology to qualify passenger flow features of public transport vehicles

This method makes the comparison of urban and conurbation transport vehicles regarding passenger comfort possible. During the counting, all the parameters of getting-ons and -offs, as well as placements in vehicles are examined. This method primarily evaluates how passengers can approach vehicle doors, and to what extent the inner setting of vehicles helps the even distribution of passengers, especially

considering physically challenged people and passengers with prams and push chairs. I determined the expected minimal values for each feature taking the data from literature into consideration, and then I formed altogether fifteen quality features that can be turned into numerals. I developed two methods to set up an aggregated index from these fifteen parameters, taking into account that in case of certain indices the minimal value while in case of others the maximal value has proved to be the best (Chapter 6.2). The method has been justified by adapting in a given example, in which two types of trams have been evaluated.

3. I stated based on the examination of passenger opinions, in which area of public transport marketing actions arrangements as well as improvement in technical managerial parameters must be done.

More than 3100 passengers have been questioned since 2002 for three years. Passengers had to answer thirteen questions listed in four categories by giving marks ranging from 1 to 5. The survey was carried out at tram, bus and local train stops of the Budapest Transport Limited. I found out during the statistical evaluation of data, that no extreme evaluations have occurred in passenger opinions, and in most areas results were in concordance with the values that can be measured objectively. In case of some quality parameters the promotion of existing good indices is a must, while in other areas (especially in case of crowding) the level of delivered service must be raised. The evaluation method formed during the evaluation of the questionnaires about quality makes the comparison of delivered and perceived quality possible (Chapter 7.).

4. I determined the quality requirements set by the passengers travelling by urban and conurbation public transport, and established that from the particularity of urban and conurbation public transport an unified quality cannot be provided.

I examined transport quality from the sides of the society, the service provider, and the user. I found out that demands of each participant differ in certain respects, and that is why each party must reach an acceptable compromise, since public transport serves a long term social benefit. I split the participants in public transport into groups according to their activities and I analysed their requirements set for this service (Chapter 2.). Considering the results of the questionnaires in Budapest I stated that in case of urban and conurbation public transport the primary goal is to keep passengers, while in case of people in active age period more and more passengers must be attracted. I stated as well, that service providers must meet different requirements in urban and conurbation areas (Chapter 7.), and that an unified quality cannot be provided due to the nature of this kind of service, this quality will vary within a certain range. The aim is to hold this quality in a determined province.

4. The author's technical literature connecting to the dissertation

Part of Book:

Mándoki P.: A térségi személyközlekedés fejlesztésének infrastrukturális hatásai. Magyarország az ezredfordulón – Stratégiai kutatások a Magyar Tudományos Akadémián – Városi és térségi közlekedés 2000. p. 37-57.

Mándoki P.: Közlekedési rendszerek értékelésének egységesítési kérdései. – Stratégiai kutatások a Magyar Tudományos Akadémián (megjelenés alatt)

International publications:

Tóth J. - Mándoki P.: Transportation data in database system. Computeranwendungen für Straßenentwurf und Verkehrsplanung 1995. p. 81-88. Graz, Technische Universität Graz, 1995.

Mándoki P.: Qualität im Verkehrswesen besonders im ÖPNV. Europäisches Institut für postgraduale Bildung p. 1-45. Technische Universität Dresden, 1997

Articles in learned journal:

Mándoki P.: Tömegközlekedési alágazatok összehasonlító vizsgálata a fővárosi agglomeráció térségében. Városi Közlekedés XXXV. évf. 1995/5. p. 285-289.

Kövesné dr. habil. Gilicze É. – dr. Havas P. – dr. Debreczeni G. – dr. Tóth J. - Mándoki P.: Költségekímélő számítógépes utasforgalmi adatfelvételek. Városi Közlekedés XXXVII. évf. 1997/1. p. 21-25.

Kelemen Zs. - Mándoki P.: Forgalmuszimulációs modell alárendelt csomópontra. Városi Közlekedés XXXVII. évf. 1997/2.p. 94-96.

Mándoki P.: A közforgalmú közlekedési rendszereket értékelő módszerek. Városi Közlekedés XLIII. évf. 2003/4.p. 189-194.

Electronic publication:

BME Közlekedésüzemi Tanszék munkaközössége (Kövesné dr. Gilicze Éva – Dr. Tarnai Júlia – Dr. Debreczeni Gábor – Dr. Mészáros Péter – Dr. Tóth János – Mándoki Péter) „A fenntartható városi mobilitás feltételrendszere” elektronikus jegyzet. 2001. november

http://www.kku.bme.hu/frame_h.html p.123-133.

