ISSN 1648-4142 / eISSN 1648-3480

VILNIUS TECH
Vilnius Gediminas Technical University

TRANSPORT

2023
Volume 38
Issue 2
Pages 116–126
https://doi.org/10.3846/transport.2023.19736

Original Article

IMPACT OF PUBLIC PASSENGER TRANSPORT ORGANIZATION MODEL ON SYSTEM PERFORMANCE AND SERVICE QUALITY

Pavle PITKA, Milan SIMEUNOVIĆ✉, Ivana MILENKOVIĆ, Milja SIMEUNOVIĆ, Ivan ŠKILJAICA

Dept of Traffic Engineering, Faculty of Technical Sciences, University of Novi Sad, Serbia

Highlights:

- limited competition model can lead to an increased efficiency of the public transport;
- continuous analysis of the transport operation leads to permanent user satisfaction;
- transition from the regulated regime to the Scandinavian model increases demands;
- Scandinavian model presents a positive base for solving transport problems in Serbia.

Article History:

- submitted 24 December 2018;
- resubmitted 29 April 2019;
- accepted 18 July 2019.

Abstract. Organization and management of Public Passenger Transport (PPT) system is a complex process, which significantly impacts the functioning of the system. Globally, there is no unique solution for organization model of PPT, but the organization models are adjusted to the characteristics of each individual area. Organization model of PPT, inherited from the self-management system of the former Socialist Federal Republic (SFR) Yugoslavia, became unsustainable in the Municipality of Inđija (Serbia) and did not fulfil transport needs and demands of passengers regarding the amount of transport and its quality in optimal manner. Old organization model has been replaced by a new modern model, based on positive experiences from developed European cities. Article presents the impact of new organization model of PPT on the work of the system. Research has been conducted in order to determine the state of both old and new system's organization model by counting and interviewing passengers during years 2008 and 2017. In accordance with the changes made in the system, comparative analysis "before and after changes" has been done along with establishing of the effects of changes on functioning of the system and service quality. Results show significantly improved service quality, while transport demands increase by 38.3%.

Keywords: public transport system, performance, public transport service quality, public transport regulation, bus subsystem, Scandinavian organization model, working parameters.

✉Corresponding author. E-mail: *milansim@uns.ac.rs*

Notations

Abbreviations:

PPT – public passenger transport;
SFR – Socialist Federal Republic.

Variables and functions:

C – line capacity [spaces/h];
P_u – total number of transported passengers on a line [passengers/h];
q_{max} – maximal flow of passengers achieved on a characteristic section of a line [passengers/h];
α – capacity utilization coefficient [passengers/spaces];
η_{sm} – passenger exchange coefficient on a line.

Introduction

Functioning and state of the PPT depends on the managing and organization model of the system, i.e., the chosen organization model of the system. Inappropriate organization method can cause numerous problems, which can be reflected on the functioning of the whole system. In the last several decades, a large number of cities in the Western Europe, with organized systems of public transport, have experienced serious reorganizations (Van de Velde 2001, 2014). The changes occurred because the city-owned PPT companies had no competition and were not efficient enough. The aim of the resulting changes was to acquire new customers by raising the quality of public

transport service system as a condition for the more efficient system functioning and preservation of the quality of life in the cities. Moreover, the resulting changes in the system organization also aimed at the improvement of cost and economic system efficiency. More efficient system functioning was achieved with the new system organization and management methods in controlled conditions. There is no global unique method for organizing the PPT system. Instead, organization system is adjusted to the characteristics of each individual area. Organizational forms, i.e., public transport system models in Europe differ from country to country but they still have several common characteristics. These common characteristics are based on the coordination of the transport service in the city and suburban area, competition between transport companies and stable resources of financing their current operations and development. Based on available literature, a conclusion can be drawn that there are 3 basic concepts, i.e., groups of organization models of the public transport system market, and they are a regulated regime model, limited competition regime model, and deregulated system model (Zatti 2012).

Regulated regime model is a classic model of public monopoly. Monopoly over PPT can be held by public or private operator (Vuchic 2005). Global experience shows that public monopoly does not present sustainable PPT system. Main disadvantages and problems of regulated regime model are: low efficiency, low level of investments into vehicles, low service quality, high influence of politics on bus operations, operator can become more powerful than regulatory authority.

Limited competition model has 2 variations. 1st variation of the model refers to various forms of tender for lines, when local governments elect the operator with most favourable conditions, i.e., lowest costs with the quality of transport service defined in advance. This type of system organization is known as Scandinavian model (Mathisen, Solvoll 2008; Van de Velde 1999). Scandinavian model is based on minimum subventions and contracts with minimum expenses for a certain number of lines, when one or more lines are tendered and the contract period is different. Positive side of this model is realization of production efficiency of the operator and a unique integration of transport services. Negative side would be a lack of systematic competition on a tactical level. 2nd variation of the limited competition model regime refers to contracts for line network management of one or more subsystems with additional stimulations/sanctions that are stipulated in the contract, and this model is known as the French model (Van de Velde 1999; Yvrande-Billon 2006; Roy, Yvrande-Billon 2007). As per French model, the local government elects transport policy and is responsible for the functioning of the system, makes decisions about the concessions index and work assessment parameters of operators. The key characteristic of this model is that there is no competition on the specific line network so that if more transport operators offer a transport service, they can operate in only one transport area. Positive side of this transport organization system is an easy integration of the transport service, whereas the negative side is the limited support for the work efficiency, limited costs of tender for potential bidders, and a possibility of information misuse during tender, i.e., election of the operators with the least favourable conditions. Experiences of many countries show that limited competition model has a great impact on improvement of system's performances and cost savings. Research conducted in Great Britain, Scandinavia, United States of America, New Zealand and Australia have shown that the unit costs are reduced in the range from 5 to 50% (Hensher, Wallis 2005). The general effect of competitive tendering on cost reduction is proven in empirical studies of the Norwegian bus industry (Bekken *et al.* 2006; Carlquist, Johansen 1999) and in several other developed countries (Button, Hensher 2005). Experience from Sweden also shows that, by using this model of organization of public transport system, the costs are reduced up to 13% (Alexandersson *et al.* 1998). Tendering typically gives around 20% reduced unit costs compared to a situation of an unchallenged public monopoly operation (Button, Hensher 2005). Alexandersson & Pyddoke (2004) have evaluated the results of 15 years of competitive tendering in Sweden, indicating a long period of decreasing costs and a substantial change in operators structure, which benefited the public transport authorities. Furthermore, Sharaby & Shiftan (2008) determined that the actual savings in real cost per vehicle-km were in the range of 18...46% after implementing competitive tendering in the public bus transport in Israel. According to empirical evidence from German local bus transport, Augustin & Walter (2010) and Beck (2011) have concluded that competitive tendering has positive influence on increase in the average number of competitors, which provide offers and high probability of changing the operator. The number of competitors that provide offers is an indicator of the attractiveness of a tender. With higher number of competitors it becomes more probable that one competitor will provide better offer than the current one, which leads to a change in the operator. Evidence from the Netherlands shows that in 26 tenders from 2001 to 2004, 66.6% lead to a renewal of the incumbent. The average number of bidders is equal to 3 (Stoelinga, Hermans 2006).

Deregulated regime model, known as the British model, is considered as the free-market model based on the competition between the transport line operators. It is applied in approximately 85% of subsystems in Great Britain, whereas London and other countries of the Western Europe have not utilized this type of organization in their public transport systems (Beesley 1991; Savage 1993; Mackie *et al.* 1995; Mackie, Preston 1996). Deregulated system model was implemented in 1985, as a result of the Transport Act. The key characteristic of this model is that, it is the model of operators' competitiveness in the transport market, and that the interventions of the local government are only limited to setting up safety standards of transport services and other institutional regulations. Deregulation did not have a large, expected impact on the increase of

competitiveness between the operators because the tickets fares were not regulated. Therefore, the bus deregulation enabled large transport operators to introduce low ticket fares causing small transport companies to operate ineffectively. This resulted in the small companies ceasing operations and larger transport operators benefiting. They introduced higher ticket fares and increased their profit on the account of passengers who were not protected from this monopoly misuse. PPT organization in London is based on the Scandinavian model so many authors have been comparing the efficiency of the PPT in London to the deregulated system used in other parts of Great Britain. According to Preston & Almutairi (2013), after deregulation, a number of passengers in London increased by 87%, while the number of passengers in the other parts of Great Britain decreased by 31%. They also found that real costs in London decreased by 28%, while the number decreased by 20% in other parts of Great Britain. Real fares in London increased by just 15%, while they increased by 55% outside London. Subvention in London increased by 84% but the rest of Britain had only 5% increase, Services in London increased by 87%, but increased only 20% outside London. If we consider the public transport bus operation system a commercial company that aims at reduction of concessions, deregulation is a success. On the other hand, if we believe that a system should function as an integration element and that it aims to serve a maximum number of journeys, deregulation in Britain is a failure.

The system organization model of PPT in municipalities of the Serbia is inherited from the self-management system of the former SFR Yugoslavia has not changed or improved over the past several decades. Today, this system cannot respond to the needs of the modern man and the new demands of the economy and society in the right way. Public transport system in the Municipality of Inđija (Serbia) had the characteristics of the regulated model regime, which failed to follow the intensive industrial development of the municipality and the increase of population standards. Therefore, there was a large socio-economical interest in organization and implementation of one modern public transport system that will operate according to the passengers' needs. Inđija is one of the 1st municipalities in the Serbia, which applied positive experiences of other countries in solving the problem of the functionality of the PPT bus subsystem. Accordingly, the purpose of this article is to present the optimized way of system organization with implementation of the Scandinavian organization model, and also to show how, with the system working parameters and passengers' satisfaction with the transport service, the utilization of this new model affects the functioning of the system and the quality of the service in the observed area.

This article consists of several chapters. After introductory part, the 1st chapter describes how the research of system's characteristics has been conducted, which include counting and interviewing passengers. 2nd chapter shows the problems of the functioning of PPT in Inđija, the state of the system before the change in organization model, and the state after the change in organization model. Comparative analysis of basic parameters of the system's operation is presented in the 3rd chapter – this chapter analyses transport demands and transport needs of passengers and it determines the effects of changes in the functioning of the system and service quality. Last chapter, based on conducted research, presents concluding considerations.

1. Research methodology

Municipality of Inđija is in the Serbia in the Srem Administrative County and it covers the area of 385 km^2. It consists of 11 local communities, and the Head of the municipality is in town of Inđija. According to the last census from the year 2011, the Municipality of Inđija has 47433 inhabitants, of which 26025 inhabitants live in the municipal center. Inđija is situated on arterial road M22-1 Subotica – Belgrade, 42 km from Belgrade and 35 km from Novi Sad.

PPT system on the territory of Municipality of Inđija is based on buses. Transport of passengers is conducted by solo buses, with the capacity of 60 passengers and 2 doors.

Research for the Municipality of Inđija has been done during 2 periods, before and after the implementation of the new PPT organization system, during the years 2008 and 2017 (Simeunović *et al.* 2009, 2017). Research methodology has been the same for both periods (Figure 1). During one authoritative day research has been conducted on all the lines for all completed departures. Research has been done inside the vehicle, manually, by the researchers (counters and interviewers).

Preliminary phase of the research included preparation of materials for counting, assigning and training of counters and interviewers, assigning and training of controllers, which were at bus stops taking materials from counters and interviewers for each line after each cycle. Counters recorded boarding and alighting of passengers into prepared counting forms. Recording boarding and alighting has been done in such a manner that each door had an assigned counter recording changes at each bus stop.

Apart from counting, within the framework of the research of PPT system's functioning, there has been a survey for the users of the PPT system on all the lines within the Municipality of Inđija. Survey has been done in order to determine users' opinion on quality of transport service, as well as their opinion on desired quality level. The survey has been performed by directly interviewing the users of PPT, according to the predefined questions within the framework of questioner. Survey of users has had 3 groups of questions for users. The 1st group contains data on user (gender, age and professional condition). The 2nd group contains data on characteristics of the trips (frequency of journey, scope of journey and ticket type). The 3rd group of questions contains data on service quality (evaluating general state of service quality of existing PPT system and

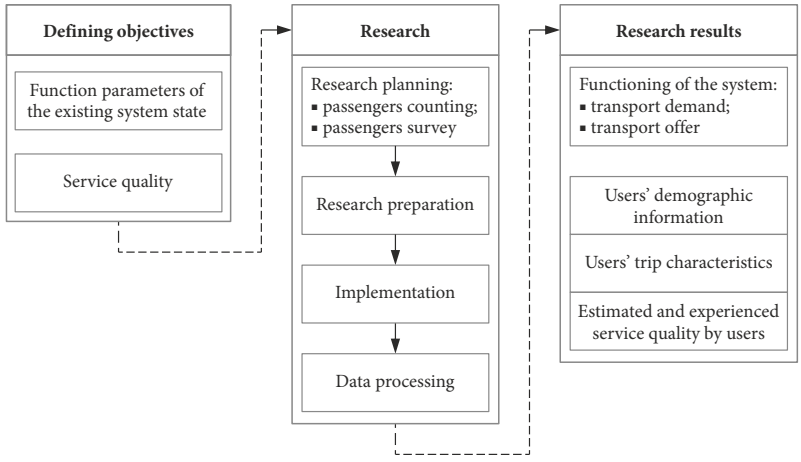

Figure 1. Flow chart of research methodology for years 2008 and 2017

its drawbacks, and satisfaction with the existing number of departures). Interviewees have been randomly chosen, while it has been planned that the sample is representative so that the obtained data reflects the state of the whole system. The plan envisioned that at least 5% of users of PPT system should be interviewed. According to the research from the year 2008, 3863 passenger daily trips have been realized within the PPT system and 330 of them have been interviewed, which represents sample size of 8.5%. According to the data from the research conducted during the year 2017, counting has determined 5341 passenger trips per day, while 459 of them have been interviewed showing a sample size of 8.6%.

After data acquisition has been finished data base has been formed in *Microsoft Excel* and it has been processed in the same manner for both research periods 2008 and 2017. Based on this, it was possible to present comparative analysis of working parameters of the system.

2. Transport regulation and organization

The role of PPT is to enable realization of one of the basic needs of the population, the need for movement. PPT is often, for large part of the population, the only possibility to realize the transport needs. Problems occur when this system does not function according to the needs of the passengers, which was the case with the Municipality of Inđija. Numerous problems in functioning of the PPT system refer to: reduced availability of the system in space and time; de-synchronization of transport demands and capacity; unreliable functioning; great deviations from time tables; headway uniformity of movement; increase of time spent in the system; reduction of comfort and safety of the passengers; inability of providing basic information towards users; increased costs of current operation etc. This PPT system has derived from the self-management system of the former SFR Yugoslavia and it was necessary to establish a new management and organization model in order for the system to adapt to real needs of the passengers.

In order to establish new organization model, 1st of all it was necessary to determine the current state of the system. Based on the results of research conducted during 2008 was determined that it was a classical system (Simeunović *et al.* 2009, 2017). All the decisions on a strategical, tactical and operational level were made by the Operator, while municipal authorities had no influence on decision making. Transport itself was operated by the Transport Company "Lasta" from Belgrade along the complete network of lines, which consisted of one urban line (Industrijska) and nine radial suburban lines: Inđija – Novi Karlovci; Inđija – Stari Slankamen; Inđija – Slankamenački Vinogradi; Inđija – Krčedin; Inđija – Beška; Inđija – Čortanovci; Inđija – Maradik; Inđija – Jarkovci; Inđija – Ljukovo. Large number of lines had overlaps due to their radial nature. The network of lines and time tables had not been changed for quite a long time period and sectional tariff system was used. Towards certain communities, the lines only had departures during peak periods. Municipality of Inđija financed the cost of transports for pupils. Ticket prices and tariff system were inherited from the previous times and local authorities had no influence on them.

After the state of the PPT system was determined, it was necessary to design and implement the new system, which would be capable of satisfying the transport needs and demands of passengers, create conditions for increasing the quality of transport service, and bring it closer to the service quality of PPT in the cities of developed European countries. The new, significantly changed and improved PPT system was implemented in July 2011. The changes have been comprehensive and before all they were aimed towards management and organization. Inđija's new PPT system is based on Scandinavian organization model (limited competition model), i.e., choosing an operator the lowest price per vehicle-km, with a predefined transport service quality and other terms that operator needs to fulfil.

At an open tender for an operator, the old one, Transport Company "Lasta" from Belgrade, was selected. By

changing the organization model of the system, the risk of achieving profit has been switched from the operator to municipality management. The operator didn't have any interest in optimizing the network of lines in the previous organization models, i.e., that they didn't want to take the risk and change by making the profit through reduction of the costs. According to the adopted Scandinavian model, the municipal management makes strategic and tactical decisions of significance to the system. After adopting the Scandinavian model, the municipal management has optimized the network of lines (Figure 2). The complicated network of lines with many overlapping has been simplified and adapted to the transport needs of passengers, and towards planned increase in transport demands. The reconstructed network of lines has been organized with 2 urban and 2 suburban lines with an average interval of half an hour in peak periods. The route of the basic urban line connects all the parts of town of Inđija, with transport of passengers organized in 2 directions (Grad A and Grad B). "Industrijska" line is the 2nd urban line, whose basic purpose is to transport workers to the North–East work zone. Suburban transport of passengers is organized with 2 lines. "Kružna" line is a circle route line with the transport of passengers organized in both directions (Kružna A and Kružna B). Kružna line connects most communities in the municipality. Inđija – Jarkovci – Ljukovo line is radial.

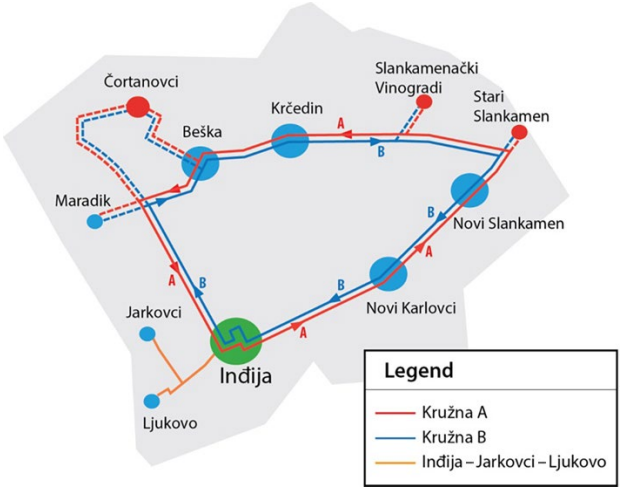

Figure 2. The reconstructed lines network

Time table for all the PPT lines in the Municipality of Inđija schedules 97 departures. Sectional tariff system has been replaced by the zonal tariff system, with 3 tariff zones, which has significantly simplified paying and income controlling processes. The new tariff system hasn't significantly changed the ticket prices. Table 1 presents the characteristics of both old and new PPT systems.

New organization method had a goal to return the possibility of management of the system, on a strategical and tactical level, to the Municipality of Inđija. Changes made on the line network have significantly improved accessibility to PPT both in space and time. Total number of km has been increased by 18%, while the annual subventions have been increased by 150000 €.

3. Comparative analysis of working parameters

Within frameworks of research from 2008 to 2017, which included counting and interviewing passengers, transport demands and transport needs of passengers have been researched on all the lines of the PPT (Simeunović *et al.* 2009, 2017).

Based on the obtained data, the basic working parameters of the PPT system (number of passengers, passenger exchange coefficient on a line, capacity utilization coefficient) have been calculated for both research periods. By comparative analysis of basic working parameters, the effects of performed changes have been determined on the functioning of the system. All the results for line "Kružna" and line "Grad" are given separately, by directions.

There are 3 interest groups in the PPT system: user, operator and municipal management. In this article, the service quality has been observed from the aspect of the user. Comparative analysis of users' opinions has been performed based on data obtained from the surveys, while the following parameters have been used: assessing the level of service quality of transport service and drawbacks of the PPT system.

Table 1. Overview of the basic characteristics of both old and new PPT systems in Inđija

System characteristics	2008 year (Simeunović *et al.* 2009)	2017 year (Simeunović *et al.* 2017)
Number of lines	10	4
Number of departures (work days)	140	97
Number of transported passengers (work days)	3863 passengers/day	5341 passengers/day
Transportation work (work days)	2444 vehicle-km	2967 vehicle-km
Transportation work (yearly level)	773472 vehicle-km	912958 vehicle-km
Subventions (yearly level)	254000 €	402000 €
System management	strategic tactical and operational levels: operator	strategic and tactical level: municipality
		operational level: operator
Tariff system	sectional	zonal

3.1. Transport demand

Passengers' daily transport demands have been analysed per each line and in both models of system organization, i.e., in the regulated regime model, and after that, when this PPT model of system organization is replaced with the Scandinavian model.

According to the results of passenger counting from 2008 (regulated regime model), it has been determined that, on the territory of the Municipality of Inđija there are total of 3,863 passengers per day, that have both origin and destination within the territory of Municipality of Inđija. Counting from 2017 (Scandinavian model) noted 5241 passengers per day within the whole system. According to this data (Figure 3), it can be concluded that the number of passengers per day has been increased by 38.3% in the year 2017 in comparison to the year 2008.

One of the important parameters that describe the functioning of PPT system is a passenger exchange coefficient on a line, which shows the average exchange of passengers per one space in vehicle from the 1st to the last station (Banković 1994). The lowest value of this coefficient is 1.0 and this relates to the situation when there is no exchange of passengers along the line, i.e., when on a certain part of line there are only passengers boarding, while on other part there are only passengers alighting. Theoretically, the highest possible value is equal to the number of stops on a line and it relates to the situation with full passenger exchange from the vehicle. Passenger exchange coefficient is calculated according to the equation:

$$\eta_{sm} = \frac{P_u}{q_{\max}}. \quad (1)$$

The value of passenger exchange coefficient in the year is 1.0 as the lowest, and 1.3 as the highest, while in the year 2017 the passenger exchange coefficient is from 1.3 to 1.7 range. The average value of passenger exchange coefficient for the research period has increased from 1.2 (standard deviation is 0.104) to 1.48 (standard deviation is 0.147) (Figure 4).

Capacity utilization coefficient of a vehicle α presents the utilization of capacity on the most heavily burdened section of the line. Characteristic section of the line is the one between 2 stops with the maximal flow of passengers. This coefficient reflects the comfort of passengers on the line, and it is calculated according to the equation:

$$\alpha = \frac{q_{\max}}{C}. \quad (2)$$

Based on results obtained from the research, the values of the capacity utilization coefficient of vehicles per lines (Figure 5) are extremely low during the year 2008 in comparison to those from the year 2017. Average value of the capacity utilization coefficient on a characteristic section of the line from the year 2008 is 0.39 (standard deviation is 0.149), while in the year 2017 it is 0.85 (standard deviation is 0.166).

3.2. Transport needs

PPT service quality can be measured in different ways, with the most common being based on the user opinion, expressed in terms of satisfaction and importance, assigned to the various service characteristics (De Oña *et al.* 2014).

According to authors Wang & Shieh (2006), the quality of the service is defined as the user satisfaction with the service based on the degree of perceived quality. For evaluating the service quality of the system, and for determining the desired service quality from the system users' point of view, survey of PPT users' opinion, about the service quality, has been conducted. The survey has been conducted for both research period, i.e., the period when

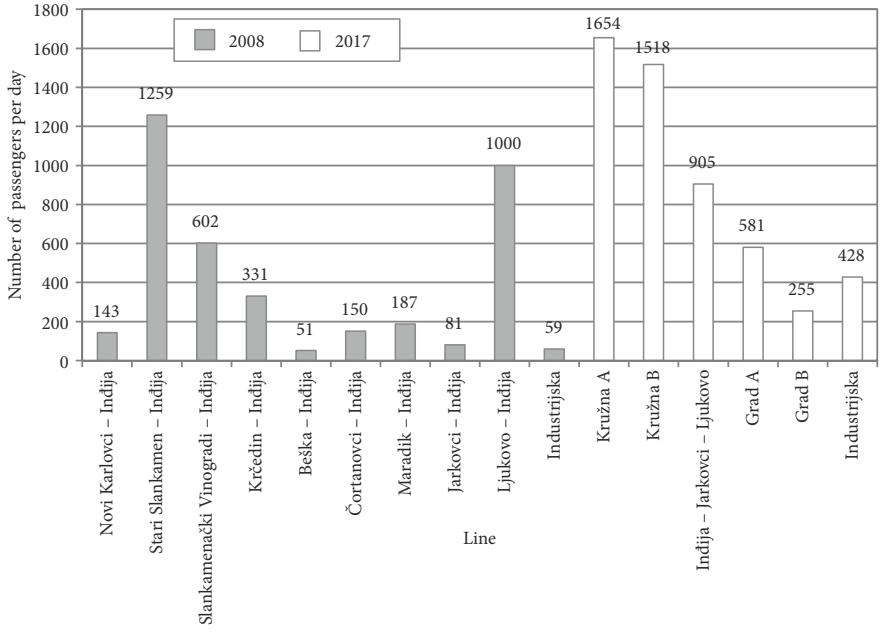

Figure 3. Passenger volume per lines within a day

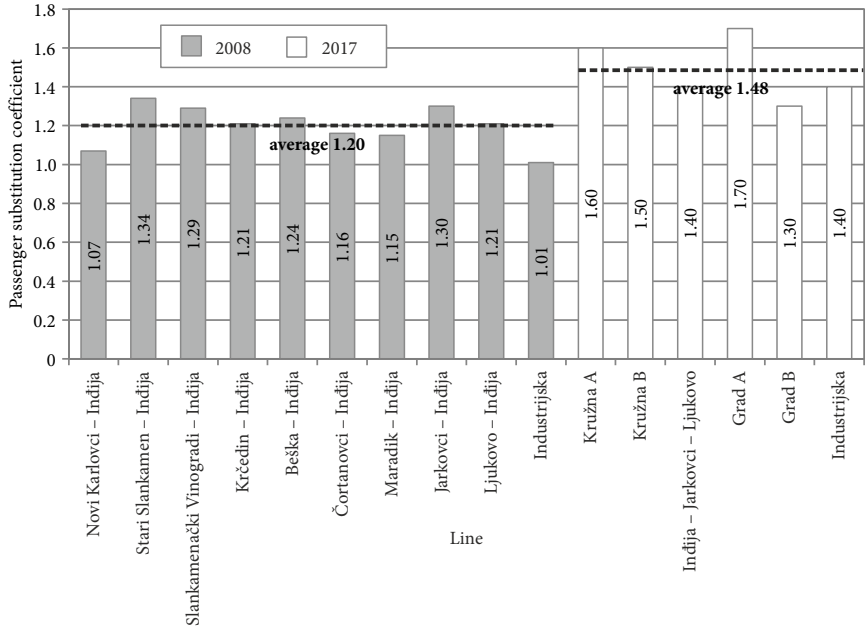

Figure 4. Passenger exchange coefficient per lines

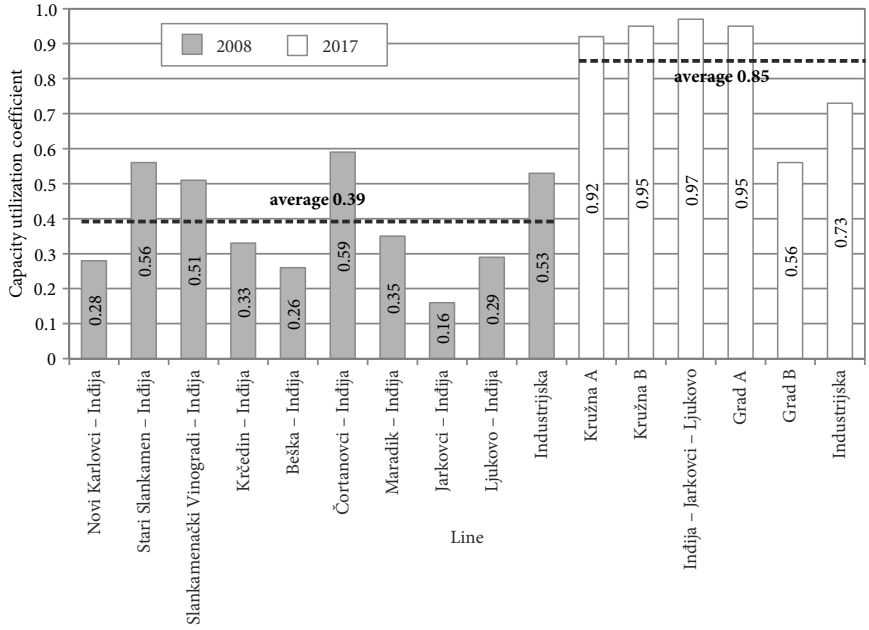

Figure 5. Capacity utilization coefficient on a characteristic section of the line

PPT system operated in the regulated regime model and the period when this method of organization was replaced by the limited competition model (Scandinavian model), in order to determine the effects of the changed system organization method on the quality of the transport service.

Characteristics of interviewed PPT users and their trips are presented in Table 2. From the total of 330 interviewed passengers in the year 2008, 48.5% were male, while 51.5% were female. Research conducted in 2017 showed that from the total of 459 interviewees, 60.6% were male and 39.4% were female passengers. According to the research conducted in 2008, the most interviewed passengers were under 18 years of age, i.e., 31.8%, followed by 27.6% of those aged from 19 to 30, while the least interviewed group were passengers over 65 years of age, 3.3%. According to the research results from 2017, the most interviewed passengers were aged from 19 to 30 and those under 18, 26.2% and 25.4%, respectively, while the least interviewed passengers were those 65 years and over, 7.9%.

Number of employed users increased in year 2017 in comparison to year 2008, and it was 44.2%. Number of pupils was higher in year 2008, it was 32.7%, while in 2017 it was 24.6%. Percentage of students was reduced in 2017, while percentage of retired users was increased to 21.2%.

Number of retired users increased due to the fact that, with the change in organization model, the municipal management provided free bus passes for this user group. Number of unemployed users was reduced in 2017 and in was 6.3% of total number of interviewed users. Parallel analysis of the users' trips has also been presented for both research periods. Different purposes of the trip were studied. As shown in the Table 2, 24.2% of interviewed passengers stated the purpose of the trip as "going to work" in 2008, and 32.0% in 2017. Percentage of interviewed passengers stating the purpose of "come back come" trip in 2008 was 29.7%, and 20.9% in 2017. Purpose of the "school/faculty" trip show more interviewed pupils and students in 2008 than in 2017, i.e., 24.5% in 2008 and 15.5% in 2017. A number of users of "going shopping" purpose of the trip increased from 1.5% in 2008 to 8.1% in 2017. Furthermore, the number of interviewed users of PPT who stated the "small personal activities" and "amusement/recreation" as purpose of the trip also seem to increase. As for the characteristics of the passenger trips, there seem to be no significant variations in the researched period. A minor increase of passengers using PPT daily is recorded. The highest number of users (71.5% in year 2008; 72.6% in year 2017) use PPT every day, while quarter of users (27.6% in year 2008; 25.5% in year 2017) use PPT occasionally. There are 3 types of tickets: single, monthly and free ticket. During regulated regime model, 2 types of tickets were used: single and monthly. After replacing regulated regime model with the Scandinavian model, a free ride for pensioners was introduced. Single ticket was used by 41.2% of interviewed passengers in 2008, whereas the research conducted after the change of PPT system organization model showed a decrease in percentage down to 18.5%. The number of passengers using a monthly ticket slightly increased after the new system organization from 55.8 to 58.0%, and 23.3% of users, i.e., pensioners used the free ride.

Table 2. Overview of the basic characteristics of PPT users and trips

Characteristics of PPT users and trips		Year 2008	Year 2017
Gender	male	48.5%	60.6%
	female	51.5%	39.4%
Age	<18	31.8%	25.4%
	19…30	27.6%	26.2%
	31…40	12.4%	16.1%
	41…50	13.0%	12.5%
	51…65	8.8%	10.8%
	>65	3.3%	7.9%
	no answer	3.1%	1.1%
Professional condition	employed	37.9%	44.2%
	pupil	32.7%	24.6%
	student	11.2%	2.0%
	retired	6.4%	21.1%
	unemployed	9.4%	6.3%
	farmer	0.3%	1.3%
	other	1.2%	0.4%
	no answer	0.9%	0.1%
Scope of journey	going to work	24.2%	32.0%
	come back home	29.7%	20.9%
	school/faculty	24.5%	15.5%
	shopping	1.5%	8.1%
	personal activities	10.8%	12.2%
	amusement/recreation	4.5%	5.7%
	others	4.8%	5.7%
Frequency of journey	daily	71.5%	72.6%
	occasionally	27.6%	25.5%
	no answer	0.9%	1.9%
Ticket type	single ticket	41.2%	18.5%
	monthly	55.8%	58.0%
	free ticket	–	23.3%
	no answer	3.0%	0.2%

In the PPT system in Inđija, the service quality has been researched from the aspect of users based on evaluation of the existing state of the system, and defining the desired service quality through interviewing users about the drawbacks of the system and desired parameters – working elements of the system. In order for the public transport system to function efficiently, it is necessary to determine what users consider as service quality of PPT. Also, it is very important to identify service quality elements that should be used in the system in order to increase the level of service quality from the PPT system users' point of view (Grujičić *et al.* 2014).

In the Figure 6 rating of the PPT system is presented. It refers to general state of service quality experienced by users. In the year 2008, out of all interviewed passengers, 8.5% of them answered that they were very dissatisfied with PPT, 25.2% said that they were dissatisfied with PPT, 41.5% said that it was ok, while 14.5% said they were satisfied and only 9.7% said they were very satisfied. In the year 2017, out of all interviewed passengers, 11.6% said that they were dissatisfied with PPT, 29.2% said that it was ok and only 2.8% said they were very dissatisfied, while 20.3% said they were very satisfied. From the presented graph it can be seen that rates of service quality of the PPT system for the year 2017 have significantly improved in comparison to those from the year 2008.

Users of transport services were able to express their opinion on the system's drawbacks and to rate them from the 1st to the 3rd place. The users were offered 6 most common drawbacks of the system in the questioner: low number of departures, lines don't operate the whole day, large crowds, long distances walked to stops, personnel not being polite, state and the hygiene of the vehicles. 3 most common drawbacks in the users' answers are presented in Table 3.

According to the analysis of the data from the year 2008, 216 interviewed of the total of 330 interviewed users, i.e., 65.5%, stated drawbacks, while in the year 2017, 169 (36.8%) of the total of 459 interviewed users stated drawbacks. The biggest drawback in the year 2008 was a low number of departures (48.1%), while in the year 2017 it was crowded vehicles (35.5%).

Table 3. Rating the drawbacks of public transport system

Significance level	Low number of departures		Lines don't operate the whole day		Large crowds		No answer		Total	
	number	%	number	%	number	%	number	%	number	%
Drawbacks of public transport (year 2008)										
1st place	104	48.1	31	14.4	81	37.5	0	0.0	216	100.0
2nd place	27	12.5	29	13.4	37	17.1	123	56.9	216	100.0
3rd place	28	13.0	20	9.3	23	10.6	145	67.1	216	100.0
Drawbacks of public transport (year 2017)										
1st place	56	33.1	53	31.4	60	35.5	0	0.0	169	100.0
2nd place	16	9.5	29	17.2	28	16.6	96	56.8	169	100.0
3rd place	8	4.7	4	2.4	7	4.1	150	88.8	169	100.0

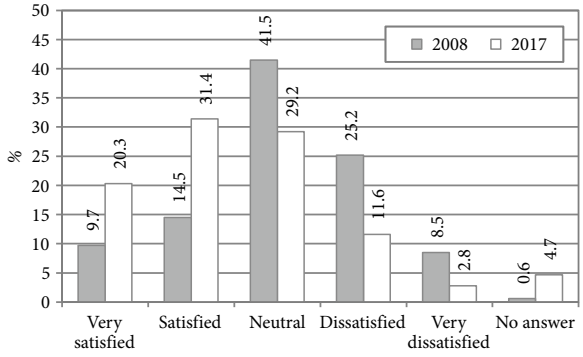

Figure 6. Graphical display of rates given to the existing PPT system

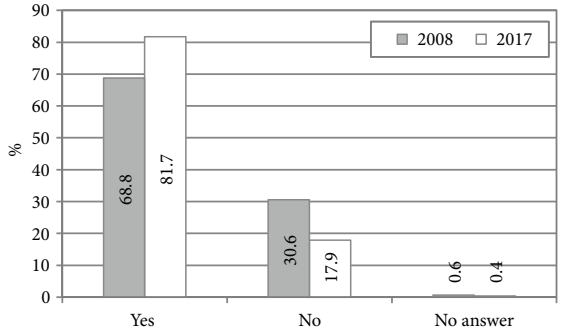

Figure 7. Users answer to the question "Are you satisfied with the existing number of departures?"

After establishing which service quality elements, important to users of PPT system, they are not satisfied with, it is possible to work on those elements in order to increase customer satisfaction.

The desired level of determined service quality was based on drawbacks that the users stated during the 2008 research. Users that weren't satisfied with the number of departures were asked additional question, to state the occasions when additional departures should be added. This information was compared to the departure times and capacity usage when designing the new PPT system based on the Scandinavian model during the year 2011.

In the 2017 research, the users named overcrowded vehicles as the biggest disadvantage of the new PPT system. After the change of PPT system organization model, a general service quality increased which made a significant impact on the number of passengers, by 38.3%. Since the capacities of lines are not synchronized with the increasing transport demands, the passengers comfort is significantly reduced, as seen in graphic (Figure 5).

Besides expressing their opinion about the drawbacks of the public transport, the users of the public transport system were asked the question: "Are you satisfied with the existing number of departures?" (Figure 7). As per graphic, 68.8% of users interviewed in the year 2008 were satisfied with the existing number of departures, while 30.6% were dissatisfied. Results from the year 2017 showed more satisfied users in comparison to previous research from the year 2008, i.e., 81.7% were satisfied and 17.9% were not.

From the PPT system user's point of view, it is possible to determine the quality elements that are important for the users and used this to achieve the desired level of service quality. To achieve the permanent satisfaction of the users of transport service, it is necessary to analyse the system operation continuously and work on removing its drawbacks so that the general users' satisfaction with the quality of the transport service can be increased, and the system can operate in accordance with the passengers' needs.

Conclusions

This article performed comparative analysis of certain working parameters of the PPT system on the territory of Inđija Municipality during 2 different time periods (2008 and 2017), before and after essential changes in the system organization, with a goal to determine the influence of the organization model of the PPT on its operation and service quality.

Many European cities have organized their PPT system according to limited competition organization model in order to improve the performances of the system. Experience of the Scandinavian countries shows, that this organization model can lead to an increased efficiency of the PPT system together with the increase of its service quality.

Old organization model of the PPT, inherited from the self-management system of the former SFR Yugoslavia, was replaced on the territory of the Municipality of Inđija

in the year 2011, by a modern Scandinavian model, which has selected the operator with the lowest price per one vehicle, per km, with a predefined service quality and other conditions the operator needs to fulfil. New organization model of the PPT has enabled the Municipality to manage the system and to make strategic and tactical decisions important for the system in accordance with their needs and wishes.

According to the research conducted in the year 2008, bad organization method of the previous system and desynchronization of transport offer with transport demands, have led to the low values of capacity utilization coefficient (0.39). After implementing the new system, capacity utilization coefficient (0.85) points towards better synchronization of transport offer and transport demands on one side, while on the other side, the values of this coefficient are within the boundaries that provide satisfying comfort of the passengers in the vehicle. After the implementation of the new system there has also been an increase in the number of transported passengers. Results of the research have shown that the number of passengers has increased by 38.3%. Larger percentage of passengers points towards the conclusion that after the performed changes, the PPT system now has significant role in the realization of transport needs of passengers on the territory of the Municipality of Inđija. Preston & Almutairi (2013) equally established that the Scandinavian model of PPT system organization, also applied in London, has a positive effect on the demand and saw an increase in passenger numbers by 87%.

Comparative analysis of service quality parameters from the users' point of view has shown that the users within the new organization method of the PPT are far more satisfied with the system on the territory of the Municipality of Inđija. User evaluation of the system's operation from the year 2017 is much more favourable than from the year 2008. The new organization model has also seen a decrease in the opinion that the system has drawbacks by 28.7%, whilst the number of users that see the existing number of departures as fine, has increased by 12.9% in comparison to the old system. Changes in organization method of the PPT system have given the possibility for local authorities to manage the system through its expert department in order to achieve higher level of service quality in transport.

Large number of municipalities in the Serbia has problems with operations of their PPT systems.

Positive results from the Municipality of Inđija with application of the Scandinavian model present a positive base for solving problems of PPT systems in the Serbia, which are inherited from self-management system, and haven't been solved for over 2 decades.

Implementation of the Scandinavian model is expected in other municipalities in the Serbia. Future research should include comparative analysis of achieved effects on all municipalities.

Disclosure statement

The authors declare no conflict of interest.

References

Alexandersson, G.; Hultén, S.; Fölster, S. 1998. The effects of competition in Swedish local bus services, *Journal of Transport Economics and Policy* 32(2): 203–219. Available from Internet: https://www.jstor.org/stable/20053766

Alexandersson, G.; Pyddoke, R. 2004. Bus deregulation in Sweden revisited: experiences from 15 years of competitive tendering, in D. A. Hensher (Ed.). *Competition and Ownership in Land Passenger Transport: Selected Papers from the 8th International Conference* (*THREDBO 8*), 14–18 September 2003, Rio de Janeiro, Brazil, 1–14.

Augustin, K.; Walter, M. 2010. Operator changes through competitive tendering: empirical evidence from German local bus transport, *Research in Transportation Economics* 29(1): 36–44. https://doi.org/10.1016/j.retrec.2010.07.006

Banković, R. 1994. *Organizacija i tehnologija javnog gradskog putničkog prevoza*. Univerzitet u Beogradu, Republika Srbija. 294 s. (in Serbian)

Beck, A. 2011. Experiences with competitive tendering of bus services in Germany, *Transport Reviews* 31(3): 313–339. https://doi.org/10.1080/01441647.2010.511299

Beesley, M. E. 1991. Bus deregulation: lessons from the U.K., *Transportation Planning and Technology* 15(2–4): 95–106. https://doi.org/10.1080/03081069108717444

Bekken, J.-T.; Longva, F.; Fearnley, N.; Frøysadal, E.; Osland, O. 2006. *Procurement and Contracts for Local Bus Services*. Oslo, Norway. TØI Report 819/2006. Institute of Transport Economics (TØI), Oslo, Norway. 109 p.

Button, K. J.; Hensher, D. A. 2005. *Handbook of Transport Strategy, Policy and Institutions*. Emerald Group Publishing Ltd. 834 p. https://doi.org/10.1108/9780080456041

Carlquist, E.; Johansen, K. W. 1999. *Local Public Transport Systems – Financial and Organisational Frameworks in Norway and Abroad*. TØI Report 451/1999. Institute of Transport Economics (TØI), Oslo, Norway. 65 p.

De Oña, R.; Eboli, L.; Mazzulla, G. 2014. Key factors affecting rail service quality in the Northern Italy: a decision tree approach, *Transport* 29(1): 75–83. https://doi.org/10.3846/16484142.2014.898216

Grujičić, D.; Ivanović, I.; Jović, J.; Đorić, V. 2014. Customer perception of service quality in public transport, *Transport* 29(3): 285–295. https://doi.org/10.3846/16484142.2014.951685

Hensher, D. A.; Wallis, I. P. 2005. Competitive tendering as a contracting mechanism for subsidising transport: the bus experience, *Journal of Transport Economics and Policy* 39(3): 295–321. Available from Internet: https://www.jstor.org/stable/20053970

Mackie, P. J.; Preston, J. 1996. *The Local Bus Market: a Case Study of Regulatory Change*. Avebury. 235 p.

Mackie, P.; Preston, J.; Nash, C. 1995. Bus deregulation: ten years on, *Transport Reviews* 15(3): 229–251. https://doi.org/10.1080/01441649508716914

Mathisen, T. A.; Solvoll, G. 2008. Competitive tendering and structural changes: An example from the bus industry, *Transport Policy* 15(1): 1–11. https://doi.org/10.1016/j.tranpol.2007.08.002

Preston, J.; Almutairi, T. 2013. Evaluating the long term impacts of transport policy: an initial assessment of bus deregulation, *Research in Transportation Economics* 39(1): 208–214. https://doi.org/10.1016/j.retrec.2012.06.015

Roy, W.; Yvrande-Billon, A. 2007. Ownership, contractual practices and technical efficiency: the case of urban public transport in France, *Journal of Transport Economics and Policy* 41(2): 257–282. Available from Internet: https://www.jstor.org/stable/20054016

Savage, I. 1993. Deregulation and privatization of Britain's local bus industry, *Journal of Regulatory Economics* 5(2): 143–158. https://doi.org/10.1007/BF01065363

Simeunović, M.; Gladović, P.; Bogdanović, V.; Papić, Z.; Leković, M.; Radojković, M.; Ruškić, N.; Pitka, P. 2009. *Studija javnog prevoza na području opštine Inđija*. Univerzitet u Novom Sadu, Republika Srbija. 159 s. (in Serbian).

Simeunović, M.; Papić, Z.; Pitka, P.; Saulić, N.; Kotarlić, D.; Alimpić, Z. 2017. *Revizija studije javnog gradskog i prigradskog prevoza putnika na teritoriji opštine Inđija*. Traffic & Transport Solutions d.o.o., Novi Sad, Republika Srbija. 120 s. (in Serbian).

Sharaby, N.; Shiftan, Y. 2008. The economic benefits from competition in bus public transport – the Israeli case, *International Journal of Transport Economics / Rivista Internazionale di Economia dei Trasporti* 35(3): 391–413. Available from Internet: https://www.jstor.org/stable/42747865

Stoelinga, A.; Hermans, G. 2006. Encouraging results of tendering in Dutch public transport, in R. Macário, J. M. Viegas, D. A. Hensher (Eds.). *Competition and Ownership in Land Passenger Transport: Selected Papers from the 9th International Conference* (*THREDBO 9*), 4–8 September 2005, Lisbon, Portugal, 1–22.

Van de Velde, D. 2014. Market initiative regimes in public transport in Europe: recent developments, *Research in Transportation Economics* 48: 33–40. https://doi.org/10.1016/j.retrec.2014.09.029

Van de Velde, D. 1999. Organisational forms and entrepreneurship in public transport: classifying organisational forms, *Transport Policy* 6(3): 147–157. https://doi.org/10.1016/S0967-070X(99)00016-5

Van de Velde, D. 2001. The evolution of organisational forms in European public transport, in *7th Conference on Competition and Ownership in Land Passenger Transport*, 25–28 June 2001, Molde, Norway, 1–19.

Vuchic, V. R. 2005. *Urban Transit: Operations, Planning, and Economics*. Wiley. 672 p.

Wang, I.-M.; Shieh, C.-J. 2006. The relationship between service quality and customer satisfaction: the example of CJCU library, *Journal of Information and Optimization Sciences* 27(1): 193–209. https://doi.org/10.1080/02522667.2006.10699686

Yvrande-Billon, A. 2006. The attribution process of delegation contracts in the French urban public transport sector: why competitive tendering is a myth, *Annals of Public and Cooperative Economics* 77(4): 453–478. https://doi.org/10.1111/j.1467-8292.2006.00315.x

Zatti, A. 2012. New organizational models in European local public transport: from myth to reality, *Annals of Public and Cooperative Economics* 83(4): 533–559. https://doi.org/10.1111/j.1467-8292.2012.00476.x