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COMPARATIVE ANALYSIS OF THE BASIC FEATURES OF THE EXPECTED AND PERCEIVED QUALITY OF MASS PASSENGER PUBLIC TRANSPORT SERVICE IN BELGRADE

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Abstract. Recently, negative trends towards the environment where the system of Mass Passenger Public Transport (MPPT) operates continue to grow. Mobility and citizens' standard of living are constantly increasing. A significant increase in using private cars (level of motorization) along with all negative consequences faced under such circumstances as an increase in traffic volume, congestions, a decrease in travelling speed, a higher number of traffic accidents, greater negative influence on the environment etc. can be noticed. The city of Belgrade has recognized the significance of continuous research and has monitored the quality of Mass Passenger Public Transport service as well as changes that are taking place in order to influence some specific parts of transport and traffic policy in the city. This paper contains the benchmarking of results obtained in research and a trend towards changes in the expected and perceived quality of service (QoS) within the system of Mass Passenger Public Transport in Belgrade within the period from 2005 to 2007.

Keywords: mass passenger public transport, benchmarking, expected quality of service, perceived quality of service, quality indicators.

1. Introduction

According to standards (ISO 8402:1994), service is defined as a result of activities between a provider (transport operator) and a user of service (passenger) and certain internal (prior) activities of the provider aimed at satisfying customers' needs. The same standards define the quality of service (QoS) as the overall features – service features related to the ability of a provider to satisfy all demanded and supposed needs of customers. These definitions are universal and applicable to all kinds of services, including those of Mass Passenger Public Transport (MPPT).

The features, sub-features and parameters of system and service quality represent a base for managing every organizational and technological system such as the system of Mass Passenger Public Transport and are the most important elements of the goals and a goal function of the system.

Expected quality expressing customers' needs is a base for planning, projecting and improving service. ***Targeted quality*** reflects the level of the coherence of customers' needs with the abilities of transport operator. ***Delivered quality*** reflects the quality of system operation. ***Perceived quality*** expresses the level of customers' satisfaction with the achieved system results.

The management of quality is a continuous search for better quality and permanent progress (QUATTRO – Quality Approach… 1998). First research on the quality of service was conducted in 1997 and repeatedly performed in 2001 (Filipović *et al*. 2002) using a sample of almost 50 000 examinees representing about 3% of the total number of daily transported passengers. Since 2005, research on the parameters of service quality has been carried out at least once a year. In 2007, service quality was researched taking into account both periods of the year that are specific for system operation: during the winter period, when the system operates with maximum capacity and in the summer period, when there is reduction in the offered capacities.

The aims of these researches were to:

- define QoS features and parameters,
- rank the importance of certain properties and sub-properties of service quality for users – expected quality,

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- define the level of users' satisfaction with the provided service – perceived quality,
- determine the trend for changes in service quality with the preceding period (internal benchmarking).

To define the required methodology (Filipović *et al.* 2006a, b), the researches and analysis of the obtained results were carried out by the Department of Urban and Road Transport and Traffic of the Faculty of Traffic and Transport Engineering at the University of Belgrade.

2. The System of Mass Passenger Public Transport in Belgrade

Belgrade, the capital of the Republic of Serbia, according to 2002 population census figures, has 1 576 124 inhabitants and occupies the territory of 322 268 hectares.

The system of Mass Passenger Public Transport in Belgrade is one of the greatest transport systems in South-Eastern Europe and consists of four subsystems including bus, trolleybus, tramway and suburban rail subsystems (Janović *et al.* 2009; Petrović *et al.* 2009).

The line network consists of more than 364 regular lines in daily traffic a total length of which is 8 500 kilometres:

- tram subsystem covers 12 lines and a total length is 127.3 kilometres;
- trolleybus subsystem has 8 lines and a total length is 58.1 kilometres;
- city bus subsystem is made up of 119 lines and a total length is 1 800.4 kilometres;
- suburban bus subsystem comprises 225 lines and a total length is 6 471.3 kilometres;
- suburban rail subsystem incorporates 13 lines and a total length is 489.3 kilometres.

A total number of passengers transported by the system of Mass Passenger Public Transport in Belgrade is 1 756 077 passengers a day and the largest share in transport operation has the bus subsystem transporting 1 434 511 passengers (81.68%), the tram subsystem with 185 228 travelling passengers and the trolleybus subsystem with 111 097 passengers daily (Filipović *et al.* 2002). The annual number of passengers transported by Belgrade's system of Mass Passenger Public Transport makes 480 million.

The biggest transport operator in the system is the state-owned company *GSP Beograd* having 1 186 vehicles (buses, trolleybuses and trams) in its rolling stock and holding a share of 75% of the city's Mass Passenger Public Transport market. The rest of the service market is held by private operators and *SP Lasta* through the tender on line assignment. *SP Lasta* is the main operator in suburban Mass Passenger Public Transport while the only operator in the suburban rail subsystem is the state-owned company *Beovoz*.

3. Defining the Features and Indicators of Quality

The features and indicators of service quality (Table 1) are defined on the basis of recommendations given in standards (IEC 60050-191 Ed. 1.0 b:1990), expert litera-

Table 1. Features and sub-features of the service quality of Mass Passenger Public Transport in Belgrade

EASY TO USE			
Station comfort	**Vehicle comfort**	**Tickets and pricing**	**Information**
protection from rain, sun and wind	not crowded vehicles	easy ticket purchase	information on PMTP in advance
station cleanliness	vehicle cleanliness	large assortment of tickets	information on PMTP at stations and in vehicles
station ventilation and heating	ventilation and heating	prepaid transfer tickets	information on PMTP at different places in town
sitting possibility	sitting possibility	discount possibility	information on lines
station aesthetics	vehicle aesthetics	ride price level	information on timetable
lighting	adapted grips	price-quality ratio	information on tickets and prices
easy boarding from the platform	ride without sudden braking		
passenger's safety at a station	music in vehicles		
	safety in vehicle		
SERVICE AVAILABILITY		**SERVICE STABILITY**	**ORGANIZATIONAL SUPPORT**
Accessibility in time	**Spatial Accessibility**	**Transport reliability**	**Staff**
a large number of departures	PMTP station vicinity	regularity	neat staff
service continuity	line covering	punctuality	identifying uniforms wearing
early morning and late evening departures	easy transfers	no other disturbances	culture and amiability
boarding on the first vehicle		expected travel time achieved	competency

ture (QUATTRO – Quality Approach… 1998; Filipović 1996; Filipović and Stanković 1996) and individual researches (Filipović *et al.* 2006a, b, 2007 and 2008).

4. Expected Quality of Service

The aims of research related to the expected quality of service were defined and ranked the importance of certain features and sub-features of service quality offered to the customers. The method of research on the expected quality of service was a direct interview – surveying Mass Passenger Public Transport users applying the defined questionnaire.

From the list offered in the questionnaire, the users chose and ranked the most important features and consequently, the most important sub-features of Mass Passenger Public Transport service.

The importance of the features and sub-features of service quality (expected quality of service) is defined in two ways:

1. According to the frequency of occurrence – ***a percentage of customers (P)*** choosing each of the features (sub-features) of quality.
2. According to the ***average rank (R)*** of the importance of all quality features (sub-features). The average rank for each feature (sub-feature) of quality is obtained as a quotient of the sum of the multiplied frequency of occurrence by ranks with a correspondent rank and the total frequency of the occurrence of that feature. The lower is the average rank the more important feature is for customers.

The results of research on the expected quality of service within the period from 2005 to 2007 are given in Figs 1–4.

According to both indicators (frequency – a total number of customers' declarations and the average rank), the users of Mass Passenger Public Transport chose 'vehicle comfort' and 'transport reliability' as two most important features of service quality. These features were chosen by almost 80% of users. Only in 2006, a significant decrease in the importance of these features making about 17% was recorded (Fig. 1).

The passengers, before all, find the feature 'transport reliability' as one having no long interruptions of system functioning and the feature 'regularity' ('which means there are no cancelled departures') is considered an important issue and as high 'punctuality' as possible by 23% of passengers, i.e. the feature of the departure of vehicles at scheduled times is chosen by 10–13% of the customers. According to the average rank, these sub-features are in the first two places (Fig. 3) in terms of their importance. Such passengers' expectations related to 'transport reliability' are understandable if accepting that Mass Passenger Public Transport in Belgrade operates under conditions of the mixed traffic flow (route type C) carrying great disturbances due to road works and congestions.

The following most important feature is 'vehicle comfort' admitted by passengers as 'uncrowded vehicles' (about 15%) and 'vehicle cleanliness' (8–14% of users). Such situation points out to the need for correcting the predicted capacities in order to provide the expected comfort in a vehicle. Among other sub-features, passengers also put emphasis on 'sitting possibility', while during summer periods, 'ventilation and heating' are also important.

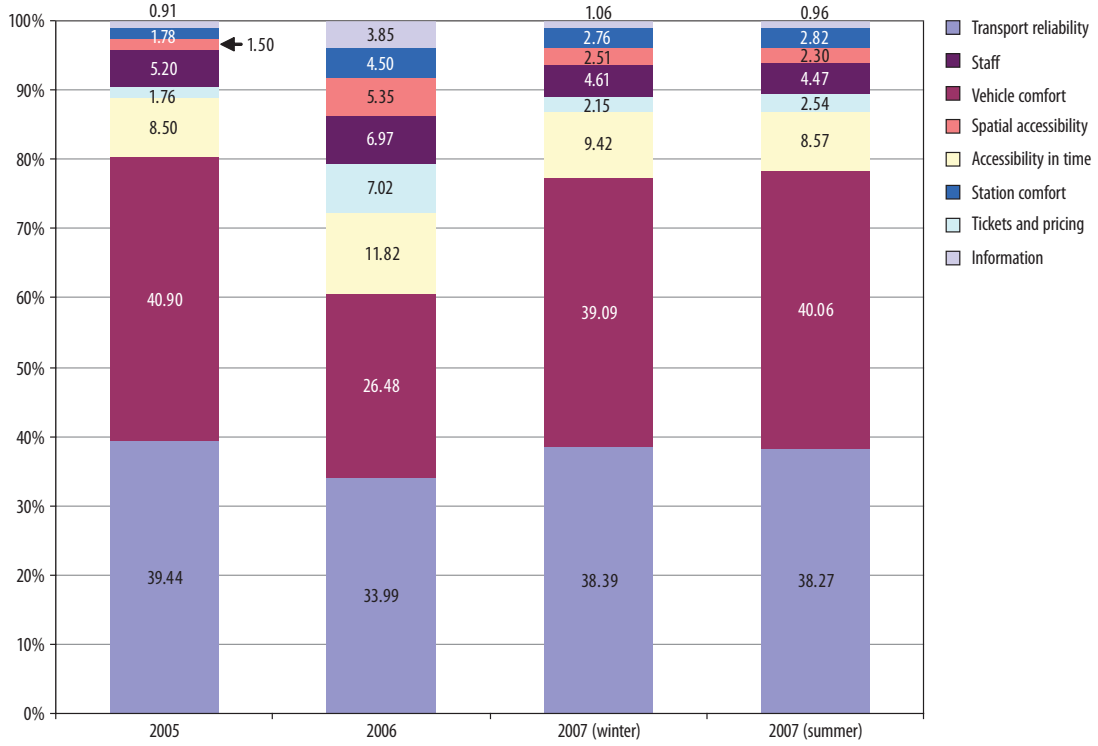
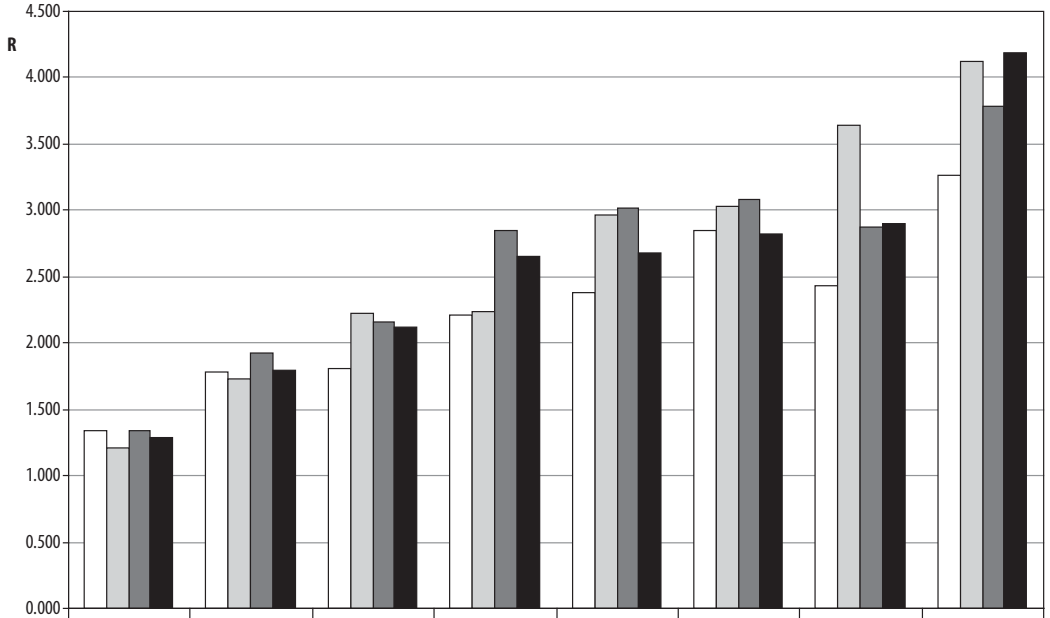


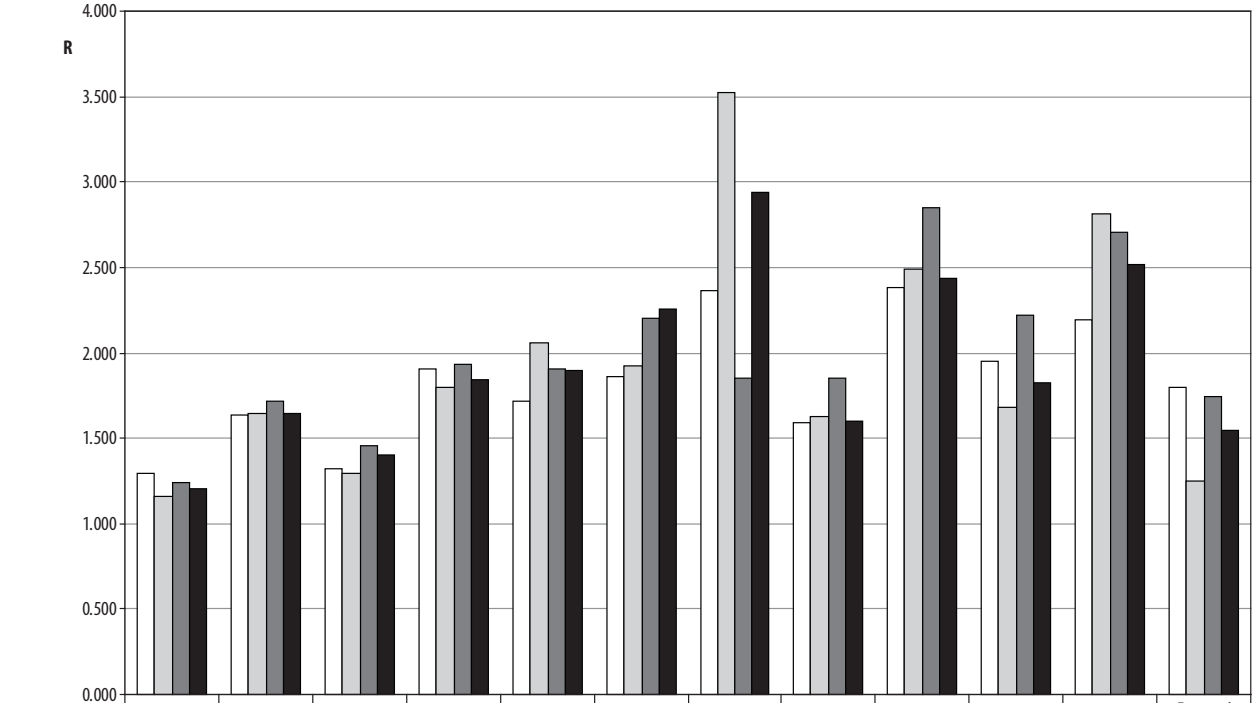
Fig. 1. Significance of the QoS features of MPPT in Belgrade from 2005 to 2007



	Transport reliability	Vehicle comfort	Accessibility in time	Tickets and pricing	Staff	Spatial accessibility	Station comfort	Information
2005	1.337	1.778	1.810	2.210	2.382	2.844	2.430	3.265
2006	1.209	1.729	2.224	2.240	2.964	3.030	3.647	4.129
2007 (winter)	1.343	1.924	2.158	2.844	3.012	3.085	2.876	3.786
2007 (summer)	1.290	1.801	2.123	2.655	2.685	2.828	2.901	4.190

Fig. 2. The average rank (R) of the importance of the QoS features of MPPT in Belgrade from 2005 to 2007

Fig. 3. Significance of the most important QoS sub-features of MPPT in Belgrade from 2005 to 2007



	Regularity	Not crowded vehicles	Punctuality	Vehicle cleanliness	A lot of departures	Ventilation and heating	Culture and amiability	Sitting possibility	Ride price level	Safety in vehicle	Line covering	Expected travel time achieved
2005	1.290	1.634	1.320	1.902	1.719	1.858	2.365	1.595	2.383	1.950	2.189	1.801
2006	1.162	1.643	1.296	1.801	2.058	1.926	3.521	1.627	2.486	1.683	2.810	1.248
2007 (winter)	1.237	1.715	1.455	1.929	1.903	2.205	1.850	1.850	2.846	2.220	2.707	1.748
2007 (summer)	1.204	1.648	1.401	1.847	1.893	2.254	2.940	1.597	2.433	1.822	2.513	1.548

Fig. 4. The average rank (R) of the importance of the QoS sub-features of MPPT in Belgrade from 2005 to 2007

The third feature of service quality, in terms of importance, '*accessibility in time*' was chosen by about 9% of users and was mainly expressed pointing to the number of vehicle departures ('a large number of departures') and operation time ('early morning and late evening departures'). A high position of this feature can be explained along with the reliability of transport because users actually expect that higher frequency may compensate for disturbances in system functioning.

Among other features, the one that should be mentioned is service quality provided by 'staff' and primarily their culture and amiability. This feature is considered important by 5% of passengers. Other features and sub-features taking into account service quality are less important for users not implying that they do not deserve further attention and analysis. A less important feature of service quality is 'information' that is expected considering the fact that more than 85% of passengers in the system are everyday users and 12% of those more frequently use the services provided by the system several times a week.

The period of the year had no crucial influence on the results when conducting researches, i.e. ranking the most important features of service quality remained the same in summer and winter periods of the year 2007.

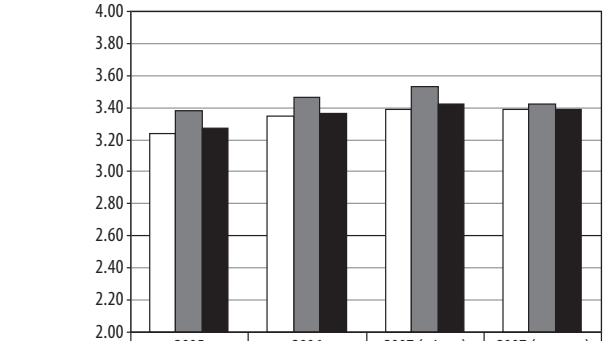
5. Perceived Quality of Service

The perceived quality of service shows *the level of customers' satisfaction* with the provided service. From the aspect of the carried out analyses, it is more important to follow trends for level changes in time rather than the level of satisfaction provided that there were no significant changes in the structure of passengers and travels. This benchmarking can help the system with locating strengths, pinpointing weaknesses and discovering possible achievements (Išoraitė 2004).

The method of researching the perceived quality of service is a direct interview which is a survey of Mass Passenger Public Transport users according to the defined questionnaire. The users perceived the quality level using grades from 1 to 5 in the following way: 1 – non-satisfying; 2 – satisfying; 3 – good; 4 – very good; 5 – excellent. On the basis of assessing certain users, examinees and the average values of service quality assessment were obtained.

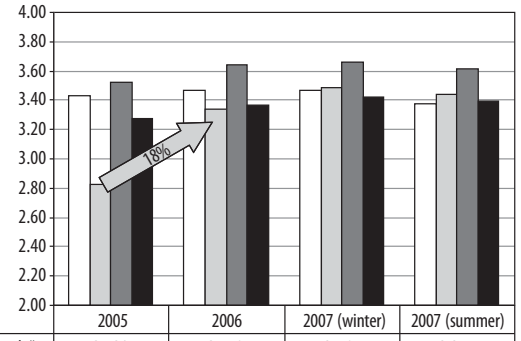
There was a separate measurement of customers' satisfaction with the overall service – *the integrated quality of service* provided by transport operators and subsystems as well as *customers' satisfaction with each of the features and sub-features of service quality.*

The increasing trend for the integrated quality of service grading is recorded in the system of MPPT in Belgrade (Fig. 5) and grade is about 4.5% higher in all subsystems in 2007 if compared with that achieved in 2005. *The overall grade of the integrated quality of service in the system of MPPT is 3.420 and is higher than the average level of customers' satisfaction of transport companies in European cities* (QUATTRO – Quality Approach… 1998).



	2005	2006	2007 (winter)	2007 (summer)
Urban MPPT	3.235	3.347	3.388	3.388
Suburban MPPT	3.382	3.463	3.528	3.420
System overall	3.272	3.367	3.420	3.391

Fig. 5. Customers' satisfaction level of integrated QoS in terms of subsystems and considering the overall MPPT system



	2005	2006	2007 (winter)	2007 (summer)
GSP "Belgrade"	3.428	3.470	3.465	3.374
Private operators	2.826	3.335	3.483	3.442
SP "Lasta"	3.526	3.640	3.662	3.618
System overall	3.272	3.367	3.420	3.391

Fig. 6. Customers' satisfaction level of integrated QoS in terms of operators and considering the overall MPPT system

If we have a look at data on different time periods of 2007, it can be concluded that *the period of year has influence on the level of customers' satisfaction,* especially regarding the subsystem of suburban lines. In the summer period of 2007, the customers were less satisfied with service and the integrated quality of service provided by the Mass Passenger Public Transport system which made difference in 2.5% in the suburban subsystem. The users of the suburban lines are more satisfied with the quality of service rather than those living within the City; however, difference is decreasing which is represented by a positive attitude of users towards the efforts aimed on improving the service quality of Urban Mass Passenger Public Transport.

The benchmarking of the perceived integrated quality of service by operators also shows growth in the level of customers' satisfaction (Fig. 6). What should be especially emphasized is an increase in the grade of the integrated quality of service offered by private operators. Their services received a significantly higher grade in 2006 if compared with that of the preceding year (grade 3.335 compared to 2.826, which is an increase in about 18%). One of the reasons for such significant increase in the level of service may be the renewal of the rolling stock of private operators in Mass Passenger Public Transport in Belgrade in 2006. The increasing grading trend for these operators was continued in 2007, however, with a lower increasing rate of about 4.5% compared to the previous period of observation.

Other operators had a significantly higher level of service quality in the starting year, so the level of customers' satisfaction had a moderate increase. The analysis of the winter period has revealed that the grade of integrated service quality has stagnated. In this case, it should be mentioned that an increasing trend for a satisfaction level is a kind of a logistic curve, i.e. when a certain level of satisfaction considered by the users as 'good' is achieved, it can be hardly changed and is inclined to become an asymptotic value. Only a certain amount of time spent conducting researches can help with establishing the level.

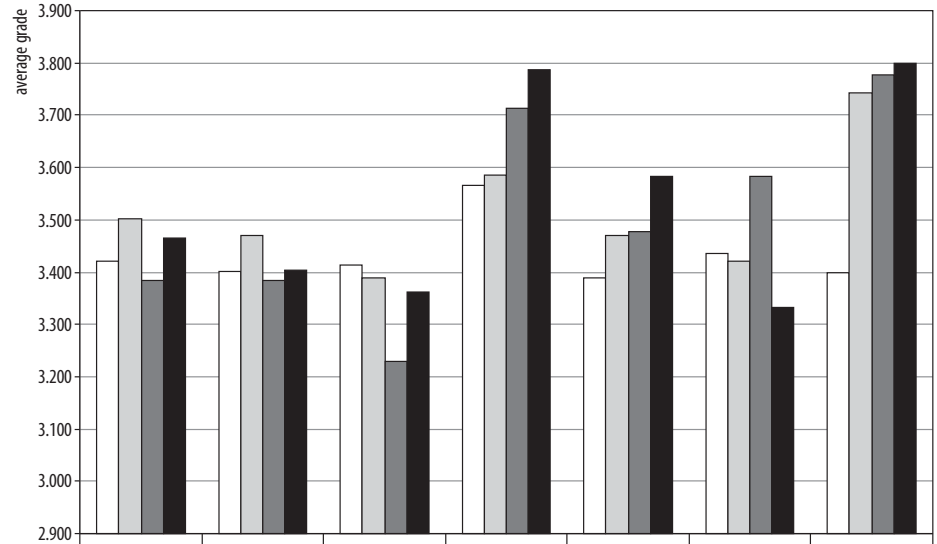
The level of satisfaction is defined by the means of establishing the level of service quality as well as reflecting the specificity of each user or a group of users. The most satisfied users are the *retired* while the greatest objections to the system of Mass Passenger Public Transport have *students* (Fig. 7). Regarding the majority of users, according to the structure of their occupations, a tendency for an increasing grade can be noticed if compared with 2005, except from students and those who 'work occasionally' where a decrease in grades makes less than 2%. However, when compared with 2006, only retired people, the unemployed and users that belong to the category of 'other' occupation gave a higher grade in the last year while other categories show a slight decrease in satisfaction with the integrated quality of service.

Comparing with 2005, ***a significant increase in satisfaction level considering the majority of the features of service quality*** was recorded in 2007 (Fig. 8) and included 'transport reliability' (+3.2%), 'vehicle comfort' (+8.8%), 'accessibility in time' (+4.5%), 'spatial accessibility' (+9.2%), 'station comfort' (+9.8%) and 'staff' (+9.1%).

The highest grade of 3.458 got the feature '*spatial accessibility*'. The second position was held by the feature '*transport reliability*' which made 3.211. The next best graded feature of the transport offer was '*accessibility in time*' with a grade of 3.022.

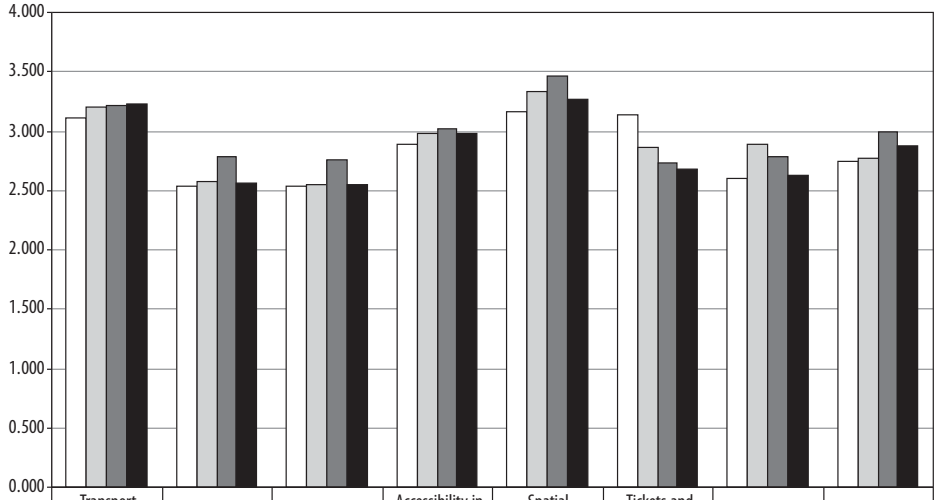
An average grade given by the users to one of the most important features of service quality – 'vehicle comfort' – reached 2.753 and was 8.8% higher than that achieved in 2005 and 7.9% higher if compared to the preceding year 2006. Regardless of the significant increase, the grade given to this feature is still low which shows that the structure of the discussed problem should be further analyzed (greater number of passengers, congestions, lack of capacity) and possibilities of improving service quality should be sought.

Customers' satisfaction with the feature '*tickets and pricing*' continues with its trend for decrease. When compared with 2006, decrease makes 4.6% and even as much as –12.7% in comparison with 2005. This shows



	Employed	Pupil	Student	Retired	Unemployed	Occasionally employed	Other
2005	3.421	3.402	3.414	3.565	3.390	3.435	3.400
2006	3.502	3.470	3.389	3.585	3.471	3.421	3.743
2007 (winter)	3.384	3.384	3.229	3.714	3.478	3.584	3.778
2007 (summer)	3.464	3.404	3.362	3.786	3.584	3.333	3.800

Fig. 7. Customers' satisfaction level of integrated QoS in terms of the groups of users

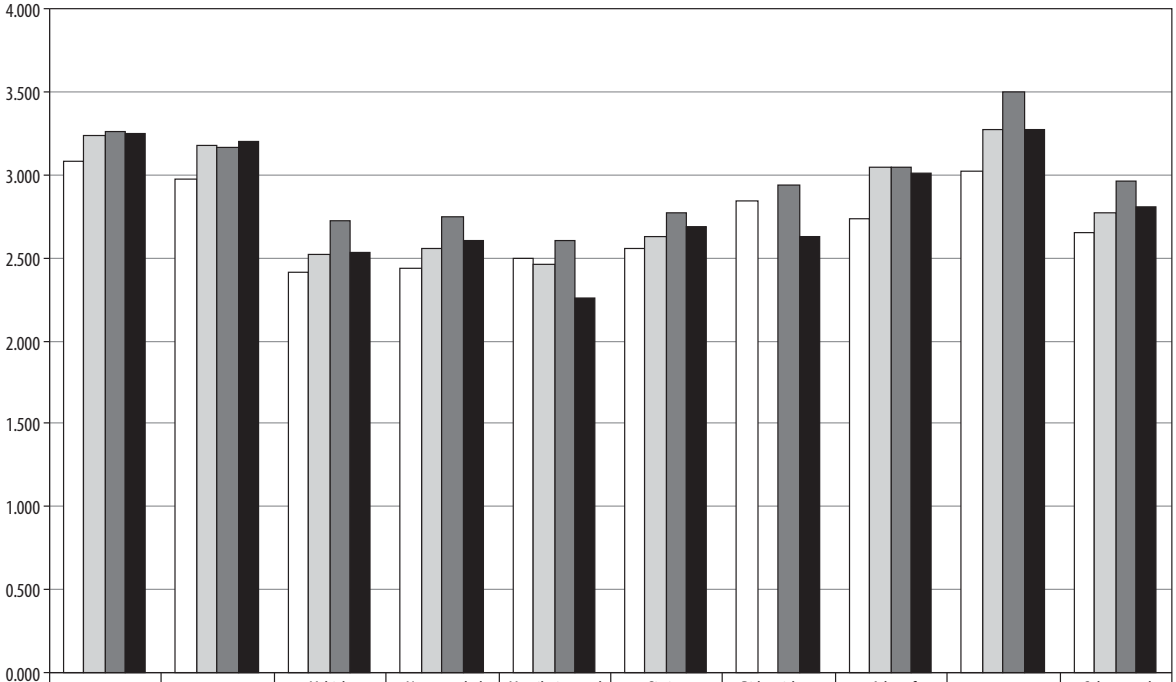


	Transport reliability	Vehicle comfort	Station comfort	Accessibility in time	Spatial accessibility	Tickets and pricing	Information	Staff
2005	3.111	2.530	2.531	2.892	3.167	3.133	2.596	2.750
2006	3.205	2.572	2.552	2.978	3.338	2.860	2.895	2.775
2007 (winter)	3.211	2.778	2.753	3.022	3.458	2.736	2.778	3.000
2007 (summer)	3.233	2.568	2.548	2.977	3.268	2.678	2.628	2.878

Fig. 8. Assessment of service quality features from 2005 to 2007

that special attention should be paid to this feature and its sub-features, and therefore it is necessary to review the goals of tariff policy, the structure of the tariff system, a ticket system as well as the system of transport service charging. The City Government bodies were not deaf to these problems and a project on a new tariff system with the automatic charging of Mass Passenger Public Transport services in Belgrade was completed. If compared with 2006, decrease was also noticed in the case of '*information*' (–4.0%), the least important feature of the quality of Mass Passenger Public Transport service for passengers.

Fig. 9 indicates that an increase in grades was also recorded taking into account the sub-features of service quality. An almost negligible decrease of grade, when compared to 2006, was noticed only in case of the sub-feature 'punctuality' (–0.4%). However, the assessment of this sub-feature was by +6.4% higher in comparison



	Regularity	Punctuality	Vehicle cleanliness	Not crowded vehicles	Ventilation and heating	Sitting possibility	Ride without sudden braking	A lot of departures	Line covering	Culture and amiability
2005	3.080	2.970	2.410	2.430	2.500	2.550	2.840	2.730	3.020	2.650
2006	3.230	3.180	2.520	2.550	2.460	2.630		3.040	3.270	2.770
2007 (winter)	3.260	3.160	2.720	2.750	2.600	2.770	2.940	3.040	3.500	2.960
2007 (summer)	3.250	3.200	2.530	2.600	2.260	2.690	2.630	3.010	3.270	2.810

Fig. 9. Assessment of the most significant service quality sub-features from 2005 to 2007

with that achieved in 2005. In spite of this, two most important sub-features of service quality – 'regularity' and 'punctuality' are highly estimated by the customers and make 3.26 and 3.16, respectively.

The only sub-feature that received a higher grade (3.50) was 'line coverage' and with as much as 15.9% more when compared to the basic year 2005, it faced the highest increase in all sub-features. This reflects a positive attitude of users towards introducing the new lines of Mass Passenger Public Transport within the territory of the City.

It is also worth mentioning that the grade for the sub-feature 'not crowded vehicles' increased by +13.2% and the sub-feature 'vehicle cleanliness' showed +12.9% of grade increase in relation to the basic year. The customers react positively to improving all these sub-features, however, the grade given to the feature 'vehicle comfort' is still lower than 2.80.

6. Conclusions

1. The results presented in this paper point towards *the stability of significance* that Mass Passenger Public Transport users give to the certain features of service quality taking into account the period of the last three years. Customers' expectations are, above all, related to *the reliability of functioning and comfort provided by a vehicle.* The remaining features are less important for passengers.
2. *There is a trend for increasing the level of customers' satisfaction with the integrated quality of service in Mass Passenger Public Transport in Belgrade*. The total grade of integrated service quality of Mass Passenger Public Transport is 3.420, and therefore is higher than the average grade in European cities.
3. *A period of the year has impact on the satisfaction level of the integrated quality of service users*. Therefore, in the summer period, users are less satisfied with the overall quality of service in the system of Mass Passenger Public Transport.
4. *The users of suburban lines are more satisfied with the quality of service than those in the urban areas;* however, difference is getting smaller which is represented by a positive attitude of the users towards the efforts aimed at improving the service quality of Urban Mass Passenger Public Transport.
5. A level of satisfaction is defined by the quality of service level and is a reflection of *distinctions between the groups of users.* The most satisfied group of users is *retired people* while most of the objections to Mass Passenger Public Transport are made by *students*.
6. The users of Mass Passenger Public Transport notice every single improvement of certain features and sub-features of service quality which is reflected by *the increasing trend for satisfaction with relatively high rates of growth.*
7. *A low level of grades* for certain features and sub-features show where operators can make improve-

ments in a short period of time and it is particularly related to *the comfort of passengers in vehicles*. Research on delivered quality (Filipović *et al*. 2008) has not shown any significant problems of overloading vehicles. However, customers want a higher level of service quality including sitting places, ventilation and heating in vehicles, clean vehicles, comfortable ride etc. This is the reason why the sub-features related to vehicles should receive particular attention. Most of these sub-features remain within the *operator's domain* and can be significantly improved enhancing service quality by means of developing these features. The largest transport operator, *GSP Beograd* has already made first steps by procurement of 100 new low-floor, air-conditioned buses produced by the local manufacturer *Ikarbus*.

8. The stagnation of the growth rate of the users' subjective assessment of integrated service quality is more probably the consequence of greater disturbances occurring in the environment (works on infrastructure, congestions of traffic network) than the result of subjective factors. What should be mentioned in this case is that *the increasing trend for a satisfaction level is a kind of a logistic curve*, i.e. when a certain degree of satisfaction considered by customers as 'good' is achieved, it can hardly change significantly which is inclined to become an asymptotic value Only a certain amount of time spent conducting researches can help with establishing the level.
9. Unfortunately, the last few years has disclosed that very little has been done on reducing a negative influence of traffic on the Mass Passenger Public Transport system in Belgrade. A series of measures for solving these problems are available to the City Authorities: all kinds of priorities (physical, legal, financial) for the vehicles of Mass Passenger Public Transport, restrictive measures for using private cars in certain periods or certain parts of the City, measures for parking area, charging the entrance of private cars in the central zone, planning measures etc.

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