

## **PROLONGED BUS WAITING TIME AT A BUS STOP CAUSED BY PASSENGERS' ENTRANCE AND EXIT<sup>1</sup>**

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### **Abstract**

Continuous mobility of citizens implies the need for movement. Public transport helps and allows residents perform activities of daily living caused by commuting and has great significance in the functioning and connecting different parts of the city. Low-floor buses are becoming increasingly popular in the public transport system compared to standard buses with steps. The number and height of stairs buses, as well as number of doors, affecting the slower entry and exit of passengers from buses, accumulation of passengers, longer standing buses on the stations, prolonged travel time, disorder intervals and timetables. Time losses cumulatively grow and can't be recovered. On the other hand, using low-floor buses may eliminate most of negative elements. This paper will compare these two types of buses in terms of the retention time on the bus stop due to the changes of passengers..

***Keywords - public transport; quality of service; waiting time;  
low-floor bus***

### **INTRODUCTION**

Passengers, users of public transport, every day meet with one part of the public transportation system directly or indirectly. So it is very important

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<sup>1</sup> Professional paper

their opinions, implementation of their proposals, and appreciation of objective and subjective suggestions or complaints.

Quality of service is based on the behaviorist approach, the subjective experience of the certain parameters, transport service, and as a result we have a fair use of public transport, which are as a rule different from the expected [1].

Aim of this paper is show how the application of low-floor buses affects the better functioning of the public transport system in terms of a short stay at the bus stops and faster changes of passengers. The paper presents the value of the cumulative waiting time of all passengers on the bus while standing on a bus stops.

In the first part of this paper will be displayed quality of service in terms of passengers, and their experience of service that is provided in the bus. Shown are the basis of quality attributes in public transport based on European standards. Chapter 3 presents the methodology that was used in the study, as well as basic information about the vehicles and the way measurement were carried out. The last part presents the results and observations that have been reached.

#### DEFINING QUALITY IN URBAN PUBLIC TRANSPORTATION

The indicators of the quality (efficiency) are quantitative expressions of the function of the goals set by the urban public transportation (UPT) system, and represent the basis for assessing the degree to which the goals of the system as a whole are fulfilled.

Depending on the author, there are differences in defining the quality of transportation service. Some authors suggest a method for “recognizing” quality known as attractive, one-dimensional, and obligatory. According to the standards of SRB ISO 9000 series (SRB –Serbian), quality is defined as the totality of features of an entity and its ability to satisfy stated needs [2]. According to IEC 50-191 (1/191-19-01) standards, quality of service is defined as the overall effect of service performance which determines the degree to which users (users’ needs) are satisfied, while it should be noted that quality of the service determines the characteristics of quality.

#### PUBLIC TRANSPORT CONVENIENCE AND SERVICE QUALITY

Although convenience is not necessarily synonymous with service quality, for simplicity, we use the term “convenience” in this paper to encapsulate both the wider scope of convenience as well as attributes of service quality. This is consistent with the scope of service quality defined in

the two European Standards created to help define (EN13816,2002) and measure (EN15140) service quality, as detailed in table 1:

Table 1. Eight attributes of service quality as defined by EN 13816[3]

<b>Availability</b>	Extent of the service offered in terms of geography, time (operating hours) frequency and transport mode
<b>Accessibility</b>	Access and egress to/from the public transport system including interface with other transport modes
<b>Information</b>	Systematic provision of knowledge about the system to assist the planning and execution journeys
<b>Time</b>	Aspects of time relevant to the planning and execution of passenger and train journeys, including journey time, punctuality and reliability
<b>Customer Care</b>	Service elements introduced to match the requirements of any individual customer, including staff reaction to customer complaints and kindness of staff
<b>Comfort</b>	Including crowding, cleanliness and service elements introduced for the purpose of making public transport journeys as comfortable as is reasonably possible.
<b>Security</b>	Offering safety and security to customers for the whole journey
<b>Environmental Impact</b>	Effect on the environment resulting from the provision of a public transport service (pollution and noise)

### MEASURING CONVENIENCE

Service quality and convenience is of increasing importance to all businesses, including public transport organizations. It influences customer satisfaction, passenger demand, investment decisions and revenue.

Availability of the service and the provision of adequate capacity are at the forefront of convenience, particularly in large, dense urban areas. High level measures can include frequency, operating hours, network structure, reliability (ensuring that passengers arrive at their destination on time) and comfort (including crowding). Ensuring that public transport is accessible to all, especially for people with special needs is vital to encouraging public transport use. Accessibility can be measured in terms of ease of getting to and from stops, ease of boarding and alighting and of obtaining a ticket [4].

The European Standard EN13816 provides a useful theoretical and practical framework for organizations to define and set convenience targets. It offers guidance on methodology for setting targets and measuring quality, and provides a comprehensive list of areas that together make up the service quality delivered to customers. The list of areas can help organizations ensure that they are considering the whole customer experience. For example, whilst aspects of journey time may be the most obvious aspects of

convenience, customers are also affected by issues such as ease of obtaining information, and operating hours.

### METHODOLOGY

In this research participated two types of vehicles for public transport system in the city of Nis, with a capacity of 110 seats. The first type of vehicle in which we have recorded entry and exit of passengers is a standard vehicle with three axles with a standard height of the floor and the stairs, while the second type is low-floor single vehicle with three axles without steps. Table 2 shows the technical characteristics of these vehicles:

Table 2. Summary of characteristics of the buses

	Standard bus	Low-floor bus
Number of doors	3	3
Door width (mm)	1260	1300
The distance from the ground to the first floor or steps (mm)	340	340/320
Height steps 1 (mm)	300	/
Height steps 2 (mm)	300	/
The total height of the floor buses (mm)	940	340/320

The survey was conducted in December 2015, during the period from 9 to 16 pm, on line 1 (Minovo naselje - Niska Banja) with turnaround time of 90 minutes.

Figure 1 shows the middle door with characteristic details, important for this study, which was recorded at the entry and exit of passengers. In this period, on the bus stops along the line are measured time entry or exit and the number of passengers in one and in another type of bus.

The number of passengers who entered or left the vehicle, is in the range from 1 to groups of 8 passengers in the bus stop and the scope will be binding for further research. Recording time entries, exits of passengers carried out on line 1, in the direction A, was done on the second door, in both types of vehicles, due to the characteristic behavior of passengers and the existence of important objects along the route of the line.



Fig.1. Standard bus with stairs and low-floor bus

### RESULTS AND DISCUSSION

After completion of the measurement and after analytical work calculated required values and check the results. The data obtained are arranged in two tables, where a special category of the average value of a time.

Table 3. Average time to enter and exit one passenger

Type	Entries (s)	Exits (s)
Standard bus	2.43	2.14
Low-floor bus	1.41	1.44

Based on the table 3 we can see that the average time to enter one passenger in the standard bus is 2.43 seconds, and in the low-floor buses has been recorded value of 1.41 seconds. The time it takes one passenger to exit from standard bus is 2.14 seconds, while the low floor needed 1.44 seconds.

Time required for entering or leaving a group of passengers are shown in Table 4:

Table 4. Average time for entry, exit groups of passengers

STANDARD BUS		LOW-FLOOR BUS		STANDARD BUS		LOW-FLOOR BUS	
Number of passengers - entry	Time of entry (s)	Number of passengers - entry	Time of entry (s)	Number of passengers - exits	Time of exit (s)	Number of passengers - exits	Time of exit (s)
1	2.83	1	1.80	1	2.97	1	1.74
2	4.26	2	2.98	2	3.64	2	3.20
3	7.05	3	4.92	3	5.20	3	4.20
4	8.16	4	4.86	4	7.20	4	5.25
5	8.72	5	5.49	5	8.60	5	6.10
6	12.10	6	6.96	6	10.14	6	7.65

7	13.46	7	7.52	7	11.69	7	8.40
8	15.26	8	8.99	8	13.12	8	9.60

Table 4 shows that the time of entry, and time of exit increases with increase number of the people in the group. This can be represented graphically in the next diagrams.

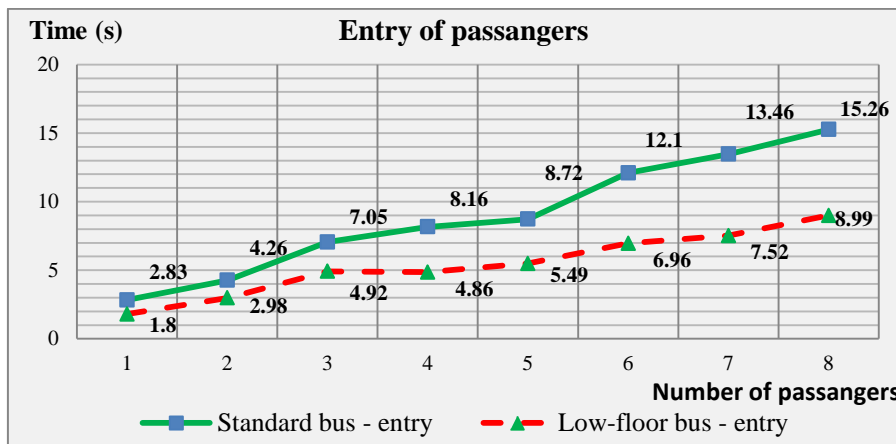


Fig.2. The time required for entering passengers depending on the type of bus

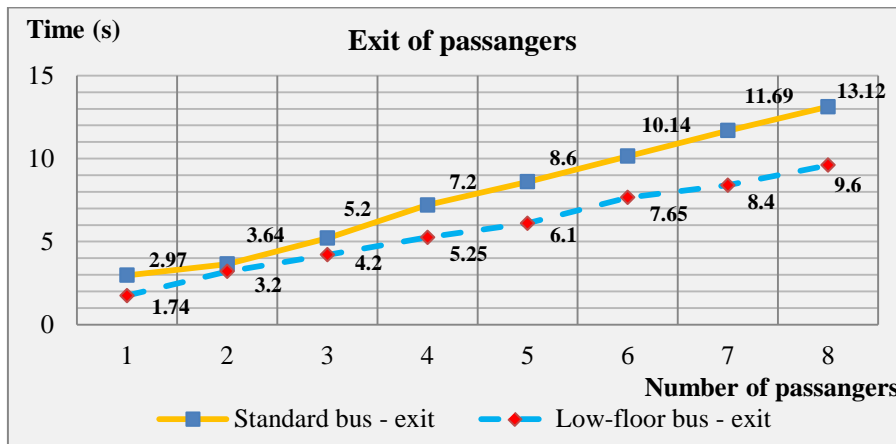


Fig.3. The time required for the exit of passengers depending on the type of bus

According to Figures 2 and 3 may be noted that passengers require more time to enter in standard bus. The entry time for groups of 8 passengers is 6.27 seconds, which is more than in the low-floor buses. Analogously entries of passengers, at the exit of passengers was recorded slight difference in

times of a standard and low-floor buses. For a group of 8 people, time of exits 3.5 seconds higher than in a standard bus.

Table 5. Continuous waiting time when entering or exiting passengers

Number of passengers	Entries (s)	Exits (s)	Assumed number of passengers in the bus	Prolonged periods during entries(s)	Prolonged periods during exits (s)
1	1.03	1.23	<b>50</b>	51.5	61.5
2	1.28	0.44		64	22
3	2.13	1		106.5	50
4	3.3	1.95		165	97.5
5	3.23	2.5		161.5	125
6	5.14	2.49		257	124.5
7	5.94	3.29		297	164.5
8	6.27	3.52		313.5	176

Table 5 shows the difference in the times of entry and exit of passengers at standard bus in relation to low-floor buses. Assumed number of passengers in the bus is 50. On this basis, we obtain the value of prolonged waiting time on bus stop during the entry and exit of passengers. The introduction of low-floor buses in the normal functioning of the public transport in Nis, would result in reducing the waiting time at the bus stops caused easier entry or exit of people from the vehicle. The values of time savings range from 60 sec for one passenger, even up to 5 minutes for a group of 8 passengers when entering. Having in mind importance of the participation of waiting time at stops in the total travel time, we can conclude that the application of low-floor buses increased quality of service to a higher level and therefore pleasure travelers. Also, in the system of public transport will be a more evenly movement of vehicles on the line, maintenance intervals, reduced turnaround time, increasing the number of departures and flow bus stop place.

#### CONCLUSION

Good customer service requests knowledge and skills. Without professional ethics and work morale they are of little use. It is important to remember that each passenger is a human being with his or her own rights. Do to others what you would like others to do to you is a good guidance in professional life as well. Individuals' actions may be small, and they often require more attention than skills. In the end, these small actions help us make the world a little better [5].

Applying low-floor buses confirmed less retention buses at stops and therefore the savings in the travel time for passengers. Specific parameters show that the average time of entering a passenger is 1.03 seconds shorter in low-floor buses compared to standard buses, and the time of exits to 1.23 seconds.

This is just the beginning, which leaves space for more detailed future research in this area.

#### REFERENCES

- [1] P. Gladović, "Sistem kvaliteta u drumskom transportu", Faculty of Technical Sciences, University of Novi Sad, Serbia, 2013.
- [2] International Standards Organizations (ISO), Available: <http://www.iso.com>
- [3] European Committee for Standardisation, 2002.
- [4] R. Anderson et al., "Measuring and Valuing Convenience", Discussion paper No. 2013-16, Imperial College London, UK, 2013.
- [5] Ministry of Transport and Communications, "Accessible Customer Service in Public Transport", Research and development programme for accessibility 2003-2006., Finland.