

IS THE URBAN RAIL SYSTEM SUFFICIENTLY UTILISED IN SOME PARTS OF BELGRADE?

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Abstract: In addition to the development of bus systems, public transport development strategies in major European cities have been based on the development of urban rail systems. Public transport cannot rely on an urban rail system only. In Belgrade, both systems are developed but traffic congestion on the city's primary routes has not been reduced as yet. Is the urban rail system sufficiently utilised? Public transport users have been polled on the issue at three randomly selected points. A comparative analysis of the results from all three points has revealed that tram timetables are not adapted to the users' needs, as well as that a separate route should be ensured for trams to increase the service speed.

Key Words: *Urban rail system, survey, rail system parameters*

1. INTRODUCTION

The Belgrade public transport system is comprised of the bus, tram and trolleybus systems. The majority of commuters, about 75 % of them, use buses, while the share of trams and trolleybuses in public transport amounts to 16 % and 9% respectively [2]. Public transport users are not primarily interested in transport technology but rather in the quality of service a given system can provide. They most frequently and most accurately identify speed and frequency as the parameters of the transport system quality. Some transport systems differ in terms of these parameters, meeting the users' needs with greater or lesser success. In addition to these two parameters, the users assess public transport on the basis of the number of options they have on a given route. They will choose the option meeting their needs at a given point in time. These assessments are used and are most credible at points where public transport routes intersect, i.e. at traffic squares and intermodal stations.

2. PROBLEM STATEMENT

The problem of provision of adequate transport systems in cities is by no means new. In addition to the development of bus systems, public transport development strategies in major European cities have been based on the development of urban rail systems, due to their advantages, are set up as the primary element of public transport systems in many

cities /Dublin (population: 2 million), Porto (1.2 million), Hannover (1.1 million), Lille (1.1 million), Manchester (2.6 million), Kuala Lumpur (2.1 million), the Cologne-Bonn conurbation (2.9 million)/, while in others they are successfully combined with the existing railway or transformed tram systems (Stuttgart, Karlsruhe, Saarbruecken) [1]. Public transport cannot exclusively rely on an urban rail system, which yields its best results when combined with other types of transport [3].

Downtown Belgrade (old town) is faced with identical problems. Large-scale population movement in this part of the city causes huge traffic jams during the day. The insufficient utilisation of the urban rail system contributes to heavy traffic jams, because the city's public transport mainly relies on bus services. The lack of a metro, free right of way, compounds the situation still further.

What is the utilisation level of the urban rail system in some of Belgrade's parts? What are the utilisation time patterns of different types of transport in them? What is the service speed and frequency in them? What should be changed in order to increase the utilisation level of the urban rail systems? The answers to these questions could be the starting point in research of the urban rail systems utilisation level improvement and coordinating them with other mode of traffic in Belgrade.

3. SURVEY

One of the ways in which data on commuters and public transport can be obtained is by conducting surveys. Three points have been randomly selected for the purpose in downtown Belgrade. They include Slavija, Vukov Spomenik and Autokomanda. The aim of the survey/polling of commuters at three points in Belgrade is to establish the reason why the urban rail systems are not used more in these parts of the city. An effort is being made to collect information on the commuters' daily mobility i.e. the time patterns of their movement at the selected points in Belgrade, and the service quality expressed by traffic frequency and speed.

The three points have been selected for the following reasons:

- Slavija is a major Belgrade traffic square, serving mainly as the point of intersection and transit of all modes of transport from Vozdovac, Kumodraz, Banjica, Dusanovac, Zvezdara, Vracar and Palilula. Slavija links these municipalities with the city centre and a large number of public transport lines run parallel to each other there.
- Vukov Spomenik has been selected being the place where several different modes of transport (buses, trams and commuter trains) intersect, i.e. the rail systems prevail at this location.
- Autokomanda has been selected in order to demonstrate how the tram and other routes not being separated affects the service quality (frequency and speed), as well as the effect of parallel tram and bus traffic, i.e. the effect of tram and bus lines running parallel to each other.

Survey refers to the habit of using public transport service by commuters at selected points, and not specifically the use of different modes of transport on it.

The survey has been structured around three segments. Its first segment focuses on the motive and direction of the commuters' movement, i.e. the points of the respondents start

using public transport services and their most frequent destinations. The second segment describes the modes of transport most commonly used by the respondents, the routes they use and when they use them. The last, third segment of the survey provides an assessment of the service quality in terms of frequency and speed. A random sample of 300 public transport users has been polled at each of the three points.

4. SELECTED RESULTS OF THE SURVEY CONDUCTED AMONG COMMUTERS

The survey was carried out in the first half of December 2010, by polling 900 public commuters. Taking into account the points where the commuters most commonly begin and end their journey, the following zones/municipalities were defined in order to analyse the commuters' movement: Savski Venac, Palilula, Vracar, Zvezdara and Vozdovac.

In figure 1 is given the aggregate data from Slavija on the commuters' movement between each pair of the listed municipalities. Most of the respondents, 40 per cent of them, travel between Slavija (Vracar municipality) and the city's very centre (Savski Venac municipality). The percentage of people travelling between other municipalities and Slavija is considerably smaller, which shows that Slavija is the transit point for the respondents travelling from other municipalities to the city centre.

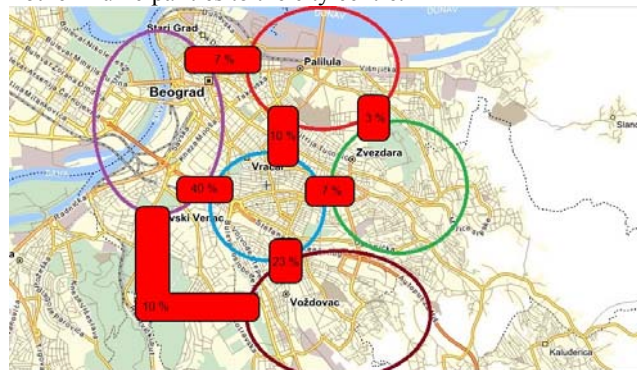


Figure 1. Respondents' movement pattern at Slavija

The analysis of the survey results from all three points has revealed that the usual afternoon pick hour at Slavija has shifted to the period between 4 p.m. and 6 p.m. (chart 1), which can be explained by the introduction of 'European' working hours and the fact that Slavija is only used as a transit point when public transport users travel to work and back. Before that, the main afternoon pick hour is in the period between 1 p.m. and 4 p.m.

The situation is somewhat different at the other two points. At Autokomanda, the afternoon pick hour begins at around 6 p.m. Public transport users returning home from work travel via this point. That part of the city (Vozdovac) is mainly a residential area, which explains the people's increased movement after 6 p.m. The situation is pretty much the same at Vukov Spomenik. Consequently, when defining timetables, they should be separately drawn up in order to coordinate them with the characteristics of the commuters' movement in the gravitation area of a given traffic square.

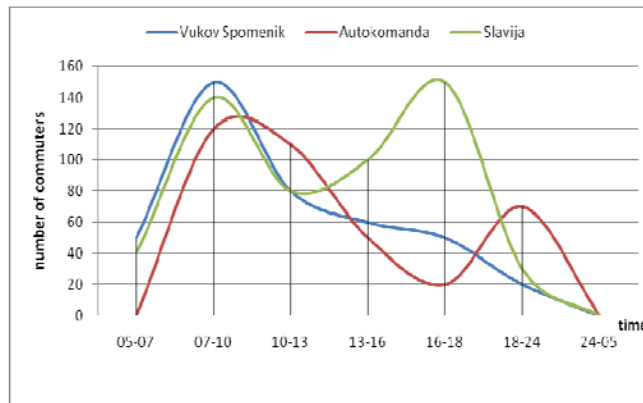


Chart 1. Comparative presentation of time distribution of the respondents' journeys from all three points

Transport needs are similar at all points in the morning. It is the time of the day when people set off for work on a large scale, so that the number of public transport users increases in a linear manner at all points, as shown in chart 1. Such a situation should imply an increase in transport capacity, i.e. a higher number of vehicles at all points or a higher capacity of vehicles (relying on higher-capacity rail systems).

The analysis of the survey results has revealed that, at Slavija, transport intensity is higher during the afternoon pick hour than during the morning pick hour (chart 1). The routes of all systems from the defined zones mainly intersect at or run via Slavija, burdening the square considerably and causing heavy traffic jams. At Slavija, 66 per cent of the respondents use buses during the pick hour, whereas only three per cent of them use trams (chart 2). All this points to the fact that timetables of existing transport systems should be reshaped and the rail system timetable should be the backbone of the whole structure.

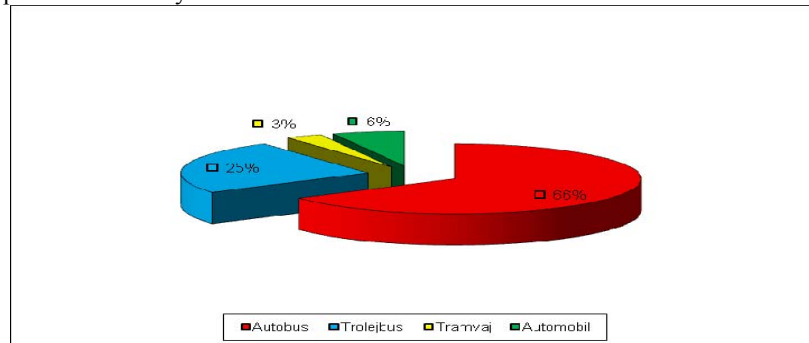


Chart 2. Mode of transport most commonly used from Slavija during the pick hour

At Autokomanda, the highest number of commuters is registered in the morning (chart 1). This is because a large number of people have to get to work in the morning. At this point, the afternoon pick hour starts at 6 p.m. and ends at midnight. The situation is characteristic of public transport users returning home from work or the city's commercial zones. As in the case of Slavija, as many as 72 per cent of the respondents at Autokomanda use buses as

the basic mode of transport, while 14 per cent of them use trams (chart 3). The respondents use buses because their timetables are better suited to the users' needs, since they run much more frequently than trams (the pick-hour ratio is 2:1 or 3:1 in favour of buses). In order for commuters to start using trams more, the tram route should be separated from road traffic (Vojvode Stepe Street), enabling trams to run smoothly. The current situation in the field (trams and road traffic sharing the route, parking places reached only by crossing the tracks and cars parked occasionally on the tracks themselves) renders it impossible for trams to be a competitive mode of transport to buses in this part of the city.

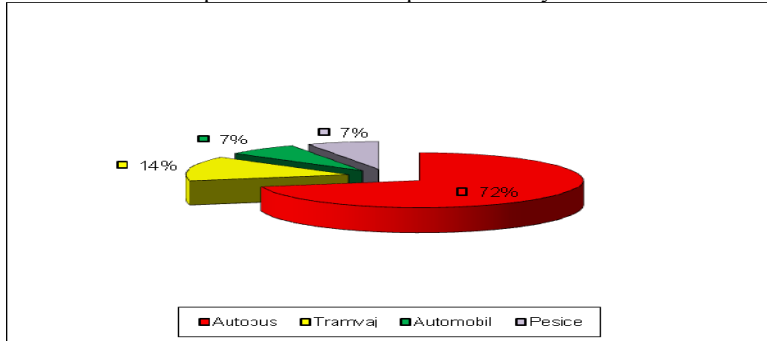


Chart 3. Mode of transport most commonly used from Autokomanda during the pick hour

During the pick hour, buses are used 18 per cent more than trams at Vukov Spomenik, but this percentage is considerably smaller than that registered at the other two points, where the tram route is not separated from road traffic (chart 4). Separated tram routes considerably improve the system parameters (speed, frequency), i.e. they have a positive effect on the increase in the use of tram traffic

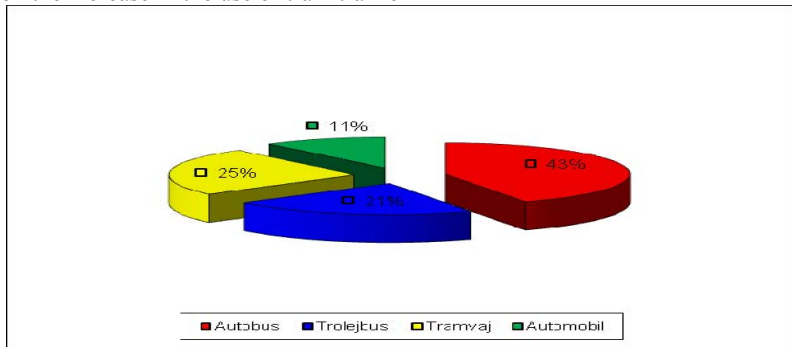


Chart 4. Mode of transport most commonly used from Vukov spomenik during the pick hour

As an illustration of existing trams serve (no)quality is the following: Analysis of traffic demand for the General metro project has shown that the establishment of the first metro lines, which largely follows the tram line no. 7, distribution of trips is as follows: share of buses has fallen to 58%, from an initial 75%, and that the LRT line down the route of the tram no. 7 attracted almost 30% travels. This line is characterized by exactly what the existing trams have: frequency (at 3 min), capacity (600 times / unit) and speed (about 28

km / h). So, tram no. 7 is on the corridor of intense traffic requirements, but is not used sufficiently because of the shortcomings identified in the paper

5. CONCLUSION

The public transport system has not kept pace adequately with Belgrade's evident development in the past few decades. By improving the service quality of the urban rail system, conditions will be created for a better use and further development of modern and efficient trams and the reduction of traffic congestion on the city's primary routes.

The comparative analysis of the results from all three points, both during the pick hour as well as in off hours, has revealed that buses are most commonly used as the basic mode of transport, their utilisation level amounting to 58 per cent and 60 per cent respectively. The unequal utilisation of the bus and rail systems and the low utilisation level of trams suggest that tram timetables are not suited to the users' needs, as well as that a separate route should be ensured for trams in order to increase their speed. The rail system's potential to increase capacity per vehicle at a slightly higher cost (the same drive unit, one driver) considerably helps reduce transport costs and traffic jams in the city. To increase the transport capacity of buses, more vehicles should be put in operation (more drivers and more drive units), which would create greater traffic jams and increase transport costs.

Tram timetables not being adapted to the commuter's needs in pick-hour is reflected also in the fact that, during the pick hour, the utilisation level of trams amounts to 14 per cent only, while throughout the day it amounts to 18 per cent. Again, it is evident that the respondents most frequently use buses during the pick hour (when they are usually in a hurry), because buses run more frequently and are faster than trams.

The survey results pertaining to the service frequency and speed show that, whenever the service frequency is described as good (64 per cent of the respondents), the service speed is described as slightly worse (53 per cent of the respondents). This can be explained by a large number of public transport vehicles operating on some route sections, aggravating traffic jams and causing the vehicles to move more slowly during the pick hour. This is yet another proof that trams are not fully utilised as a mass transport system. The introduction of the tram routes separation can alleviate the negative effects on the speed of trams. All these measures should be backed by better-quality timetables of all systems, i.e. by their coordination with the commuters' needs in pick-hour. This means that, on sections where bus and tram routes for the largest part run parallel to each other, buses and other systems should only be used to support the rail system.

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