

ANALYZING AND MODELING THE IMPACT OF TRANSPORT SERVICE RELIABILITY ON PASSENGERS BEHAVIOR

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Abstract: As a result of increasing demands for mobility and high consumer expectations of society, the reliability of transport service becomes more modern, necessary and important. The reliability of transport service can be defined as the ratio between the supply (referred to in the schedule) and actually implemented public transport services. The patterns of passengers' behavior in different situations, such as early arrival or delay of vehicles express the perception of transport service reliability in different manners. This article is a study on the impact of the reliability of transport process on the passenger behavior

Keywords: SERVICE RELIABILITY, VARIABILITY, TRANSPORT MODELS, IMPACT OF SERVICE RELIABILITY

1. Introduction

As a result of growing demands for mobility and high user expectations of society, the reliability of the transport service becomes more modern, necessary and significant. Today, the main challenge for transport operators is to provide a more reliable and quality transport services. This is so, because more reliable transport services are a prerequisite for addressing the needs of current users and an opportunity for attract new ones. The routes, characterized by unreliable transport services, experience difficulties in attracting new passengers or suffer from a reduction in passenger flows over time.

Significant are efforts, which are being made in this direction. These efforts are justified, because improving the level of reliability of transport services benefit both users (reducing the time of travel, improving the quality of the service provided, etc), and for operators (a higher level of competitiveness, more efficient use of resources, more revenue, etc.).

The reliability of the transport service can be defined as the ratio between the proposed (referred to in the schedule) and actual realized public transport services. The interaction between the supply of a transport service (consisting of order activities, the main of which are moving people and material objects in space and time) and her demand reflect the actual level of reliability relevant transport system. Unreliability of the transport service appearing in interaction of two sides. Of the supply side consists of services such as time travel and space. Of the passenger side is determined by their behavior and experience. The patterns of passengers' behavior in different situations such as before arrival time or delay of vehicles reflect different way perception of the reliability of the trip. In the current article is examining impact a reliability of the transport process on users.

2. Importance of the reliability of the public transport service

Along with growth of the economy increases and the mobility of the population. It must be recognized, that monitoring development of mobility (based on data from the National Statistics Institute), we see that the number of trips made by public transport is much smaller than those made by road (fig1).

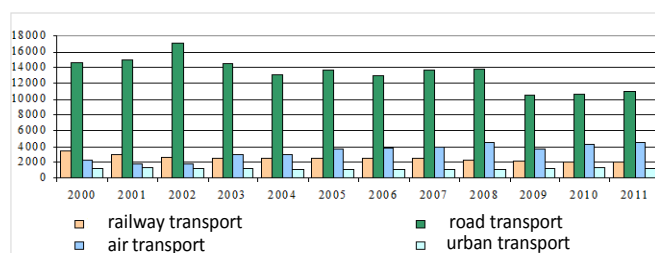


Fig.1. Work done during transport of passengers by modes of transport

To increase the role of public transport in total mobility is necessary significant improvement in quality of services, offering public transport. Enhancing the reliability of the transport service is one of the main factors for increasing hers quality.

It should be noted, that in public transport the main process is operation of the vehicles. The result of this process is vehicle journeys, including actual times of departure and arrival. The schedule in this case is of fundamental importance, because it defines the standards for time and place of travel. Ideally, the vehicles arrive and depart according to the scheduled time. In reality, large part of the trips does not coincide with those specified in the schedule. This is so, because transport system operates in an environment under the influence of a wide variety of influencing factors like: passengers and driver's behavior, weather conditions, road conditions and etc. Something more, the result of impaired functioning of the transport system is unreliable service, which itself leads to consequences for both transport operators and consumers.

The relationship between transport operators, users and reliability of service is presented in Fig. 2.

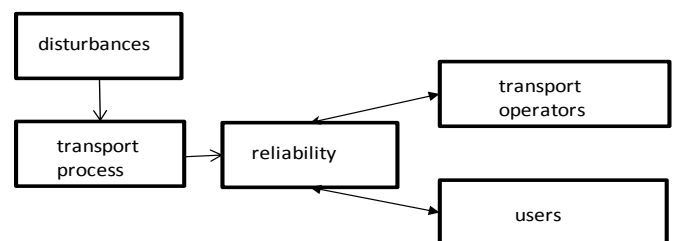


Fig. 2. Relationship between the passenger behavior, transport operators and reliability of the service.

Reliability of transport services is controlled by transport operators. By the level of reliability of the service provided, which the user perceives, supply side may affect in transport demand. Namely provided level of reliability of service determined this whether the traveler will use public transport services or would prefer another way of moving. Therefore reliability affects in passengers behavior.

The relationship between the demand side and the reliability of service is expressed in consumer behavior. They turn influence by increasing or reducing transport demand. It must be recognized, that both transport operators and users influence the reliability of the service, but without a doubt that reliability is important for both sides.

$$(4) \quad T_{w,l} = \sum_j (\alpha_{l,j} * T_{w,l,j}) \quad \text{with } \sum_j \alpha_{l,j} = 1$$

where:

$T_{w,l}$ - average additional travel time per passenger on the complete line

$\alpha_{l,j}$ - proportion of passengers of line l boarding at stop j

The resulting value (2.51 min) is lower compared to the values of other stops, wherein the additional time reaches to 10 minutes per passenger. The reason for this is the pattern of demand on the line. The majority of them, beginning their journey in the first stops, where additional time is less, respectively, and the average is lower compared to the values of the rest stops

It should be noted that unreliability leads to an average increase in the total travel time by about 36%, in terms that, the average travel time of a passenger is 7 minutes.

The second model is when passengers arrive randomly. This pattern is typical for passengers using services with high frequency. For them, to comply with an interval is the most important measure of reliability, because the headway between vehicles determined the waiting time.

Figure 9 shows the distribution of the irregularity of vehicles on stops from the routing line. The impact on passengers, transforming the irregularity in additional waiting time (Formula 5) is presented in Figure 10.

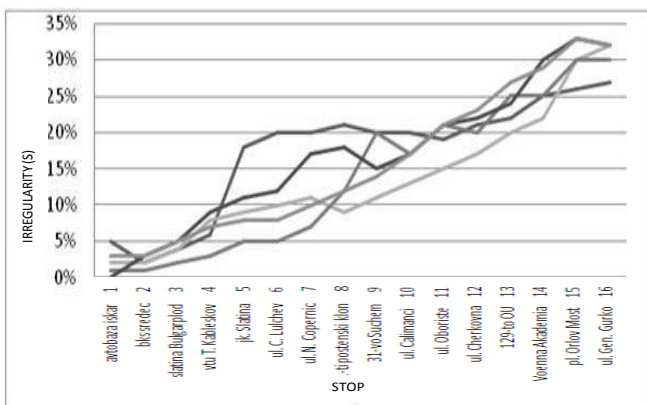


Fig.9. Irregularity of vehicles on stops

$$(5) \quad T_{(w)j} = \frac{H_j}{2} * \left(1 + \frac{VH_j}{(H_j)^2}\right)$$

where:

$T_{(w)j}$ – passenger waiting time at stop j;

H_j – actual headway at stop j;

VH_j – the variance of the headways at stop j.

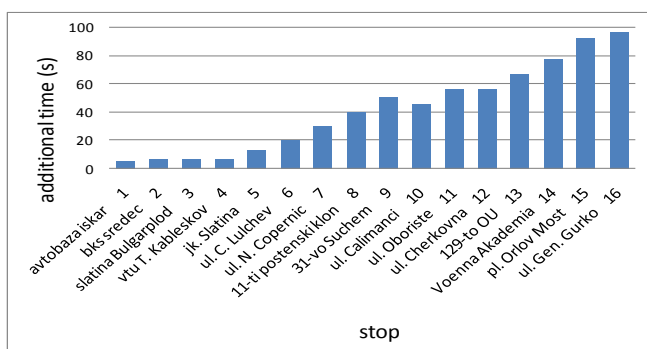


Fig.10. Average additional time per passenger per stop on bus line

The result again is that passengers at the end of the line are the most affected, because the total travel time will be extended by 10%.

In view of the results obtained, related to the effects of the reliability of provided service on users, we can conclude that the individual components of the travel time is influenced by variable headways, departure times, trip times and arrival times of vehicles (Table 1).

Types of service variability	Main impacts on
Variability of departure times	Waiting time
Variability of headways	Waiting time
Variability of trip times	In-vehicle time
Variability of arrival times	Arrival time

Table 1. Types of service variability

5. Conclusion

The variability of the service provided is an unwanted effect during operation of the transport system. The appearance of variability is the reason for reducing the level of reliability, which in turn has consequences for both transport operators and consumers.

In terms of the supply side, the unreliability is an expression of impaired functioning of the transport system, leading to inefficient use of resources, reduce demand, more costs and less revenue.

From consumer point of view, unreliability is expressed in extra travel time, which they could use for other more productive activities. The value of extended time (based on their experiences) the user takes into account in making process a decision. Exactly this value determines whether users will continue use the services of public transport systems, or would prefer another mode of transport.

The attention of transport operators should be directed to the analysis of reasons leading to the variability of service and focus on those of them, on which they can impact. In this way, they have able to take measures to reduce variability. This will enable them to meet the requirements of current users and the ability to attract new ones. Something more, reliability of the transport service, may affect the future use of public transport systems.

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