International Journal for Traffic and Transport Engineering, 2022, 12(3): 302 - 314

DOI: http://dx.doi.org/10.7708/ijtte2022.12(3).01 UDC: 656.025.2(497.11)

SERVICE RELIABILITY IN PUBLIC TRANSPORT – BUS LINE NUMERICAL EXAMPLE

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Received 1 July 2022; accepted 23 August 2022

Abstract: Reliability in the public transport system represents one of the characteristics of the quality of service, which influences the system's attractiveness and its potential for sustainable development. Reliability in the public transport system is characteristic of the system`s adequate performance in a specified time period. Reliability can be expressed via key performance indicators (KPIs). The precise evaluation of KPIs presents the approach in the reliability analysis. Line is a basic structural element of the public transport system. Line represents an example in reliability analysis and it can be used to develop a model that can be applied to the analysis of the entire system's reliability. This paper presented a numerical example of the quality of service KPIs in public transport. The developed methodology and the selected KPIs are applied on one bus line in the city of Belgrade.

Keywords: public transport, service reliability, key performance indicators.

1. Introduction

Public transport system is an open and complex organizational and technological system with stochastic change of operating conditions, where the main goal is to satisfy passengers' transport demand and as a final product, the system provides transport service. To be able to provide transport service continuously, it is necessary to eliminate internal and external disturbance factors. Current operational conditions, level, and intensity of disturbance factors can be determined via public transport reliability analysis and it represents the subject of this paper.

Reliability analysis is performed through several tasks. First, we define the quality of transport service and give a literature review. The next part contains a description of the research methodology defined and applied in this paper. The selection of the KPIs is presented in the next part, followed by the analysis of results and applied methodology. Conclusions of the analysis and proposals for future research are presented in the last part of the paper.

Quality of service in public transport is defined through sets of various transport service characteristics. For the reliability analysis, the most important sets of characteristics are service availability and service stability. Service availability includes the ability of the public transport system to provide the transport service at the moment required by the passengers and the ability to continually provide service in the required period. This set of characteristics contains

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two subsets which are service accessibility and service continuity. Service accessibility comprehends characteristics that refer to the ability of the public transport system to provide service in place and time where and when it is required. Service continuity is the ability of public transport to continually provide transport service in actual functioning conditions with a predefined tolerance margin. Service stability is the ability of the public transport system to continually provide transport service without excessive deterioration, and this definition indicates a high level of correlation between service reliability and service stability.

2. Literature Review

Key performance indicators (KPIs) are quantitative tools used to express a level of specified transport service characteristics. KPIs are significant parameters that can provide information about the current condition of the public transport system or one of its parts. KPIs can also be used in projecting and planning terms or in the assessment of the applied measures within the system.

Key performance indicators are elementary tools required for reliability analysis. Service reliability is the main subject of many literary works, and each contains KPIs that further explain various aspects of service reliability. Tica *et al.* (2021) states that the basic indicators of service reliability are coefficient of reliability, coefficient of punctuality and coefficient of regularity. The coefficient of reliability (k_p, equation 1) represents the ratio of the number of realized departures and the number of planned departures.

$$k_p = \frac{\left(\sum_{v=1}^{Nr} n_{T_v}\right)_r}{\left(\sum_{v=1}^{Nr} n_{T_v}\right)_p} \tag{1}$$

where:
$n_{T_{v,r}}$ – number of realized departures on the line;
$n_{T_{v,p}}$ – number of planned departures on the line.

The coefficient of punctuality (Kt, equation 2) determines the degree of on-time performance of departures. The coefficient of regularity (Kr, equation 3) indicates headway evenness on the line. Coefficients of punctuality and regularity are based on passengers' time loss expressed via planned and realized values of headway and the hypothesis that the arrival of the passengers at the stop is distributed uniformly, meaning that scheduled passengers' time loss is equal to one-half of the squared value of scheduled headway. Experienced passengers' time loss differs depending on the coefficients, where for the coefficient of punctuality, this indicator is the sum of half of the squared value of scheduled headway and numerical factors that describe deviations from the scheduled headway, but for the coefficient of regularity, this indicator represents half of the squared value of actual headway. These coefficients are graphically displayed in Figure 1.

$$Kt = \frac{\frac{1}{2}\sum_{k=1}^{n}(i_p)^2}{\frac{1}{2}\sum_{k=1}^{n}(i_p)^2 + \sum_{k=1}^{n} a*b} \tag{2}$$

where:
i_p – scheduled headway;
a, b – numerical factors that describe deviations from the scheduled headway.

$$Kr = \frac{\frac{1}{2}\sum_{k=1}^{n}(i_p)^2}{\frac{1}{2}\sum_{k=1}^{n}(i_r)^2} \tag{3}$$

where:
i_r – actual headway.

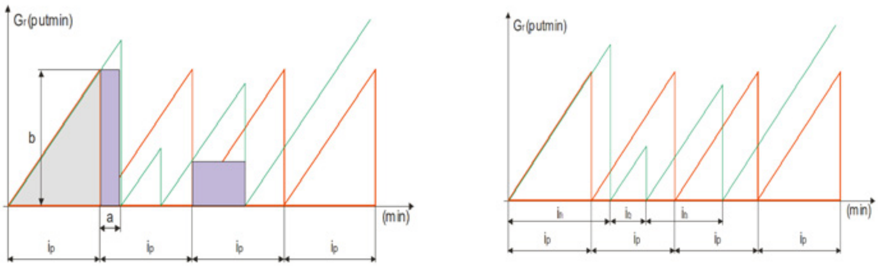

Fig. 1.
Coefficient of Punctuality (Left) and Coefficient of Regularity (Right)

Carrasco (2011) points out *travel time, speed, punctuality* and *regularity* as the most important indicators of service reliability. The author determined mean values, a statistical distribution of values and different percentiles for travel time and speed, while punctuality and regularity were determined through schedule deviation and headway deviation at different levels (route or stop). Kimpell *et al.* (2004) developed the model that defines the *optimal range of travel time* between median and 95th percentile travel time.

Van Oort (2011) based his research on two aspects of reliability in public transport. He defined indicators from the operator's point of view and the passenger's as well. From the passenger's perspective, Van Oort (2011) analyzes travel time and its components. From the perspective of the operator, analysis is based on the *headway* and *vehicle frequency deviation*, where the *coefficient of variation of headway* is emphasized. The coefficient of variation (CV, equation 4) is a ratio of standard deviation and scheduled value of headway.

$$CV = \frac{s_{i_r}}{i_p} \tag{4}$$

Besides the coefficient of variation, the same paper presents the *percentage regularity deviation mean* (PRDM, equation 5), which is an indicator that points out the difference between scheduled and actual headway. The author also highlights punctuality as the main aspect of reliability.

$$PRDM = \frac{\left|\frac{i_p - i_r}{i_p}\right|}{N_r} \tag{5}$$

where:
Nr – number of vehicles on the line.

Coefficient of variation is also a major indicator of reliability according to Figliozzi *et al.* (2012). They defined the *level of service* (LOS) as the indicator that puts the coefficient of variation in ranges marked by alphabetical letters from A to F. Criteria for the interpretation of this indicator is that LOS should strive for a higher range, meaning that the coefficient of variation should record smaller values (Table 1).

Table 1

Level of Service in Public Transport System

LOS	Coefficient of Variation Value Range
A	0.00 – 0.21
B	0.22 – 0.30
C	0.31 – 0.39
D	0.40 – 0.52
E	0.53 – 0.74
F	> 0.75

Another approach in reliability analysis is developed by Vincent and Hamilton (2008), who claims that components of public transport reliability are *punctuality, cancellations, variabilities around departure, travel and arrival time* and *waiting time variability*. Punctuality is defined as adherence to schedule, and cancellations present whether a scheduled vehicle actually arrives. Variabilities are defined as spread around scheduled values.

All of the mentioned indicators are based on statistical methods of interpretation. It is also possible to implement probability methods in the reliability analysis (Tica *et al.*, 2021), where indicators can be the probability of actual headway being smaller than or equal to the scheduled headway (equation 6).

$$P\left(i_r \leq i_p\right) = F(i) \tag{6}$$

where:
$F(i)$ – cumulative distribution function.

The same authors also define the probability of actual headway being within the margin of half of the scheduled headway (equation 7).

$$P\left(\frac{1}{2}i_p \leq i_r \leq \frac{3}{2}i_p\right) = F(i_p + \Delta i_p) - F(i_p - \Delta i_p) \tag{7}$$

The probability of actual travel time being smaller than or equal to the scheduled travel time (equation 8) is an indicator analogue to the KPI shown in equation 6.

$$P\left(Tp_r \leq Tp_p\right) = F(i) \tag{8}$$

KPIs can also be defined from the aspect of passengers and most of the indicators are based on waiting time or travel time. Soza-Parra *et al.* (2021) present an indicator that points out the time that passengers need to include in their travel planning to be completely sure that they will arrive at their destination on time. This indicator is named *reliability buffer time* (RBT, equation 9) and it is calculated as a difference between 95th percentile travel time and average travel time.

$$RBT = Tp^{95th} - Tp^{avg} \tag{9}$$

As presented in this section of the paper, service reliability has a variety of approaches and many indicators can be used to point out this segment of public transport functioning. The focus of the following section will be on the selection of the described indicators, with an explanation of the reasons for the inclusion or exclusion of each indicator in our methodology.

3. Selection of the KPIs

The elementary classification of the reliability KPIs is on the basic and the specific KPIs. Basic KPIs are indicators that point out the achieved rate of the dynamic elements of the public transport line, such as travel time, headway, and vehicle frequency. Basic KPIs also include indicators that refer to the quality of the performance of elements set up by the line’s timetable. These indicators are coefficient of reliability, coefficient of punctuality and coefficient of regularity. Specific KPIs are derived through the models that include a combination of basic KPIs among themselves. All of the key performance indicators are summarized in Table 2.

Basic KPIs included in this analysis are dynamic elements of the line, with the main focus on travel time and headway. Travel time is a component of the service reliability that has to be statistically processed, meaning that KPIs relating to this component are mean value, standard deviation, coefficient of variation, and parameters such as median and 95th percentile, which refer to the process of the optimization of travel time. Travel time in this paper is considered as a total time from the moment of the departure from terminal 1 to the moment of arrival at terminal 2. Mean value, standard deviation and coefficient of variation are also necessary for the presentation of actual headway on the line with a comparison to the scheduled values. Vehicle frequency shows the ability of the operator to provide the projected quality of service, and this indicator is also included in the analysis. Level of service (LOS) is the main specific KPI that encompasses analysis of the dynamic elements concerning the accomplished quality of service. Reliability analysis is concluded by the indicator that points of deviations of the headways (PRDM) and the indicator that shows the impact of line functioning on the passengers’ travel planning (RBT).

Some of the indicators mentioned in section 2 of this paper will not be included in the analysis. Speed is one of those indicators. Speed will not be included in the analysis because it points out the cause of the possible unreliable functioning, and the main goal of the analysis is to make the reliability evaluation. All of the models for the evaluation of punctuality and regularity will be excluded except the coefficients of these indicators, and the reason for it is the simplification of the analysis within these components of the reliability. Probabilities concerning travel time and headway will not be included also. Travel time is going to be analyzed through an optimization model, which makes this KPI unnecessary. Coefficients of punctuality and regularity have higher priority and they are also the more comprehensive KPIs than probabilities mentioned in the previous section. Indicators such as variabilities of departure, travel and arrival time are also excluded because these indicators require a timetable for each stop on the line, whereas some public transport system does not have this kind of timetable within their bus subsystem.

Table 2
Key Performance Indicators for the Reliability Analysis

Basic Indicators	**Symbol**	**Unit**	**Criteria**
Coefficient of reliability	k_p	-	max
Coefficient of regularity	Kr	-	max
Coefficient of punctuality	Kt	-	max
Travel time	Tp	min	
Mean value	Tp^{sr}	min	= plan
Standard deviation	s_{Tp}	min	min
Coefficient of variation	CV	-	min
Median	Me	min	
95th percentile	Tp {F(x) = 0,95}	min	min
Recovery time	Top	min	min
Headway	i_p	min	
Mean value	ir^{sr}	min	= plan
Standard deviation	s_{ir}	min	min
Coefficient of variation	CV	-	min
Speed	Vs	km/h	max
Vehicle frequency	f	voz/h	max
Specific Indicators	**Symbol**	**Unit**	**Criteria**
Level of service	LOS	-	A
Reliability buffer time	RBT	min	min
Percentage regularity deviation mean	PRDM	-	min
Probability of actual travel time being smaller than or equal to the scheduled travel time	$P\ (Tp_r <= Tp_p)$	-	max
Probability of actual headway being smaller than or equal to the scheduled headway	$P\ (i_r <= i_p)$	-	max
Probability of actual headway being within the margin of half of the scheduled headway	$P\ (1/2\ i_p <= i_r <= 3/2\ i_p)$	-	max
Average punctuality	Kt^{pros}	-	max
Relative vehicle frequency	fr	voz/h	max
Variabilities around departure, travel and arrival time	s (DT, TT, AT)	min	min
Waiting time variability	s (WT)	min	min
Cancellations	n_{pf}	-	min

4. Methodology

Reliability in public transport can be analyzed on many different levels, where the basic level is reliability analysis on the line. The first step in the analysis is to define the line that will be the main focus of the analysis. A few guidelines can be applied to filter and select the representative line. Those guidelines are:

- The line belongs to the subsystem with the highest proportion in the public transport system's modal split;
- The route of the line must be in the urban area;
- Only radial, diametrical and tangential types of the routes should be taken into consideration;
- Availability of the data, meaning that sometimes data from all of the lines or all of the operators are unavailable for the analysis;
- Vehicle frequency on the line, meaning that only high-frequency lines, with 5 or more vehicles per hour during the peak periods, should be included;
- Lines with the lowest values of the coefficient of reliability and the "extent of service", both calculated for the previous few months, where this period is defined arbitrarily, but must be at least 3 months long, for the more precise results.

The extent of service is the mean value of the percentage of realization of the effective hours and effective kilometers, where the term "effective" means that out of these indicators should be considered only those realized during the functioning process. The selected line should be the line with the highest absolute difference between the coefficient of reliability and extent of service.

After the line selection, the second step is to review the static and dynamic elements of the selected line. Dynamic elements include travel time, travel speed, headway, vehicle frequency, number of vehicles on the line, line capacity, and others. These elements can be found in the line's timetable or calculated from it. The period of the observations should not be shorter than five working days, during the period of a year with the highest transport demand in the system. Also, the focus of the observations should be on the peak periods of the day.

The third step of the analysis refers to the determination of realized values of the dynamic elements, which can be found in the automatic vehicle location (AVL) systems. This procedure introduces the next step, which is the main step in the analysis, and that is the evaluation of the selected KPIs. The last part of the analysis is the conclusion, with the propositions for the reliability improvements on the line. The methodology for the reliability analysis is presented in Figure 2.

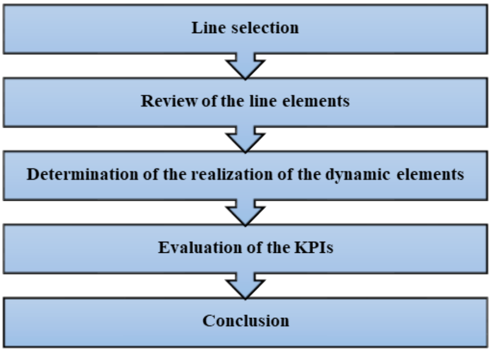

Fig. 2.
Public Transport Reliability Analysis Methodology

5. Results

The methodology that was presented in the previous section has been applied to the public transport system in the city of Belgrade. The mass public transport system of Belgrade consists of four subsystems, where the main role, from the aspect of modal split, belongs to the bus subsystem. Belgrade's bus subsystem network has 155 lines, with more than 1,100 vehicles engaged. This subsystem makes 44% of all trips made in the urban area of Belgrade, which means that nearly 1,800,000 passengers are being transported by bus. The line that was selected using defined guidelines is line 18 (Medaković 3 – Zemun /Bačka/). This line is diametrical, meaning that connects zones on the edges of the urban area, passing through the central city zone. The line has 69 stops divided into two directions, and the length of the line is 18.86 km. Dynamic elements are depending on the observed peak period and direction. Travel time is in the span of 51 min to 67 min. On line 18, the number of vehicles amounts to 21 articulated buses, with scheduled headway being between 6 min and 6.7 min, on average level. The length of the observation period is 5 working days during January.

The coefficient of reliability is around 91 percent, which means that over a hundred departures, out of nearly 1,400, have not been realized during the period of observation, which is shown by applying equation 1.

$$k_p = \frac{\left(\sum_{v=1}^{Nr} n_{T_v}\right)_r}{\left(\sum_{v=1}^{Nr} n_{T_v}\right)_p} = \frac{1{,}277}{1{,}395} = 0.9154$$

The coefficient of regularity analysis is divided into directions and peak periods. The best results regarding the mean value of this coefficient are recorded in direction A, AM peak period. In other periods and direction B, the results are similar, and in the range of 0.53 to 0.57, which points out that nearly half of the headways on the line were not realized according to the scheduled values. The exact results are presented in Table 3.

Table 3

Mean Values of the Coefficient of Regularity by Direction and Peak Period

Direction A		**Direction B**	
AM peak	**PM peak**	**AM peak**	**PM peak**
0.7135	0.5378	0.5610	0.5559

The coefficient of punctuality is analyzed the same as the previous KPI. Mean values of this coefficient (Table 4) show that approximately two-thirds of departures are realized accordingly to the timetable during the PM peak period and AM peak period in direction B. During the AM peak period in direction A, the results are slightly better.

Table 4

Mean Values of the Coefficient of Punctuality by Direction and Peak Period

Direction A		**Direction B**	
AM peak	**PM peak**	**AM peak**	**PM peak**
0.7506	0.6273	0.6788	0.6659

Using data from Belgrade's AVL system in the public transport, realized values of travel time have a high range of values, which indicates high values of standard deviation. These high ranges are characteristic of the peak periods, and these periods are highlighted in Figure 3.

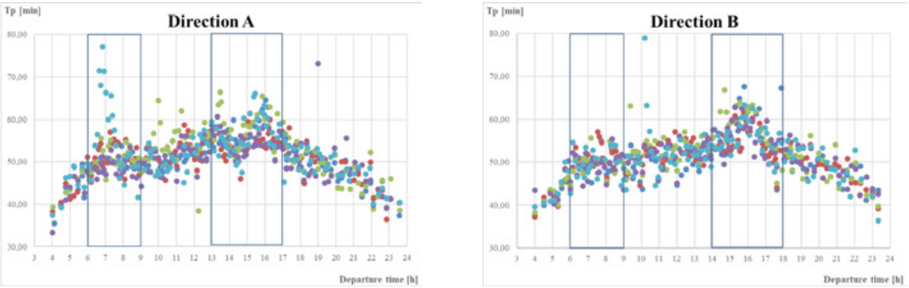

Fig. 3.
Realized Values of the Travel Time

Mean values of realized travel time are significantly higher in the PM peak period and values are around 55 min. Standard deviation records the highest values in AM peak period in direction A, but that deviation is the result of excess travel times in this period. As excess travel times are considered those that quite exceed the margin of 60 min. This result of standard deviation further leads to the high value of the coefficient of variation for this period and direction. The more precise period in terms of variability of values is the PM peak in direction B, with a higher density of values around the mean value, and records a coefficient of variation of around 0.07. The application of the optimization model shows that travel time optimization is necessary for most periods. Only AM peak in direction A has planned values within the optimal range. The most unfavourable case is recorded in the PM peak period in direction B, where some of the planned values are lower than the median. In the rest of the periods observed, the planned values exceed the 95th percentile travel time. All of the values mentioned in this paragraph are recapitulated in Table 5.

Table 5
Travel Time – Mean, Variability and Optimization Values by Direction and Peak Period

KPI	Direction A		Direction B	
	AM peak	PM peak	AM peak	PM peak
Tp^{sr}	51.44	55.32	49.93	55.08
$s_{(Tp)}$	5.48	3.79	2.52	4.27
CV	0.1066	0.0685	0.0504	0.0775
Tp plan range	53 - 60	56 - 64	51 - 59	51 - 67
Me	50.0	54.8	49.8	54.4
Tp {F(0,95)}	61.8	61.8	54.8	62.8

Headway analysis is focused on determining trends of mean values and standard deviation on the line. These trends are based on the stops. Mean values of actual headway are constant along the line route, in the range from around 7 to slightly over 8 min. An indicator that shows the percentage deviation of actual scheduled headway is PRDM and it shows that in direction A, these deviations are in the range from 11% to nearly 21%, depending on the peak period, while in opposite direction, these values are concentrated around 19%. These overruns of scheduled values require the inclusion of a standard deviation of headway in the analysis. Standard deviation trends are increasing with each stop, overcoming the margin of 5 min, which explains the mean value of actual headway being higher than scheduled. The higher values are recorded in the PM peak period, regardless of the direction (Figure 4).

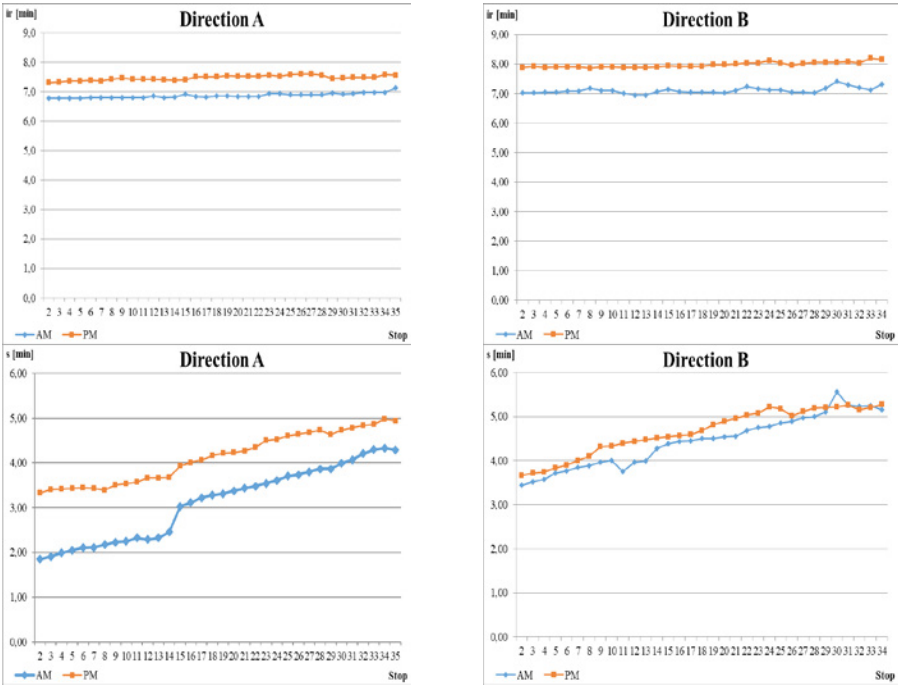

Fig. 4.
Mean Values (Upper Row) and Standard Deviation (Lower Row) of Actual Headway by Direction and Peak Period

The coefficient of variation of headway has the same trend as the standard deviation, meaning that increases with every stop on the line. This indicator shows mean values of 0.6075 and 0.7221 for direction A and direction B, respectively, which further means that level of service is in the range E. This points out a low level of service, considering the criterion.

Vehicle frequency is observed throughout the entire period of functioning during the day (4:00 – 24:00), and peak periods are parts of the day with distinct variabilities of this

KPI. The planned vehicle frequency was not realized to the required extent on any day during the period of observation. The highest value of planned vehicle frequency is 10 vehicles per hour, and lower values than this margin point out the shortage of vehicles on the line, and the operator's incapability of providing the required quality of service to the passengers. Higher values of realized vehicle frequency than planned, during the off-peak period, show the existence of delays on the line (Figure 5).

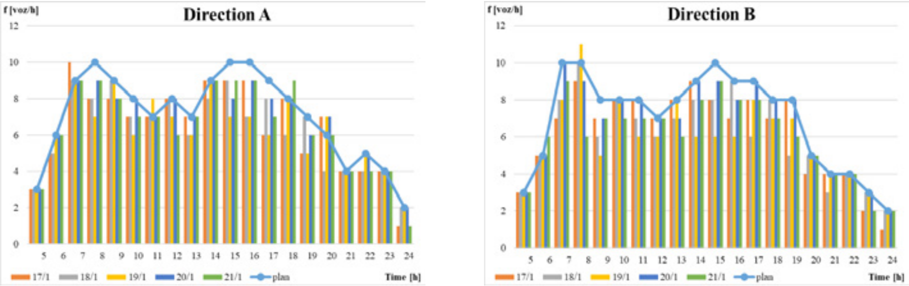

Fig. 5.
Planned and Realized Vehicle Frequency

The last of the KPIs is the reliability buffer time, which includes passengers' aspect of the quality of service. RBT can be determined via the difference between 95th percentile travel time and the mean value of travel time. In this analysis, the highest value of this indicator is in AM peak period, direction A, and it surpasses the margin of 10 min, while the lowest value is recorded during the same peak period in opposite direction (< 5 min). The previous statement means that reliability buffer time makes from 10% to 20% out of mean travel time. And with the hypothesis that most passengers do not travel from starting to end point on the line, these percentages can only become higher. Absolute values of RBT are shown in Table 6.

Table 6
Reliability Buffer Time

Direction A		Direction B	
AM peak	**PM peak**	**AM peak**	**PM peak**
10.62	6.46	4.92	7.73

6. Conclusion

One of the tools for representing the quality of transport service in the public transport system is reliability analysis. The subject of the analysis can be the entire public transport system or certain parts of it. The simplest approach is to develop the methodology based on the line of the system because the line is the basic structural element of the public transport system, and this approach was applied in this paper. The methodology of the analysis is based on the systemic approach, where the analysis is decomposed into five steps, which need to be conducted in the defined order. Line selection was defined as the first step, followed by the review of the line's elements and determining the realized values of the dynamic elements. The final steps were the interpretation of the obtained values and the conclusion of the analysis.

The representation of the reliability was made over the number of departures on the line, where the reliability was expressed as the ratio of the realized and planned number of departures. Reliability analysis is more complex than this way of its presentation, and it included other aspects that also show a level of quality of service on the line and these aspects are punctuality and regularity. Punctuality shows the level of compatibility of realized departures with the timetable, while regularity points out actual headway compatibility with planned values.

Besides these indicators, reliability analysis was evaluated over the realization of a line's dynamic elements. Elements that stood out were travel time, headway, and vehicle frequency. Reliability analysis provided models that enable travel time optimization. Headway analysis was necessary to determine the level of service on the line. Vehicle frequency showed the operator's ability to provide the required quality of service defined by the timetable. Dynamic elements with punctuality and regularity made a group of basic indicators of reliability. The specific indicators were evaluated by the combination of certain basic indicators, and these indicators pointed out some elements within the basic KPIs, such as headway deviation mean or reliability buffer time.

The numerical example presented in this paper showed unstable trends of many KPIs, which were observed based on the line direction and peak period. The coefficient of reliability showed that almost 10% of the planned departures have not been realized. Analysis of regularity showed that in most of the periods, only a little bit more than a half departures are realized according to the scheduled headway. Punctuality also showed an unstable trend, where the percentage of departures realized according to the timetable is in the approximate range of 60% to 75%, depending on the observed period. Travel time analysis pointed out the necessity for the optimization of this indicator in both peak periods in direction B and the PM peak period in direction A. Headway analysis presented the increasing trend of standard deviation concerning the number of stops on the line. In direction B, the value of the standard deviation of headway increased over 5 min, which is very close to the value of scheduled headway. This further means that the coefficient of variation of headway is also high, and that is summarized through the level of service, which is in range E. Vehicle frequency showed the inability of the operator to provide the planned number of vehicles on the line. Reliability buffer time pointed out high values of the time that needs to be added during the passenger`s travel planning.

The reliability analysis model that is presented in this paper is based on an evaluation of the reliability. Determination of the factors that destabilize the functioning of the public transport system can be the next step of this kind of analysis. Also, with the inclusion of the passengers' flow, the analysis could evaluate the influence of the reliability on the passengers. Reliability is an important part of the public transport system, and with the analysis of it and with a continual observation of the reliability aspects, it is possible to make improvements to the system's functioning, which further improves the satisfaction of both passengers and operator(s).

References

Carrasco, N. 2011. Quantifying public transport reliability in Zurich. In *Proceedings of the 11th Swiss Transport Research Conference,* Monte Verita, Ascona, 1-26.

Figliozzi, M.; Feng, Wu.; Lafferriere, G.; Feng, We. 2012. *A Study of Headway Maintenance for Bus Routes: Causes and Effects of "Bus Bunching" in Extensive and Congested Service Areas.* Portland State University, USA. 68 p.

Kimpell, T.; Strathman, J.; Callas, S. 2004. *Improving Scheduling Through Performance Monitoring Using AVL/APC Data*. University of Wisconsin, USA. 54 p.

Soza-Parra, J.; Raveau, S,; Munoz, J.C. 2021. Public transport reliability across preferences, modes, and space, *Transportation* 49: 621-640.

Tica, S.; Živanović, P.; Bajčetić, S. 2021. *Technology of Passenger Transport [In Serbian: Tehnologija transporta putnika].* Faculty of Transport and Traffic Engineering, Serbia. 376 p.

Van Oort, N. 2011. *Service Reliability and Urban Public Transport Design*. Delft University of Technology, Netherlands. 276 p.

Vincent, M.P.; Hamilton, B.A. 2008. *Measurement Valuation of Public Transport Reliability*. Wellington: Land Transport New Zealand, New Zealand. 128 p.