The aim of this paper is to analyze reliability indicators for the public transport system of Sibiu city, specifically one of the most crowded routes. The approach is applied to the real task of estimating reliability for Sibiu city public transport route. This way, the assessment of public transport benefits will be substantially improved.

**Keywords** — urban public transport, reliability, passenger waiting time

**I. INTRODUCTION**

The current passenger transport has become an element of human life standard, offering everyone the opportunity to travel, communicate, perceive, assimilate, etc.

This transport activity has come to account for 10% of EU GDP, namely 4.5% in Romania. In the context of the development of urban areas, passenger transport plays a vital role because it contributes to the transport demand rhythmically, safely and with an appropriate degree of comfort. Parallel to these positive aspects, it has also negative aspects:

1) Traffic jams;
2) The time lost in traffic jams;
3) Environmental pollution by exhaust gases;
4) Noise, etc.

Ensuring a quality public transport has become a priority issue because of traffic congestion in big cities because of the increasing number of cars. Using public transport instead of private cars would solve both traffic congestion and negative issues derived from it: pollution, congestion, stress, delays, etc.

Increase of economic efficiency in transport activity must be conducted through the rational use of vehicles and high problem-solving and programming modernizing transport capabilities [1]. For this it is necessary to know the transport demand, to determine the most economical routes and deploy vehicles depending on the size of passenger flow distribution by developing so-called free programs that meet the demands of the route. Urban transport, in particular, its main component, public transport of passengers, must be viewed in the context of the overall development of the city, its political and social cultural importance, determined by the extent of the territory served, number of inhabitants, transport demand and the specially volume variation in time and space.

By the urban passenger transport we achieve a reduction in lost time for moving to time for rest, relaxation, self-training, children’s education, business and political concerns [2] - [4].

Lack of transport system reliability affects the travelers by additional increasing of the waiting time early or late arriving at destination, lost of the links [3].

The aim of this paper is the analysis of reliability indicators for public transport system of Sibiu city, specifically one of the most crowded routes.

**II. RELIABILITY OF URBAN PUBLIC TRANSPORT IN SIBIU**

A. Factors affecting the reliability

Reliability of a transportation system depends on a number of factors such as traffic volume carried by a bus/day trip, transfer time, waiting time, transport network density, coefficient of agglomeration [5] - [6].

Thus,

1) **Traffic volume** (number of passengers carried is given by):

\[ Q_{zi} = \sum Q_i \]  \hspace{1cm} (1)

where:

\[ Q_n \] - the amount of traffic carried by a car per day

2) **Journey time is determined** by: position stations, service frequency influencing waiting times, traffic characteristics, the system of payment of the journey, etc.

3) **Waiting and transfer times are delaying trip**.

Passengers value the waiting time for urban transit almost twice the in-vehicle time, [7] - [8].

\[ RW_{it} = AWT_{it} - SWT_{it} \]  \hspace{1cm} (2)

where:

AWT- Actual wait time

SWT - Average scheduled wait time

High waiting times in a public transport network is highly likely to affect the patronage and is therefore an important factor to focus on.

4) **Average length of travel**
The selection of the route was made on three criteria:
1) Frequent service having headways of less than 10 minutes: in cases of frequent service, the average wait time is half the headway as passengers arrive randomly at the bus stop.
2) Availability of secondary information: the collects data on bus arrival times at the bus stops with their on-board GPS-based own vehicle tracking system.
3) Entry time in roundabouts.

After the collected data there were established the stations serving mostof the routes. These are: Mcdonalds and Simerom stations with 10 routes, also we have 3 stations serving eight routes. The Theatre, Nufarul and Lidl Alba Iulia. A double number serving seven routes: Alba Iulia station, Muzeu, Parcul tineretului, Polisib 1 Simerom, County Hospital. Serving a large number of routes some stations have a flow of over 5500 travelers from Monday to Friday, Fig.2.
Since A11 route serving West Platform is one of the busiest routes in the city reliability of this route was examined.

This route stretches along Boulevard and Highway V. Milea and Alba Iulia streets that are crossed by a large number of vehicles.

The streets served by route, passing through the center of Sibiu, a situation that leads to heavy traffic they intersect the majority arteries often resulting in traffic jams.

At the requirements of passengers there was a deviation of the route to facilitate access to jobs. It created a reconfigured route, creating one-way streets, and subsequently went to the creation of new streets for this route, by the Municipality of Sibiu.

The average number of passengers on this route can be seen in Fig. 3 with the 2 peak hours. To assess the reliability of public transport system in Sibiu we took into account the indicators in table II. They are the ones who minuses and pluses highlighted transport activity evaluated.

On the basis of these parameters were calculated as follows:

1) The volume of passengers

According (1) the number of passengers carried on the route A11 is \( Q_{ci} = 176 \times 12.5 = 2200 \text{ bus/day} \), and for all buses \( Q_{ci} = 176 \times 50 = 8800 \).

2) Travel Time

The reliability of travel duration was calculated for the entire route of the bus A11, and the results are shown in table III.
the result travel time reliability measures low, on route sections A11 to Cedonia and from Continental to the bus station, indicating that the measure is capable of depicting the observed problem areas.

3) Passenger wait time

The last reliability measure calculated was the excess wait time. The average wait time for boarding a frequent service is half the headway; in the case of Route A11, it was 2.52 min. The actual wait time of passengers were derived from the model outputs on total passenger waiting time and the number of waiting passengers. The expected wait time of 3 minutes was subtracted from this to get the excess wait time for each service at each bus stop.

4) The average length of a passenger traveling on the A11 route according to (3) is 3.7 Km.

The excess wait time for the individual services are shown in Fig. 4. When the (actual) headways were over 4 minutes, the excess wait time increases with increasing headway. The highest excess wait time was observed on the 07:30 service which had an actual headway of 20 minutes.

To make this route reliable and reduce waiting times in stations, 2 more buses were introduced between the hours 07.15-9.10 AM and 14.30-16.30 PM, because the first interval is passenger flow by moving to jobs, and the second interval is largely return to their point of origin or moving purposes other than professional.

III. Conclusion

This study was aimed the reliability of Sibiu public transportation performed by S.C. Tursib S.A. and the particular route A11. We chose this route because it serves the western industrial zone, which has undergone an extensive and rapid development through the set up of multinational companies that attract a large number of employees.

After analyzing the resulting increase in the number of buses serving the route that rose to 4 in the hours 07.30-9.10 AM and 14.30-16.30 PM. The monitoring of reliability of public transport from Sibiu and in particular quality its should be a daily practice.

REFERENCES


