

Marko Stanković, BSc¹
E-mail: marko@busroutes.io

¹ Bus Routes
Novi Sad, Serbia

OPPORTUNITIES OF INTELLIGENT TRANSPORTATION SYSTEMS FOR PUBLIC TRANSPORTATION

Key Words

Public
transportation;
ITS;
Big data

Abstract

Cities that have yet to implement intelligent transportation system give us great opportunity to analyze current state of public transportation and measure how well public transportation companies in those cities are fulfilling demands. Many companies involved in public transportation around the world are relying on outdated forms of data collection from their users. Lack of proper data causes those companies to operate in sub-optimal way organizationally, financially and operationally. Team behind Bus Routes software platform took Novi Sad as example of a city without implemented ITS for analysis. It turns out that 82.4% of survey participants experience some kind of incident with public transportation daily. Those incidents range from being late to important event, not knowing when bus is going to arrive or experience missing scheduled bus journeys. This paper provides suggestions on how most valuable data from users of public transportation can be acquired which presents great opportunities for all companies involved in public transportation worldwide to serve people in a better way by analyzing it and providing better service while lowering expenses.

1. INTRODUCTION

The way that public transportation companies are creating their timetables, driving schedules and projections of customer behavior is mostly based on trends in tickets sales and surveys. Most of the time surveys are conducted over few weeks in different parts of the city.

Usually questions are structured in such a way so that participants in public transportation give answer about when they require transportation during the day. Examples of questions in these kinds of surveys are: “When do you usually leave for work”, “When do you usually make a return trip” and “How do you travel to initial station where you wait for public transport” [1].

There are variety of models of surveys that use different forms, questions and sampling techniques [2].

The idea behind survey is to provide random sample of real users of public transportation and based data gathered help traffic planner predict and anticipate the volume and demand for public transportation.

While these surveys themselves are good and give some insight into needs of end-users this kind of approach in data gathering can be misleading and could cause unnecessary additional expenses for companies involved in public transportation.

Projections based on partial data can cause companies to create suboptimal timetables as well as cause them to use their resources sub-optimally. The reason why is because when surveys are filled in they aren't taking into consideration weather, city-wide events or time of the year and in some cases time of the day. The results are adjusted statistically based on those parameters or they are ignored completely. All mentioned factors greatly alter behavior of those who need and use public transportation.

The missing data of those times when surveys aren't conducted and data from people who haven't participated in surveys can be acquired by using intelligent transport systems (ITS) and big data analysis. The role of ITS and analysis of data is that it should give complete overview of end-user behavior and demand for transport year round.

2. CURRENT TRENDS IN PUBLIC TRANSPORTATION

There are huge efforts being made all over the world to lower the number of vehicles especially private single occupancy vehicles. The reason why this is the case is that private vehicles create additional strain and burden on existing traffic infrastructure which causes traffic jams, more traffic accidents and difficulty of keeping transportation effective in urban areas.

Many cities are adopting policies that are having demotivating effect on citizens that are using private vehicles in those cities. Some of the policies involve increased pricing for public parking spots or increasing number of cycling lanes so that bikes can be used as alternative to daily migration.

The matter is sometimes worse due to increased number of people that are using ride sharing services like Uber and Lyft which have set a new standard of customer experience [3-4].

EU is stimulating public transportation campaigns and promoting it as much as possible [5].

They are advising usage of C-ITS - coordinated intelligent transport systems which is a strategy that recommends actions to create synergy between different initiatives and improve interoperability as well as recommending adopting customer-centric mindset and prioritizing sustainability [6].

At the moment companies that are involved in public transportation have great challenges ahead of them. Their goals aren't just to provide transportation services to citizens but to be accountable and reliable. Transportation in urban areas needs to be as, if not more, reliable than all other means of transportation in order to be attractive to end-users. Public transportation companies need to offer same customer experience that ride sharing applications are offering in order to be considered by some end-users.

3. INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent transport systems are systems that encompass traffic management, helping drivers and overseeing the movement of vehicles. ITS is used in traffic lights, roads, and bridges, to establish an interconnected transport system with direct communication between vehicles and devices. ITS can control traffic so it runs smoothly and public transport runs according to schedule. ITS sees that citizens can retrieve real-time information about traffic and public transportation and it can provide valuable data to companies involved in public transportation based on which they can serve everyone on higher standards than ever before.

Implementing ITS minimizes pollution because it promotes usage of public transportation in general masses. By providing real-time data about transport schedule, delays, cancellations they provide great alternative to private vehicles. The more people use public transportation less private vehicles are involved in traffic thus lowering traffic congestion and lowering pollution levels. Having ITS in place would allow cities, public transportation companies and anyone involved in traffic to benefit from it. Timetables, route information and payment systems would be electronic. Ease of use encourages travelers and tourists to use public transportation instead of ride sharing applications. Part of ITS are mobile applications that are used to provide users of public transportation with real-time data but they also collect data about users behavior which and it can provide year round complete overview with visible changes for the demand for public transportation over the holidays, summer, vacation season, daily migration, etc.

4. PUBLIC TRANSPORTATION WITHOUT ITS - CASE STUDY OF THE CITY OF NOVI SAD

Novi Sad is the second largest city in Serbia with urban population of 277,522 and the only form of public transportation is road transportation and it is specifically by bus. Which is the case for many cities in Europe where buses are also the only way public transportation operates. Even though there are suggestions from EU to

diversify the ways transportation operates in urban areas buses still make up 83% of all public transportation journeys worldwide [7].

The Public City Transport Enterprise of Novi Sad has not yet implemented any Intelligent Transportation Systems at the moment and as such is a great example for analysis how public transportation operates without having any ITS implemented.

In 2018 informal survey was completed in order to find out how satisfied end-users with public transportation services in Novi Sad are [8].

Survey results concluded that:

- 12% of participants aren't satisfied with transportation services
- 36% are partially satisfied
- 79% had incidents where they missed important event because bus was late
- 65% rely on taxi services when time is of the essence

The team behind Bus Routes conducted another survey in summer of 2019 specifically targeting Novi Sad. This time there was 846 participants and most of them were students between the age 19 and 26. Students were chosen as a focus group because they are using public transportation for their daily migration most consistently in Novi Sad. Goal of the survey was to find out how often is focus group late to important college or work related events and what is the frequency of those incidents. Results were following:

- 82.4% of participants experience such incidents daily
- 15.4% of participants experience them from time to time

One important thing to note is that huge majority more than 80% expressed desire to know where the bus is and when it's coming without having to predict that themselves based on timetables.

Novi Sad could benefit greatly from implementing ITS.

5. DATA ITS CAN PROVIDE

Mostly companies involved into public transport analyze the data they have which is usually one time survey. The idea behind survey is to provide random sample of real users of public transportation and based on that help traffic planner predict and anticipate the volume and demand for public transportation.

That doesn't have always to be the case. Depending on day if there was for instance big city event survey will have different profile of people filling it in. Ticket sales also are partial indicator of true need for public transportation. Tickets sold at specific time just isn't good enough metric for determining the demand for transportation. That is only a metric of those who actually participated in that journey but the missing subtle data point are all people who wanted to use transportation but were unable because they waited for transport for too long or they used inaccurate timetable and they were forced to use any other means of

transportation. More convenient, reliable and on-demand service will always win the customer.

Public transportation companies that rely on surveys and tickets sales as data which they use to model their driving schedules, timetables and frequency of transport journeys are missing key data points. The demand for public transportation is dynamic and changes on daily basis.

By having the public transportation demand data from users companies can provide better service to the people while minimizing expenses.

In this day and age there are a lot of applications that offer information about public transportation in certain cities. Google transit, Transit app, Moovit app are just a few examples of this new trend [9-11].

These applications boost ticket sales because of the data they provide to users of public transportation. Even though they don't contain support for canceled trips.

Most of those applications don't give the most valuable data back to the transportation companies which traffic and data analysts can use it in their analysis of demand for transportation in urban areas.

Most valuable data points for transportation analysis are:

- sheer volume of people by time of the day and time of the year
- which lines are needed and when
- which bus stops are points of interest and when
- vehicle capacity utilization

All the parts of cities including suburbs have different kinds of demands for transportation depending on time of the year and even time of the day.

Public transportation companies need to have control over the data that users are generating in order to properly anticipate and predict demand and come up with proper response to fulfill that demand.

Public transportation companies that are having the data would allow them to optimize operating procedures and cut costs. Knowing how many passengers are using which bus line at what time is one of the most important data points for any company that deals with public transportation. The more knowledge companies have about how their routes are being used the more cost efficient they can be in deploying their resources.

They can predict targeted increases in ticket sales. Having big data at your disposal can create system-based sales forecast based on historical data. Of course big data applications can do more than that. They can employ techniques of machine learning to accurately predict customer behavior based on weather, city-wide events, holidays, previous predictions... All this allows companies to improve timetables, better predict customer behavior and act in a more customer-centric way.

Some experts advise cities to fully delegate their public transportation or partially delegate some aspects of public transportation to ride sharing companies. Many of them are citing Uber and Lyft as great candidates that are popular but due to

regular financial losses that those companies are suffering every quarter it is very risky. Risk comes from the fact that if those companies were to shut down or be dissolved due to their financial problems cities that use them to assist public transportation could come to a grinding halt [12].

6. CONCLUSION

With trends of increased number of people in urban areas that are migrating great strides are being made from government bodies and also local authorities to keep private vehicles off the roads and provide great public transportation.

Opportunities for ITS and data analysis are vast and should be used in order to provide best possible value to most people. Companies involved in public transportation that are neglecting customer experience could be easily solved with proper application of software, ITS and data analysis of customer's needs. Using big data application systems would lead company to being more in line with current trends in EU that are striving to minimize greenhouse emissions while reducing operational costs and improving customer experience.

REFERENCES

- [1] Regional Agency for the Development of Small and Medium Size Enterprises,, "STUDIJA INOVACIJE I REORGANIZACIJE PREDUZEDA ZA JAVNI GRADSKI TRANSPORT PUTNIKA U SUBOTICI," Subotica, 2012.
- [2] E. S. A. A. H. M. Anthony J. Richardson, Survey Methods for Transport Planning.
- [3] Uber, [Online]. Available: <https://www.uber.com/>.
- [4] Lyft, [Online]. Available: <https://www.lyft.com/>.
- [5] UITP Europe, "UITP PRIORITIES FOR EU POLICY 2019-2024".
- [6] E. C. -. M. a. Transport, "Transport in the European Union - Current Trends and Issues," 2018.
- [7] UITP Europe, "Financing schemes for bus electromobility in Europe," 2019.
- [8] M. Stanković, Software application for public transport management using Clojure programming language, Novi Sad: Faculty of Technical Sciences, 2018.
- [9] Google, "Google Transit," [Online]. Available: <https://maps.google.com/landing/transit/index.html>.
- [10] Transit, "TransitApp," [Online]. Available: <https://transitapp.com/>.
- [11] Mooveit, [Online]. Available: <https://moovitapp.com/>.

- [12] A. Sammon, "When Cities Turn to Uber, Instead of Buses and Trains," 2019. [Online]. Available: <https://prospect.org/infrastructure/cities-turn-uber-instead-buses-trains/>.