



## Improvement of the public transport system in Novi Sad by applying the journey planning app – project TRIBUTE

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### ABSTRACT

A well-organized public transport system, which includes, among others, the provision of quality information to users, is one of the key factors in the creation of a sustainable transport system. Residents' everyday needs mainly include the use of cell phones, so their use in the context of the information system in public transport via a smart phone application is a practical way to make this mode of transport "at hand" of users. This paper outlines the activities on improving the public transit system in the city of Novi Sad carried out through the TRIBUTE project - inTegRated and Innovative actions for sustainaBle Urban mobiliTy upgradE. Improvements to the public transport system have been achieved through the mobile app and its integration with the taxi and bike-sharing system, and information displays on bus stops.

## 1. Introduction

The tendency of modern society to use private passenger cars and the need to be mobile, combined with the low occupancy rate of passenger cars - an average of 1.7 passengers/pa (Fiorello, Martino, Zani, Christidis, & Navajas-Cawood, 2016), very often leads to conditions the result of which is a burdened and not infrequently congested street network in cities. Traffic in cities faced with these challenges needs efficient and sustainable solutions and mobility services that are adapted to today's needs of citizens.

Within the EU 2020 Strategy (European Commission, 2010) the potential social, environmental, and economic benefits of multimodal mobility solutions are emphasized. Accordingly, the TRIBUTE Project is conceived as a set of activities within which, among other things, practical solutions aimed at the promotion and development of sustainable mobility will be applied. Over the past years, the City of Novi Sad has implemented various activities that include the creation of strategic documents, traffic policy measures, reconstruction and regulatory measures aimed at

improving sustainable mobility and resolving traffic problems in this city. This paper describes the activities of the City of Novi Sad - the City Administration for Traffic and Roads and the Public City Transport Company of Novi Sad, which were implemented within the TRIBUTE Project.

## 2. TRIBUTE Project

The TRIBUTE project was aimed at testing the possibility of integrating innovative tools and implementing activities related to the creation, i.e. improvement, of sustainable urban mobility in the cities of the Adriatic-Ionian region (AI region) through the creation and implementation of eight "living laboratories". The activities on the TRIBUTE Project were implemented within the framework of eight action plans and pilot projects that include innovative and sustainable solutions, from innovative public transport services and on-demand services using electric vehicles, to a network of "green" bicycle paths and integrated systems for public transport and car management along congested corridors

Through the implementation of the defined objective, the TRIBUTE Project should in the future achieve the promotion of international co-operation between public authorities and their transport entities. In this way, it is possible to create strategic elements intended for planners and decision makers related to mobility in a sustainable and integrated transport system.

The project was implemented through the participation of nine partners (Politecnico Milano, City of Milan, City of Ljubljana, City of Maribor, City of Zagreb, City of Patra, City of Sarajevo, City of Podgorica and City of Novi Sad - City Administration for Traffic and Roads) and six associated partners (City of Igumenica, City Public Transport Company Novi Sad, Zagreb County, Tourist Board of Zagreb County, Tourist Board of the City of Zagreb and Regional Development Agency of the Ljubljana Urban Region).

**Table 1** Basic information about the TRIBUTE Project

Project title	inTegRated and Innovative actions for sustainaBle Urban mobiliTY upgrade (Integrisane i inovativne akcije za održivu nadogradnju urbane mobilnosti)
Project acronym	TRIBUTE
Programme	Adriatic-Ionian Transnational Programme - "ADRION"
Programme priority	Priority 3. Connected regions
Specific objective of the priority	Improvement of capacities for integrated transport, mobility and multimodality services in the Adriatic-Ionian region.
Name of the Lead partner	Politecnico Milano
Project duration	30 months (from January 1 <sup>st</sup> , 2021 to June 30 <sup>th</sup> , 2023)
Total Project budget	3.269.400,00 €

Source (Interreg ADRION, 2022)

### 2.1. The role of the City of Novi Sad in the TRIBUTE Project

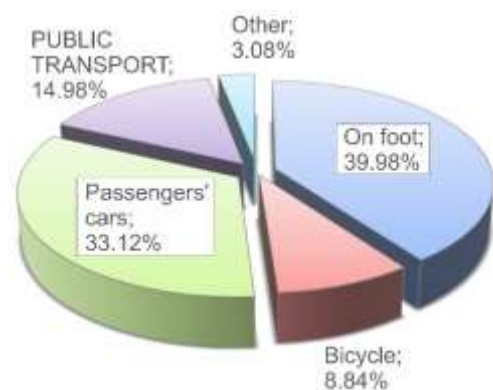
City of Novi Sad - City Administration for Traffic and Roads participated as a programme partner within the TRIBUTE project. The basic idea of the Novi Sad pilot project is based on the introduction of an application for smart mobile phones that will enable service users to be informed about public bus transport, by providing information about the arrivals/departures of buses on one of the public transport bus lines. In addition, the above-mentioned application provides information on additional publicly available transportation services (taxi transportation and bicycle rental) so that users have the opportunity to plan city transportation in a way that satisfies and fully adapts to their individual needs. In addition, it is planned to install displays with information about bus arrivals/departures at several of the busiest city bus stops served by the bus line number 4, so that all the citizens who do not use smart phones and applications (e.g. senior citizens) can get the necessary information about public transportation in real time.

The practical implementation of the pilot project was realized through the participation of the City Public Transport Company Novi Sad (JGSP), which participated in this project as an associated partner. The activities on this project are carried out by the City of Novi Sad and JGSP in five steps:

1. Procurement and placement of GPS devices in buses and displays with information at bus stops;
2. Creation of an application for smart phones with information about public bus transport and alternatives;
3. Promotional activities;
4. Collecting, analyzing and summarizing the key results of the pilot from all relevant participants in order to create a transnational strategy;
5. The establishing of a "living laboratory" in which the participation of all relevant stakeholders in the field of transport (working bodies founded by the City of Novi Sad, higher education institutions, civil society, business entities, etc.) is planned, including end users.

### 3. Public transport in the City of Novi Sad

According to the latest research on the characteristics of the traffic system in the City of Novi Sad conducted in 2017, an increase in the number of trips compared to 2009 was determined. However, compared to the situation in 2009, there have been changes in the visual distribution of trips. According to the results of research carried out in 2017, there was a decrease in the number of trips made by public transport by 6.5%, i.e. the share of public transport in the total modal distribution of trips in 2017 was 14.98% (Faculty of Technical Sciences Novi Sad, 2019). The following Figure shows the percentage participation of other modes of transport in the total number of trips made during the day.

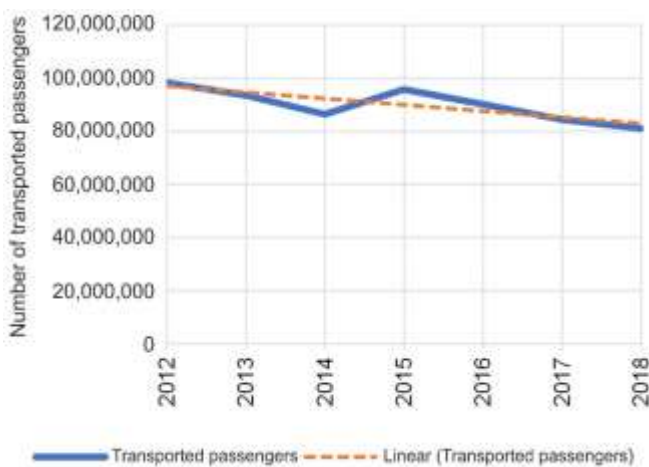


**Figure 1** Modal split in Novi Sad in 2017

Source (Faculty of Technical Sciences Novi Sad, 2019)

During the previous period, due to various circumstances, there was a change in certain operating parameters of the system of the city and suburban passengers public transport in the territory of the City of Novi Sad. The activities carried out by the City of Novi Sad and JGSP followed the change of the street

network and the dynamics of the city's constructional development, so the routes were changed and certain lines were reorganized. The increase in the degree of motorization and the degree of use of cars, the decline in quality and unfavourable operating conditions of public transport affected the decrease in the attractiveness of using the city public transport, which resulted in a constant decrease in the number of transported passengers. The number of passengers transported by public transport in the period 2012 - 2018 recorded a constant decline at an average annual rate of -2.7%. In absolute terms, the reduction in volume amounts to 12.7 million transported passengers or about 2.5 million transported passengers per year (Faculty of Technical Sciences Novi Sad, 2019).

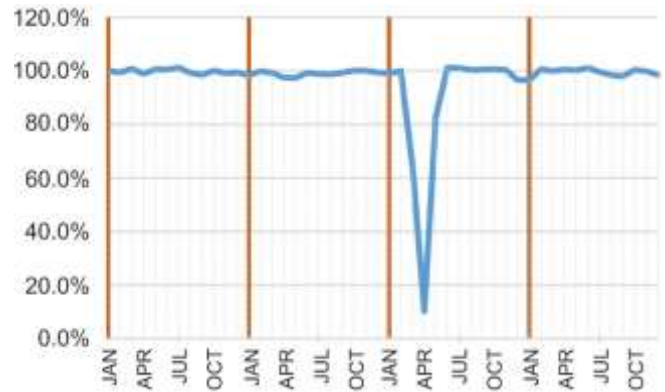


**Figure 2** The trend of transported passengers in public transport in the period from 2012. – 2018  
Source: (Faculty of Technical Sciences Novi Sad, 2019)

On the other hand, the general decline in the level of service on the street network, i.e. the intersections and the lack of priority for public transport vehicles, affected the increase in travel time, which also affected the decrease in attractiveness. Additionally, the passenger information system as an important element of the public transport system is reduced to publishing static timetables, which are sometimes not implemented for objective reasons.

### 3.1. Impact of COVID-19 virus pandemic

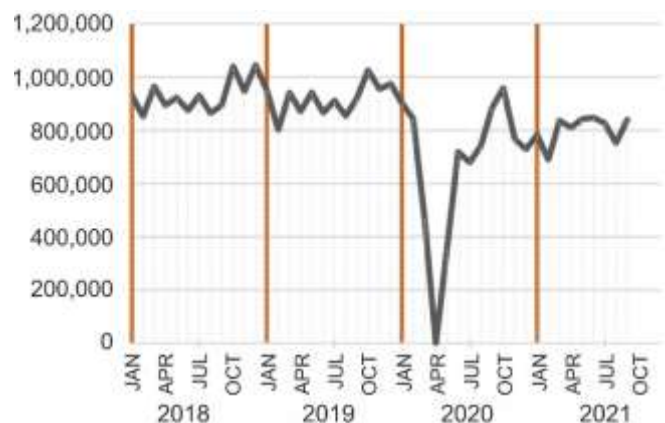
At the beginning of 2020, the global problem of the spread of the COVID-19 virus pandemic had a large, and apparently long-lasting impact on the public transport system in the City of Novi Sad. At the very beginning, the measures to prevent the spread of the pandemic had a direct impact on the implementation of the timetable, that is, on the reduction of transport work.



**Figure 3** Percentage of transport work implementation on the JGSP lines in the period from 2018 to 2021  
Source : (Traffic Projects, 2021)

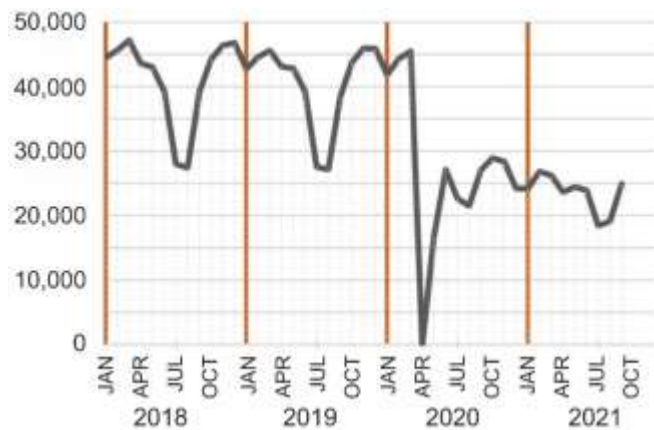
The drastic decline in transport work in the period from February to June 2020 had a significant impact on the effects of the transporter's work. After the easing of restrictive measures and the normalization of the situation in June 2020, the service was stabilized, and the realized transport work was returned to the level of the planned transport work. Furthermore, until September 2021, the implementation of the transport work was aligned with the planned work.

The long-term effects of the pandemic affected the decline in the number of tickets sold, in other words, the number of users of the public transport system. The decline in the number of tickets sold is evident in the period from February to June 2020, which is a consequence of the reduced volume of work. However, after the stabilization of the service, the number of tickets sold has not returned to the situation before February 2020.



**Figure 4** Number of individual tickets sold on the JGSP lines in the period from 2018 to 2021  
Source: (Traffic Projects, 2021)





**Figure 5** Number of the sold subscription tickets on the JGSP lines in the period from 2018 to 2021  
Source: (Traffic Projects, 2021)

Therefore, taking into account the change in the number of tickets sold, it can be concluded that the outflow of passengers from the public transport system is evident. The fact that the decline in the number of sold subscription tickets is more significant than the decline in the number of individual tickets is especially worrying. This fact indicates a direct decrease in the number of regular (daily) users of public transport in the City of Novi Sad.

In accordance with the above, there was an objective and necessary need for improvement in the public transport system. As one of the areas of improvement, in accordance with the recommendations of the Smart Plan (Faculty of Technical Sciences Novi Sad, 2019), the introduction of a modern public transport management system and electronic payment of public transport services was proposed. One segment of this modern system is certainly the system of timely, accurate and reliable information for travellers, which should support the traveller in the process of planning and realizing the trip. These activities are aimed at increasing the attractiveness of public transport in Novi Sad and, ultimately, increasing the participation of this mode of transport in the total visual distribution of trips.

#### 4. "EasyGONS" mobile application

The basic types of information that must be presented to passengers can be classified into two categories:

1. Information before entering the system, and
2. Information obtained in the system.

Both types of information can be either static (unchangeable) or dynamic (changeable in real time). This information mostly refers to the network of lines and the established (planned) timetable. In addition to static information for passengers, which is mainly used to plan the trip before it starts, dynamic information is also of great importance to the user of public transport. Dynamic information, which continuously changes as a result of real-time events and is mainly used during travel, usually refers to vehicle tracking intervals, arrival

time and/or delay of the next vehicle, cancellations and disruptions in the functioning of the passenger transport system, as well as other service information. This information is important to the user during the trip because it allows the user to monitor his/her trip at any stage and to change the plan based on it. They include, for example: changes of departures from the next station, change of mode of transport (metro, tram, bus, walking, etc.), but it can also be the data about the remaining journey (data about the next station, remaining travel time, etc.).

Starting from this way of organizing the passenger information system, and with the aim of increasing the attractiveness and efficiency of the public transport system, the City of Novi Sad - City Administration for Traffic and Roads and JGSP Novi Sad started implementing a pilot project of introducing a mobile application as a passenger information system. The mobile application involves informing service users about public city transport, by providing information about the arrival of the bus at the bus stop. Within the framework of the pilot project, the stops on the route of the public city transport bus line number 4: Liman IV - Centre - Railway Station (Figure 6) are included.

The "EasyGONS" mobile application presents a set of several functions that serve the travellers to get the desired information related to the organization of their trip by public transport in Novi Sad in an easier, faster and more modern way. In addition to information about the public bus transport service, the mobile application represents an integration system unique to the City of Novi Sad, within which it connects city public transport with taxi transport and the "NS bike" bicycle rental system. The application is bilingual, in Serbian and English.



**Figure 6** Route of the bus line 4: Liman IV - Centre - Railway station Source: JGSP Novi Sad, 2022)

The following Figure (Figure 7) shows the "EasyGONS" mobile app.

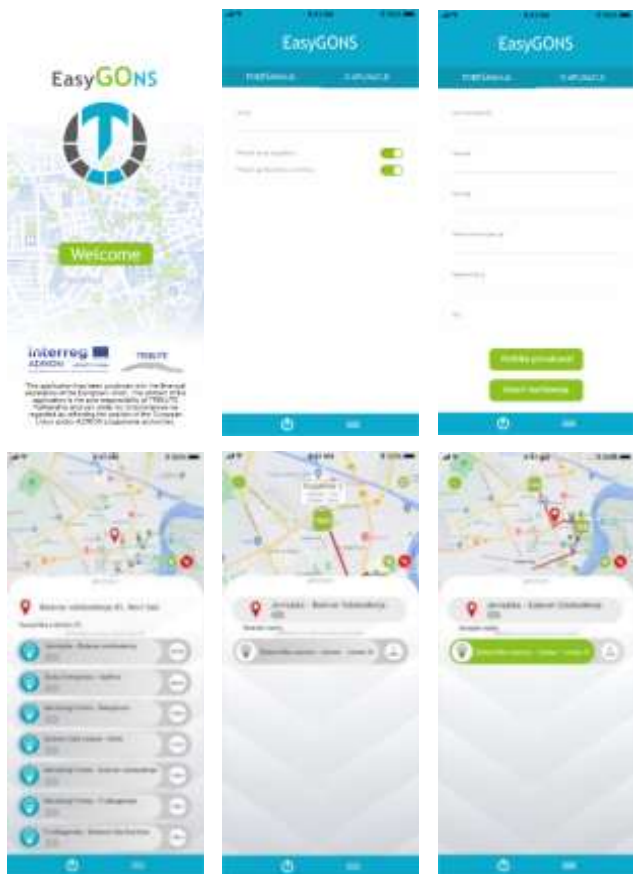


Figure 7 Layout of the "EasyGONS" mobile application page

The mobile application has the following options:

- Display of information about the timetable for the considered line (bus line no. 4),
- Graphic representation of the route of the line in question,
- Announcement of the arrival of the vehicle at the selected stop by the user,
- Display of information on the connection of bus stops (time and length of walk) with the nearest taxi stations and bicycle points of the "NS bike" system intended for picking up and leaving service bicycles.

In addition to the mobile application, station information monitors (ST\_DISP 88.240 7WR0420 SS 00) are installed at the most frequent stops served by bus line number 4, through which the information about the arrival of the next bus at the observed bus stop is displayed. The pilot project included a total of seven stops:

- Stops on the line number 4 in direction A
  - 0417B Narodnog fronta - Bulevar oslobođenja
  - 0416B Narodnog fronta - Šekspirova Street
  - 0418B Fruškogorska – Dr. Ilija Đuričić Street
- Stops on the line number 4 in direction B
  - 0337B Jevrejska - Bulevar oslobođenja
  - 0403A of the Narodnog fronta - Fruškogorska
  - 0401A Žarka Zrenjanina - Municipality
  - 0402A Bulevar cara Lazara - Urbis

The monitor placed at the stops (on the inside of the stop) consists of a field of view, white in colour, made in high-brightness SMD LED technology, which displays the timetable and other current information.



Figure 6 Layout of the ST\_DISP 88.240 7WR0420 SS 00" monitor  
Source: (NOVATRONIC doo, 2021)

The use of station monitors made it possible that even those users of public transport who do not have the possibility to use the system via mobile phones, have the insight into the necessary information.

In order to ensure the proper operation of the system for information providing, it was necessary to ensure complete compliance of the mobile application and station information monitors with the technical characteristics of the equipment in the vehicles. In accordance with that request, the vehicles were equipped with a GPS device ("Teltonika FMB125" device) within the project.

### 5 Conclusion

According to all previous research conducted in many cities in Europe, the most important incentive for sustainable urban mobility is the development of efficient and high-quality public passengers' transport. The City of Novi Sad has recognized the need to develop sustainable urban mobility and has supported the development of all sustainable modes of transport. Particularly significant steps were taken in the previous period when the City purchased and made available to JGSP Novi Sad over 100 new vehicles that use CNG as fuel. This activity had the effect of significantly increasing passengers' comfort and reducing harmful gas emissions.

The activities carried out within the TRIBUTE Project continued to further improve the public transport system, primarily in the segment of passengers' information. By creating a mobile application and

placing information monitors at the stops, public transport users are enabled to monitor the arrival time of the vehicle at the selected stop in real time. In addition, through the mobile application, passengers can get information about the nearest taxi station and bicycle rental station of the "NS bike" system. In this way, the users of the public transport system are offered other acceptable modes of transport as an alternative in the journey planning process.

In this step, the "EasyGONS" mobile application was implemented as a pilot project with the aim of examining the possibility of its application. Considering that, the system included only one line of urban transport and the stops on its route. In the following period, the development of the application, that is, the system, will take place through improvement in the sense of creating more complex options for journey planning, e.g. choosing the optimal mode of transport and route between the two selected points on the network, or introducing the possibility of payment through the application.

Further activities of the TRIBUTE Project will include promotional activities, collecting, analysis and summarization of the key results of the pilot project and the establishing of a "living laboratory". These activities should provide results that will serve as a basis for further development of the application and its use on the entire network of public transport lines in Novi Sad.

### Acknowledgment

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