The reduction of the fuel consumption and of the pollution through the city public transport

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Abstract. The public transportation represents the ideal solution that can be offered with the purpose of satisfying the mobility request through an urban area. A highly organized and efficient public transportation system which offers adequate movement possibilities, in a short time and through high safety and comfort conditions, forms the basis of an urban transportation system that improves the sustainable development of a urban area. Over this paperwork it is going to be estimated the optimization effects of the Pitesti urban transportation system, and even more, it is going to be established the „translation” way of the different improvements for the public transportation system as input data into the urban transport model. In this way it will be shown how the renewal of the vehicles and the modernization of the bus stations could get to the increasing of the urban transport share, thus succeeding the decrease of the own vehicles transport. As a consequence, through the private vehicles movements decrease it is get, in the end, a fuel consumption and gas emissions reduction, in the same time resulting a high traffic performance both for the public transportation and for the own private vehicle transportation.

1. Introduction

The traffic problems faced by the administrations of most of today's modern cities are a real challenge, and numerous studies and researches are being carried out to solve them. An important solution to solve the traffic jams that occurred at peak hours, reducing the pressure created by passenger cars with insufficient parking space and crowding the city center as well as reducing the traveling time of city travellers is the optimization of the public transport services. The present paper refers precisely to such an action, which the administration of Pitesti city intends to apply. Thus, it is intended to increase the bus fleet of the company that provides urban public transport in the city of Pitești, with the beneficial effects mentioned above.

For this, a traffic study was carried out which had the following objectives:
- explanations regarding the population living in the study area of the project as well as the prognoses regarding its evolution, taking into account the forecasts of the Sustainable Urban Mobility Plan of the Pitești city, with an impact on the transport;
- particularities / problems with private transport / public transport of passengers / non-motorized transport, as the case may be in the study area of the project;
- collecting traffic data on the existing situation;
- the number, type, average speed of vehicles;
- the number, average speed and frequency of public transport buses,
- passenger flows using public transport, traffic congestion / delay, etc
- the traffic forecasts and the effects of project implementation (time gain and reduction of NOx) for two scenarios (without project implementation and with project implementation) for the year 2030.

2. The analysis of the public transport system in Pitesti city

The public transport network was defined according to local and external transport services. The public passenger transport system has been defined for each route and includes all public transport stations and terminals. The route timetable is embedded in the transport model as well as the tariff system for each public transport mode.

For defining the base year 2017, data on the transport system was collected to develop and calibrate the transport model. The collected data refers to the following categories of information:
- the transport areas and the socio-economic data of each area;
- the road and street network;
- public transport network, stations and characteristics of the public passenger transport service.

The transport network of Pitesti city is developed mostly linearly in the North-South direction due to the geographical location of the city (in terraces parallel to the central axis), which did not allow the radial development of the transport lines. Of course, the radial network is the most appropriate for public passenger transport. There is also a polarization of large industrial areas in the northern area and in the southern area of the city, and in order to meet the transport demand it was necessary to extend the routes, the development of the transport network being made linear.

The length of the bus transport network is 41.07 km. The total length of the 19 routes is 168.03 km; there are 99 bus stops and 8 bus lines: Arpechim, Doja, Războieni, Sud, Trivale, Găvana, Alprom, Bascov.

The circulation of buses on the transport lines is made on the basis of the traffic diagrams drawn up by the operating service of the public transport company. As the streets and configuration of the transport network did not allow the organization of central dispatchers, traffic management is made from the line ends through a central dispatcher. In order to comply with the traffic diagrams and the planned scheduled transport capacity, a number of six dispatchers located at the line ends and a central dispatcher located at the headquarters of the company are currently operating.

The current peak hour frequency usually has a 7-15 minute interval, with 3 exceptions, of which one of 25 minutes, and another two of 60 minutes, not specific to urban transport but for a necessary social service with low demand.

Figure1. The public transport network with the bus stops.
3. The proposed solution for optimizing the urban public transport system

At this stage, the purchase of new buses and setting up of three new bus lines were considered as follows:

- Trivale - Depositelor and return;
- Războieni - Depositelor and return;
- Războieni - Gara – Calea Bucuresti and return.

As a result of the introduction of the three new bus lines, a simulation of the urban public transport system was carried out and the following results were obtained:
- increasing the volume of passengers transported by public transport per hour at the peak hour from 12,696 passengers to 13,471 passengers, thus a 6% increase in the number of passengers;
- the decrease in the number of car journeys, expressed in cars in traffic per hour at the peak of the morning, from 25,930 to 25,309 cars, so a 2.4% decrease in the number of cars. It is mentioned that the occupancy rate is about 1.25 persons per car.

Thus, the main outcomes of the 2030 forecast for the peak hour in the morning are shown in the following figures (figure 3 and figure 4).

4. Conclusions

In the case of the acquisition of new buses and the establishment of the three new lines for the city of Pitesti, from the analysis of the results obtained at the travel time level for all O-D (Origine-Destination) relations, it is found that the total time of travel and the distances covered by the vehicles, in the situation without and with the implementation of the project, for the forecasting year 2030, in the morning peak hour, are estimated as shown below (table 1).

Of the above, there is a decrease of 1,236 vehicles-hour of total traffic time, and a decrease of 9,824 vehicles-kilometer, both of which showing the benefits of the project.

Concerning the public transport of passengers it is established the following (table 2).
Figure 3. Passenger flows by public transport, hourly, during morning peak hours, without the implementation of the new project, in 2030.

Figure 4. Passenger flows by public transport, hourly, during morning peak hours, after the implementation of the new project, in 2030.

From the above, there is a reduction of 358 passengers-hour in the total volume of passenger-km, as there is an increase in the number of passengers with public transport. Also, the total journey in passenger-km decreases by 7,019 passenger-km, which leads to the conclusion that the accessibility
for passengers with the public transport increases substantially in the situation of the implementation of the project.

**Table 1.** Vehicles traffic, forecast for 2030.

| SCENARIO                                                                 | Total travel time, in veh-hour | Distance covered by the vehicles, in veh-km |
|--------------------------------------------------------------------------|--------------------------------|---------------------------------------------|
| **Morning peak hour**                                                    |                                |                                             |
| Current situation / no acquisition of new buses, without new routes      | 17322                          | 260874                                      |
| The situation with the acquisition of new buses, and with 3 new bus routes| 16086                          | 251050                                      |
| **Difference**                                                           | 1236                           | 9824                                        |

**Table 2.** Busses traffic, forecast for 2030.

| SCENARIO                                                                 | Total travel time, in veh-hour | Distance covered by the vehicles, in veh-km |
|--------------------------------------------------------------------------|--------------------------------|---------------------------------------------|
| **Morning peak hour**                                                    |                                |                                             |
| Current situation / no acquisition of new buses, without new routes      | 7279                           | 59143                                       |
| The situation with the acquisition of new buses, and with 3 new bus routes| 6921                           | 66161                                       |
| **Difference**                                                           | 1358                           | -7019                                       |

As a general conclusion, the implementation of the proposed project within the Pitesti city will have beneficial effects in the medium and long term, contributing to development of a sustainable public transport system.

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