

SHORT REVIEW OF FACTORS THAT EFFICIENCIES THE DOOR TO DOOR PUBLIC TRANSPORTATION SYSTEM

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Abstract— The paper presents the situation nowadays regarding the door to door public transportation. It highlights the key factors that influence the door to door public transportation system along with the advantages and disadvantages produced in the transportation field. The main areas this paper is focused on are: prioritization of public transportation, transport hubs, ticketing system, trip planners, all of them used to increase the passengers' mobility. A parallel between three countries in E.U. region: Holland, Portugal and Romania presenting the reached level until now along with the future plans in door to door public transportation mobility was made. Solutions to increase the public transportation mobility are: prioritizing the public transportation vehicles, informing the car drivers, creating intelligent infrastructure, more accessible and high-tech transport hubs. Solutions to attract more passengers: easy access to information creating: websites, trip planners, data for smart and regular phones, info panels in stations, info desks; easy ways to collect the fare from users: paying by scanning your mobile phone, recharging the contactless card online or at any automated teller machine (ATM) with credit and other benefits for users such as: free internet in the vehicle, television (TV) with news in vehicles, the possibility to use the transportation contactless card for other purposes: access in parking lots, stadiums, cinemas, library, work office, rent a car or a bicycle and the facility to take the bicycle with them on the bus, tram, metro or train.

Keywords— door to door, planner, program, public transportation, ticketing, transport hubs.

I. INTRODUCTION

IN the 21st century the passengers' demands changed. Public transportation increased, forcing municipalities along with public and private transport operators to create and implement new innovations regarding the door to door mobility. Nowadays on long journeys "passengers want to travel fast having a high comfort during the journey, price not being so important" [1]. "There is a philological level for transfers from one vehicle to another that should not be crossed. The total number of transfers during a trip should not exceed one for citizens living in big cities and should not be higher than three for commuters" [2]. If these numbers are exceeded than the potential passengers can choose other

ways of transport such as: personal vehicles or taxi. Not choosing the public transportation will lead to traffic congestions, higher number of accidents, delays and a lower commercial speed for the public transport operator's vehicles, higher level of CO₂ emissions, dust, noise pollution and the public operator loses potential clients. To avoid these situations which are not good for: the environment, municipality, public and private transport operators and citizens, the transport operators together with the municipalities developed some solutions that we called the key factors to efficiencies the door to door public transportation system. The paper is structured in 6 chapters as follow: introduction, infrastructure of public transportation, ticketing system, trip planners, parallel between 3 countries in European Union (E.U.) region, conclusions and further research.

II. INFRASTRUCTURE OF PUBLIC TRANSPORTATION

The infrastructure is one of the main determined factors for the efficiency of the door to door public transportation system. A well designed infrastructure bring advantages for the public transportation, passengers and environment such as: increases the commercial speed of the public transportation vehicles, increases the safety of the passengers, lower the numbers of transfers from one vehicle to another, offers citizens access to park and ride, car sharing, bicycles, protects the environment by reducing: the CO₂ emissions along with dust and noise level resulted from the traffic congestions. To offer more benefits for passengers and attract new ones it is necessary to have an infrastructure with: transport hubs and prioritization methods for public transportation.

A. Advantages and disadvantages generated by transport hubs

Creating transport hubs is mandatory for public transportation in the 21st century. When designing a transport hub the following aspects have to be taken into consideration: the place where it is constructed, the purpose of the hub, the information that is delivered and

the facilities that it offers. Per example in most of the cities in Holland the main hubs are represented by the railway stations considered as starting point for the entire network of public transportation of the city. The facilities offered nowadays by the transport hubs are: it connects different means of passengers transport such as: planes, “boats” [3], trains, metro, trams, trolleybuses, buses, taxi, car sharing, park and ride and bicycles, it offers easy access to information by having info points, info panels, easy access to info and vehicles for persons with disabilities acoustic info, escalator, elevators, special access doors, it offers a safe environment for passengers and other facilities such as: eating, drinking, resting, recharging the subscription or buy tickets and luggage deposit. All the facts mention above are advantages offered by the transport hubs. The disadvantages are that building a transport hub takes a lot of space, it is very expensive also brings a lot of noise, dust and a high CO₂ level for that area where it is build. The plans for the future is to build green transport hubs that use alternative electricity, are located out of the city avoiding the noise, dust and CO₂ emissions, each hub to have free internet access for passengers and all of the hubs to be connected international by one transport “contactless card” [4] and one trip planner such as rom2rio.

B. Prioritization methods for public transportation

Public transportation prioritization is another key factor for a well designed transport infrastructure. There are many methods to prioritize the public transportation such as: creating special lanes for public transportation vehicles Fig. 1., green light activated by inductive sensors located in the road Fig. 2., or cameras mounted on the pillars Fig. 3. The photos were made in Lisbon a city where the prioritization of public transport using the green light method is at a pilot study level being implemented on two bus special lanes measuring 500m each.



Fig. 1. Dedicated lanes for buses.



Fig. 2. Green light.



Fig. 3. Green light corridor.

Public transportation vehicles will also play an important role in the future of public transport prioritization such as: electric buses that can run without driver such as “Phileas” [5] used (with driver due to the transport regulations) in Eindhoven, “superbuses” [6] designed by Delft University that can reach a speed up to 250km/h and “amphibious buses”[3] that run nowadays just for tourists in Amsterdam, Budapest, Rotterdam, running on water and land. In Fig. 4., [7] is represented the working principle of green light phase extension that will be implemented in Timisoara city. This model is used by the special control prioritization of public transportation algorithm.

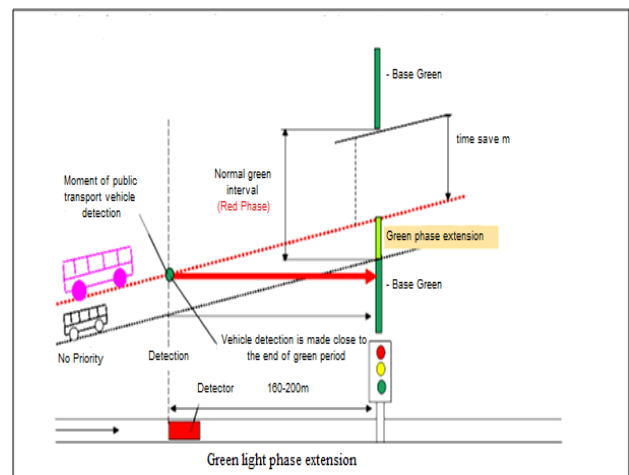


Fig. 4. Green light phase extension.

III. TICKETING SYSTEM

In the 21st almost in all major cities from Europe was implemented the ticketing system which is a necessity for an efficient door to door public transportation. The ticketing system brings benefits for transport operators such as: fleet monitorization, determine the productive routes and create new ones, reduce the fraud, helps collecting the money from passengers, help making statistics about who uses the service, why, when, how often, reduce the maintenance costs. For passengers offers easy access to information by: info panels, free internet in vehicles, trip planners also it offers an easy and cheaper way to pay the ticket per distance using a contactless card. For environment it reduces the paper waste by giving up the paper ticket and using contactless cards, reduces the noise, dust and CO₂ emissions by

decongesting the city and using electric, hybrid or natural gas public transportation vehicles. We will present “the ticketing system that is implemented in Timisoara which consist in two programs one named: Automatic Taxation System (SAT) and the other one is Vehicles Tracking System (SMV)” [4].

A. The Automatic Taxation System

It has a platform called SAT-Sale that has the purpose to stock all the information regarding personalized cards such as: information regarding the owner of the card, information about card validation. It helps to recuperate the data on a contactless card in case the owner lost or deteriorate the card, or the card is stolen from him. Also any card can be blocked in the same condition mention above to avoid being use by someone else.

B. The Vehicle Tracking System

It has a platform called RadFleet and gives information about: location of the vehicle, number of passengers in the vehicle along with number of validations, time table, commercial speed and carburant consumption for each vehicle, direct communication between vehicle driver and dispatcher. In Fig. 5., [7] is presented the Vehicle Tracking System.

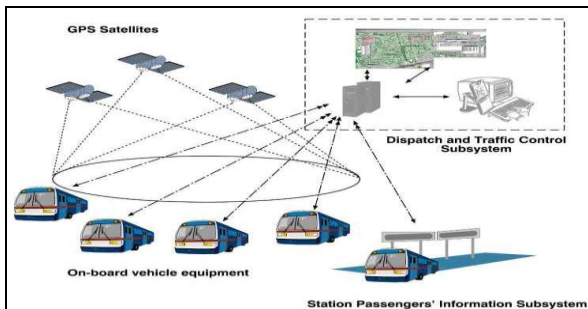


Fig. 5. Vehicle Tracking System.

The on board equipment that is present on a public transportation vehicle used in the ticketing system is presented in Fig. 6., [8].

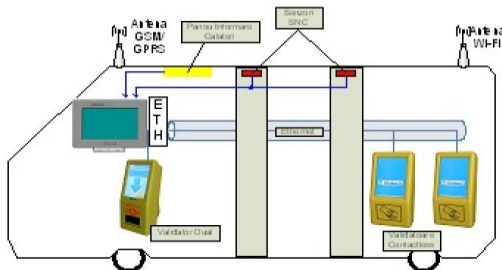


Fig. 6. On board equipment.

In Timisoara there are 12 vehicles equipped with counting door sensors for passengers Fig. 7., [4], in this way it can be determine how many passengers are in the vehicle, in other cities such as Eindhoven is not necessary to have such a system because it is mandatory to validate when you leave the vehicle. The same principle used by the ticketing implemented in

Timisoara, is used in other cities such as: Lisbon, Eindhoven, Bucharest that is the reason why we presented the platforms and equipment used in Timisoara.

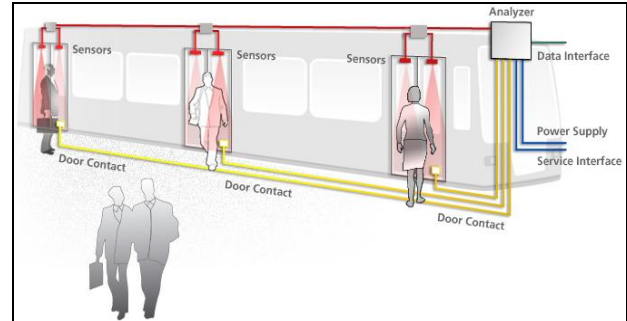


Fig. 7. Door sensors for passengers counting.

Regarding the “advantages and disadvantages using validation system in public transport vehicles” [8] the opinions varies some said that is good having a ticketing system others said that it not bringing any benefits for passengers (Timisoara case) but there are plenty of “future plans regarding the ticketing system in Timisoara and the public transportation in general for 2030” [9].

IV. TRIP PLANNERS’ UTILITY IN DOOR TO DOOR PUBLIC TRANSPORTATION

Nowadays almost each city and in some cases countries such as Holland developed a trip planner to help the passengers get from origin to destination point. The differences between planners are made by the amount and accuracy of information that they provide the friendly interface and how easy it can be accessed by the passengers. One of the most complex trip planners is (www.9292.nl) “Multimodal travel is by its very nature more complex. That is where multimodal journey planners come in. These online tools can help travelers plan a journey from A to B detailing the different types of transport to take, times and even fares” [10]. One of the small steps that offer information such as: means of transport, duration, length of the route, but only for some regions along Europe continent is Google Maps. The main issues of this platform planner are: it does not combine the means of transportation; it just shows them separately and does not give any information about the price of the entire journey. In our opinion combining information from Google Maps along with the information retrieve from all the national trip planners can be a solution in making only one trip planner for all Europe such as „www.rom2rio.com“.

V. PARALLEL BETWEEN THREE COUNTRIES IN E.U. REGION: HOLLAND, PORTUGAL AND ROMANIA

In this chapter are presented some differences and similarities between 3 countries from E.U. regarding the public transportation ticketing system.

TABLE I
CHARACTERISTICS OF TICKETING SYSTEM IN HOLLAND, PORTUGAL,
ROMANIA

Characteristics of Ticketing System	Holland Eindhoven	Portugal Lisbon	Romania Timisoara
Composition of vehicles fleet and engine type	Buses gas, electric Phileas	Metro -electric Trams electric Buses - gas - natural gas Boats - diesel	Trams electric Trolleybuses – hybrid (electric and gas) Buses - gas
Ticketing equipment	On board equipment: - On board computer (OBC) - GPS tracking device - Video cameras - Simple contactless card validators Servers, platforms, website, national trip planner (9292.nl) Information panels in stations Special equipment for control Contactless cards Mifare Automatic Ticket machines	On board equipment: - On board computer (OBC) - GPS tracking device - Video cameras - Door counting sensors - Simple contactless card validator Servers, platforms, website, regional trip planner (transporlis.sapo.pt) Information panels in stations Special equipment for control Contactless cards Calypso Automatic Ticket machines	On board equipment: - On board computer (OBC) - GPS tracking device - Video cameras - Door counting sensors - Simple and dual contactless card validators Servers, platforms, website, local trip planner (tptm.ro) Information panels in stations Special equipment for control Contactless cards Mifare Ticket shops 16
Contactless card character.	Two types of card: -personalized -non-personal Valid in all country Offered by a specialized company (translink.nl) It is sold No possibility to validate for 2 or more persons Expire after 5 years	Two types of card: -personalized -non-personal Valid in Lisbon urban and suburban Offered by a specialized company (otlis.com.pt) It is sold No possibility to validate for 2 or more persons Expire after 5 years	Two types of card: -personalized -non-personal Valid only for Timisoara Offered by the local PTO (ratt.ro) It is offered for free Possibility to validate for 5 persons Does not expire
Price fare and ways of recharging the contactless card or buy ticket	Pay per distance PTO Office, driver, shops, on line, vending machines	Pay per distance for subscriptions only PTO Office, driver, shops, ATM, vending machines	Pay fix price PTO shops (Total 15 recharging points) and other shops for tickets only

Characteristics of Ticketing System	Holland Eindhoven	Portugal Lisbon	Romania Timisoara
Validation rules	It is mandatory to check in and out	It is mandatory to check in	It is mandatory to check in
Types of PTO	Private companies	State owned and private companies	State owned

VI. CONCLUSIONS AND FURTHER RESEARCH

In our opinion the door to door mobility development is just at the beginning. The E.U. future plan is to implement a global ticketing system and one contactless card that can be used in all the public transportation vehicles all over Europe and for other purposes besides public transportation such as: bicycle and car renting, pay for parking, access to work and leisure activities. Designing more complex hubs, interconnecting them and make them sustainable by using alternative energy is another goal of European Union. Creating a global trip planner that can help passengers travel by all means all over the globe and using public transportation vehicles that run on alternative combustible, have a higher commercial speed due to public transportation prioritization are goals that are almost achieved (see rome2rio trip planner). The more efficient becomes passenger transportation the greener the environment gets. Our further research is to create a trip planner for Romania and connect it with trip planners from E.U.

ACKNOWLEDGMENT

“This work was partially supported by the strategic grant POSDRU 107/1.5/S/77265, inside POSDRU Romania 2007-2013 co-financed by the European Social Fund – Investing in People.”

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