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NEEDS FOR APPLICATION OF MODERN FARE SYSTEMS IN PUBLIC CITY PASSENGER TRANSPORT[1]

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Abstract

Systems of urban and suburban passenger transportation, according to the principles of the European Commission have a key role in achieving the goal of sustainable development and sustainable transport in cities. The fair system, tickets system and system for payment have significant impact on the public urban transport system, primarily because of the charge a fee for transport services, represents the basic mode of financing of system in addition to subsidies and grants from the city budget. If the percentage of payments from ticket sales is high therefore the amount of subsidies and grants will be smaller and thereby in the city budget remains more resources for the improvement of transport service. The main objective of this paper is to show the importance of application of modern ticketing systems and fare collection in relation to the applied system of public transportation in the cities. Also, authors will show some existing modern fare systems which are implemented in public transport in cities.

Keywords–public transport; fare systems; tickets system

[1] Professional paper

INTRODUCTION

Inside the urban area there is a constant need of population movement in order to meet the various needs e.g. going to work and returning back home, going shopping, recreation and others. Public City Passenger Transport (PCPT) is active component in city life and, in that sense, can have the role of initiator of its development. However, it can often be seen as a component which represents constraint and limitation of further development.

Public City Passenger Transport (PCPT) development should be focused on increasing the quality of services that will satisfy modern city consumer. Its function, for the future, should be to attract the citizens who have their own car, which would result in reducing the burden of city roads and parking surface.

Having in mind the complexity of the systems, some features and quality indicators are to be defined in order to point out the effectiveness of relevant system:

1. **Organizational support services –** It can be defined as a set of activities on ensuring the basic elements of transport production (instruments of labour, buildings and equipment, financial and human resources, etc.) and their organizational connections through the transport process, which result in the transport service**.**
2. **Convenience for use of services** – This quality service feature most largely represents the requirements and objectives of the system users of PCPT. Convenience for use of services includes supporting or providing support for the realization of services and includes:
    - User information system,
    - Tariff system,
    - The system of maps and billing,
    - Vehicle characteristics - comfort.
3. **Service availability** –Service availability consists of accessibility and continuity features, and can be defined as the willingness of the public transportation system to carry out a transport service when it is required by the user**.**
4. **Service stability** – Service stability represents providing transportation service without some interruptions. This quality feature of transport services is subject to numerous factors. Stability of services can be accurately measured as the ratio of the projected and actual timetable, i.e. can be determined by the difference between the projected and actual number of

departures, as well as through the number of failures of already started drivings.

5. **System production capacity** - can be defined as the ability of the system to meet transport requirements for given needs within the given internal conditions. The most important quantitative indicators are the scope of work, distance travelled, time, capacity and other.
6. **Exploitation reliability of technical exploitation** - It is defined as the ability of the system to provide, under the given terms, adequate active resources for the work in order to meet the transport requirements within the set of requisite internal conditions. The most important indicators are availability, time when the vehicle was technically correct, the number of technically correct vehicles and other.

From the above, it can be concluded that the tariff system, cards and billing system have a significant impact on the system of public transport. Primarily because, their charge of fee for a transport service, is a basic way of financing together with subsidies and grants from the city budget. As the percentage of collection from ticket sales raises the subsidies and grants will be smaller and the city budget will have more funds to improve transport services.

The main objective of this paper is to show the significance of the tariff system and the system of cards and billing in relation to the applied system of public transportation in the cities, as well as view of the existing electronic billing systems and their way of functioning.

Various research methods were applied, such as the collection and analysis of data from existing systems (Penta - Croatia, BusPlus - Beograd), collecting data through the Internet and from the professional literature, systematization of existing work on this subject and textbooks in the field of public passenger transport was also performed.

DEFINING THE PROBLEM

There are 4 models of tariff systems in public city passenger transport:

- Flat faretariff system,
- The zonal tariff system,
- Sectional tariff system and
- A Combined tariff system.

From the point of billing systems, a flat fare tariff system [1] gives you the best opportunities for the introduction of a rational system of collection, because they simplify the billing system and reduce the number of billing

types. This tariff system was the most applied in former Yugoslav cities, while according to data in European cities most applied is the zonal tariff system.

Most issues during the introduction of modern billing system have the cities with sectional tariff system [1], since large number of billing types raise a problem with the issuance and annulment of tickets and control of the passengers. To some extent, the problem can be simplified by reducing the number of sections (e.g. English towns). Also, certain simplifications in terms of reducing the number of billing types can be achieved with the zonal tariff system, but the fact that it is much easier to rationalize the billing systems in cities that have a single tariff system, than in those which have zone and sectional systems remains.

TICKETS FOR LOCAL PUBLIC PASSENGER TRANSPORT

Types of tickets in public transport can be observed as from the point of the amount of the price to be paid for them, and by way of their sales. According to the method of the sale there can be **individual tickets** or **individual tickets for one ride**, that the traveller buys most often in the car or on cells and **season tickets** which are bought mostly out of the vehicle and are valid for a certain period of time (month, week), or certain number of rides.

Since it is obvious that sales of season tickets accelerates handling of passengers and allows faster circulation of vehicles due to lower retention in the cell, it is a rule, that season tickets are being sold with a discount in order to stimulate passengers for their purchases. In addition, there is a financial interest of Transportation Company, which is reflected in the fact that for the sale of prepaid cards company receives a share of the income in advance, which can improve the business.

The objective of introducing a system of prepaid cards is that as many passengers buy tickets outside the vehicle. This frees staff in the vehicle sales of individual tickets and accelerates the circulation of passengers. According to some authors, it should be at least 50% of passengers that buys season tickets if we want to talk about rationalization of the billing system.

According to some researches, number of passengers that use some kind of season tickets purchased in advance in the European cities that have introduced automated billing, is in range between 90-94%, so that only 6-10% of travellers buy individual tickets [2]. In our cities which use modern billing system and where passengers are offered a wider range of prepaid cards, such as Belgrade, Novi Sad and etc. a large number of passengers buy pre-season tickets, especially tickets for preview (monthly tickets) (60-90%) [3] [4].

BILLING SYSTEMS

Billing systems can be divided in several groups. It may come to some misunderstandings during billing classification caused by mixing subjects of collection, such as the conductor, the driver or a passenger, automate or other. Starting from the point that billing subject is the passenger the basic classification can be made, according to which there are three billing systems:

1. Billing system through the conductor,
2. Billing system over the driver,
3. The self-service billing system.

Rationalization of billing systems has become very relevant to us lately, and in the last decade in the majority of European cities significant improvements, and a new streamlined billing systems can be recognized. The main reason for modifying the current billing system, lies in the fact that wages in the transportation companies in our country represent 55% from total cost, with a further tendency to rise, while in Western European enterprises this share is moving up to 70% of the total costs, so that the tendency is to reduce them.

Rationalization of billing systems for local public passenger transport, should create the opportunities to transport as many passengers or becoming more passenger-kilometres with as few workers in traffic. The introduction of more rational payment system should be preceded by a series of measures, such as adjusting the tariff system and the system of prepaid cards, reducing the load of the vehicle on an appropriate measure, adaptations, preparation and training of personnel and others.

POSSIBLE SOLUTIONS

It is quite certain that one of the most important conditions for the implementation of the rationalization billing systems is suitable selected billing system. Namely, in the system of work with one man it is necessary to free up as many drivers' jobs related to ticket sales, i.e. drivers selling the tickets should be kept to the minimum possible level. For this purpose it is necessary to create conditions for the restructuring of passengers to buy tickets outside the vehicle. Measure to achieve this objective is to conduct a policy of selective price at which tickets are purchased the most expensive in the vehicle coupled with permanent adjustment of the rights which give season tickets the real needs of users.

The difference in the prices of individual tickets purchased on and off-board in the beginning should not be greater than 30% in order to avoid a

drop in revenues from this type of ticket. In the later stages this difference should be increased, until the moment of realization of a modern billing system, when buying tickets in the vehicle will be completely eliminated.

The existing selection of tickets on network lines JGPP in the cities of Serbia can be characterized as acceptable, but it does not provide the flexibility to choose the best variant for the payment of transport. This means that the system of tickets continues to consist of two basic sets, prepaid tickets and the tickets out of the prepaid regime - individual tickets.

With the introduction of the ETS (electronic tariff system - a system of payment) ticket range would consist of:

1. Standard paper tickets (individual ticket)
2. Magnetic tickets with size of EUROCARD used as a ticket for a certain number of rides or monthly tickets
3. Contactless or contact SMART CHIP tickets size of a EUROCARD to be used as a monthly, semi-annual or annual tickets.

Fig.1.Various types of cards supported in ETS

Electronic tariff system allows the sale of individual tickets in the vehicle. It is done by a special unit that is installed in the vehicle. The advantage of this method of selling is that it automatically tracks and maintains records of the number and price of individual tickets sold. Figure 2 shows one of the devices that are installed in a vehicle used for the sale of individual tickets.

Sales network improvement should be accompanied by the introduction of ETS. Ticket sales to customers can be conducted in several ways:

1. Ticket sales in shops, kiosks and newsstands, and
2. Ticket sales via vending machines.

Existing terminals that are used for ticket sales should remain in the new tariff system also, but with the difference that the sales network should extend across the newsstand shops located along the route of almost all city lines, thus the line passing through the city street network.

Fig.2.The appearance of units for sale of individual tickets in vehicle

DISCUSSION

Management of the tariff system, tariff policy and price policy, billing system and toll system means constantly adapting to changes in the environment, changes in the characteristics of passengers (standard, level of motorization, etc.), and travel, mobility, mobility PCPT, the length of driving and travel, changes in the transportation system (constraints and modes of movement and parking of vehicles, etc.). This is not possible without reliable information base, which is only possible through modern electronic billing systems.

In fact, one of the main benefits of modern electronic billing systems is to provide opportunities for the creation of an information base for system PCPT management. For this reason, the technology of passenger's entry in the car and drive validation, must be such to take full advantage of modern billing systems.

Information that can be obtained in electronic billing system, can be divided into:

- **Public information** - any information relating to the tariff system, the type of ticket, the cost of transport, billing system, the right to use, grid lines, timetables, tariff frontiers, etc.
- **Personal information** - information that are subject to the Act on data privacy (personal data about users, their movements, etc.).
- **Business information** - information related to the functioning of the system of maps (data on passengers and travel, structure charts and earned income), financial transactions, etc.
- **Sensitive information** - information related to security procedures and of the movements of some people.
- **Very sensitive information** - security keys

Especially important information are the one about the functioning of the billing system, as well as information related to the design of PCPT and above all static and dynamic characteristics of the transport network:

- Characteristics of passengers and type: mobility (number of trips and travel) by categories of users and ticket types, matrix of stopover passengers (from one line to another) and the matrix source-target movement.
- Transport requirements: entries and exits, flow rates of the stations, vehicles, craft, lines, directions, hours, days, average length of driving and travel, shift of passengers along the lines of, directions, hours and days.

One of the system that allows the above is a system that is called the Electronic tariff system (ETS) Corporations ERG TRANSIT SYSTEMS [5]. This system is intended to work on the vehicles of public passenger transport and can be applied on all its subsystems (trains, trams, trolleybuses, buses, minibuses, ferries, etc.).

CONCLUSION

The electronic tariff system is a powerful tool for automatic traffic management, collection and storage of numerous information, which in a completely technological level and level of the future, gives all conditions to significantly increase the efficiency of public transport. As part of intelligent transport systems for support of passenger transport in cities, it provides reliable information about the journeys of passengers on certain routes, which enables better planning of capacity utilization, cost of transport and from that safer and more comfortable journey.

Electronics and telecommunications progress have led to developing numerous different billing systems which are already in use in certain cities

in the world. Each of the applied billing system has its advantages and disadvantages, but in relation to the existing billing systems in Serbia 'electronic' systems have significant advantages.

Having in mind the above facts it is clear that in order to cover the operating costs of the transportation company a key source of financing income is from ticket sales. Accordingly, billing system which enables the realization of revenue is a key part for the operation of public transport system and the overall tariff policy and funding.

In addition to increasing revenues ETS enables cost reduction and the ability to continually monitor the number of passengers in vehicles on certain routes, based on which it will be possible to optimize the fleet (avoiding empty runs, achieving optimal capacity utilization, etc.). In this way it can significantly reduce fuel consumption as a significant portion of total operating costs of the transportation company.

According to statistics of producers, the companies that introduced electronic tariff system, on average, increased their income by about 30% and reduced their costs by about 20% [5].

REFERENCES

[1] Dr Pavle Gladović, Vladimir Popović, Dr Milan Simeunović:"**Informacioni sistemi u drumskom transportu"**, izdavač Fakultet tehničkih nauka u Novom Sadu, 2014. godina, (udžbenik), UDK: 007:656.1.]:004(075.8), ISBN: 978-86-7892-610-5, strane: 284

[2] UITP, Rublic transport economics – www.uitp.org, 2011.

[3] Studija javnog prevoza grada Novog Sada, FTN 2008.

[4] Studija javnog masovnog prevoza grada Niša, SF Beograd 2007.

[5] http://www.itso.org.uk/page129/ERG%20Transit%20Systems%20UK, 2011.